A thesis submitted in part fulfilment of the degree of

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VOLUME ONE

RESEARCH COMPONENT

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Overview

This thesis is submitted in part fulfilment of the degree of Clinical Psychology Doctorate (ClinPsyD) at the University of Birmingham.

Volume I comprises the research component of the thesis, consisting of two research papers. They are a literature review and an empirical paper, both of which are to be edited for submission to the 'British Journal of Clinical Psychology' (see Appendix 1 for author guidelines). The literature review offers an account of a literature search and evaluation of articles exploring the impact of depression on neuropsychological assessment of memory in individuals with traumatic brain injury (TBI). The empirical paper details the procedure that was undertaken to provide base-rate data of common cognitive complaints in non-clinical individuals using the Common Cognitive Complaints Checklist; and the process of identifying common cognitive complaints that discriminate between three populations (see Appendix 2 for a public domain briefing paper).

Volume II consists of five clinical practice reports (CPRs). CPR1 presents the case of Colin, a 42 year old male with paranoid schizophrenia who has social phobia, formulated from both a cognitive and psychodynamic perspective. CPR2 is a case study report of a piece of work with 'B', a 48 year old man in a medium-secure forensic unit, after being charged with attempted murder while suffering from psychosis. CPR3 presents the case of 'D', a 91 year old lady referred for help with worries.CPR4 offers an account of an evaluation of equity-of-access in a clinical psychology service for people with learning disabilities. The final CPR was delivered as an oral presentation and is reported in abstract form. It describes the case of Jan, a 16 year old female, referred for anxiety management.

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Paper to be edited for submission to the 'British Journal of Clinical Psychology'

DOES DEPRESSION AFFECT PERFORMANCE ON NEUROPSYCHOLOGICAL ASSESSMENT OF MEMORY AFTER TRAUMATIC BRAIN INJURY (TBI)?

LITERATURE REVIEW

Abstract

Objectives: To review the literature exploring the impact of depression on neuropsychological assessment of memory in traumatic brain injury (TBI).

Methods: A literature search using Psycinfo, EMBASE, Ovid MEDLINE-R, and CINAHL-EBSCO identified articles that considered the relationship between depression and memory performance after TBI. Search-terms "depression," "neuropsychological assessment," "memory," and "traumatic brain injury" (and variations) were used. The search was not limited by a start date and it included articles published up to September 2012. Inclusion/exclusion criteria were applied. Eleven articles published between 1986 and 2010 that (each to some level) considered the relationship between depression and neuropsychological assessment of memory in TBI were shortlisted.

Results: Studies employed multiple approaches, generating 107 results. Study quality was assessed using Caldwell, Henshaw and Taylor's (2005) framework; and considerations of participant inclusion criteria; depression measures; and methodological weaknesses. Sixteen memory tasks were employed in five recall conditions.

Conclusions: The evidence suggests a possible impact of depression on learning and specifically, processes measured by the CVLT. However, the question posed by this review remains unanswered, since the studies were of moderate quality and not set up to answer the question directly. Future research should aim to address the weaknesses currently present in the literature.

Keywords: Traumatic Brain Injury (TBI), Memory, Depression, Neuropsychological Assessment

Introduction

This paper will review the literature exploring the impact of depression on performance on neuropsychological tests of memory in people with traumatic brain injury (TBI). The review begins with definitions and an explanation of the concepts to be addressed and goes on to describe the literature search strategy. The review then considers the articles' participant inclusion criteria, their measurement of depression and methodological weaknesses. The quality of the articles is assessed and the review presents the findings relating to the impact of depression on different types of memory tests. The paper concludes with a summary and suggestions for future research.

In 2010, a consensus statement was established by an international and inter-agency working group that defined traumatic brain injury (TBI) as "an alteration in brain function, or other evidence of brain pathology, caused by an external force" (Menon, Schwab, Wright & Maas, 2010). In addition to impact, such external forces include acceleration and deceleration which result in the brain being jolted and bouncing inside the skull, sustaining damage in the process. This is further subdivided into open head injury or penetrating head injury and refers to injuries where there has been penetration of the skull from an object or missile; the terms closed head injury, blunt head trauma or blunt injury refer to cases where the skull is not penetrated – although there may be fracture of the skull; and the term concussion is often used to describe a mild form of TBI (Lezak, Howieson, Bigler & Tranel, 2012). Over half of all injuries are caused by motor vehicle accidents, while others are caused by falls, assaults, sporting accidents and recreational accidents (Taylor, 2007) and all can result in differing levels of injury severity from mild traumatic brain injury (MTBI), to moderate and severe TBI. For consistency, in this review the term TBI will be used.

As well as cognitive deficits such as memory impairment, traumatic brain injuries can cause changes in affect and can lead to psychological disorders including major depression (Taylor, 2007). The incidence of depression in TBI ranges from 11.1% (Silver, Kramer, Greenwald, & Weissman, 2001) to 70% (Kreutzer, Seel & Gourley, 2001), depending on how depression is measured. The Diagnostic and Statistical Manual of Mental Disorders (Fourth Edition, Text Revision) (DSM-IV-TR, 2000) provides diagnostic criteria for the diagnosis of major depressive disorder stating that it is characterised by "one or more major depressive episodes (i.e., at least 2 weeks of depressed mood or loss of interest accompanied by at least four additional symptoms of depression)." As well as impacting on daily activities, research on psychiatric populations has found that depression can affect performance on neuropsychological memory assessments. In 1995, Burt, Zembar and Niederehe in their meta-analysis concluded that there was a significant stable negative association between depression and neuropsychological assessment of memory in non-TBI populations. However, the impact of depression on performance on memory tests has not gone undisputed. For example, Rohling, Green, Allen and Iverson (2002) pointed out that Burt et al's (1995) meta-analysis was based on papers which themselves were flawed and thus conclusions based on the reviewed papers were also flawed. The authors also highlighted some methodological problems in the literature such as failures to control for confounding factors. One of these is the lack of symptom validity testing. In fact, they suggested that once this is controlledfor, the effect of depression would be nullified.

The case is no clearer in relation to the impact of depression on neuropsychological assessment of memory after TBI. Rohling, et al (2002) attempted to address the

weaknesses they had identified in the literature and recruited individuals with TBI and neurological disorders to examine the effect of depression on neurocognitive test performance (including memory tests). They found that depression did not impact on memory or other cognitive tests and suggested that this was due to having excluded individuals who had failed symptom validity tests.

The presence of memory impairment and the factors that may impact on memory test performance are important when it comes to treating individuals with TBI. Treatment may be different, according to the cause of memory impairment. If the cause stems from the injury, then compensatory techniques such as the use of helpful aids/strategies may be indicated (Evans, 2004). On the other hand, if the underlying cause is depression, then treatment may include psychological intervention, or antidepressant medication with the expectation that memory test performance may improve once the emotional difficulties have been treated (Hall, Barrera & Randon, 2000; Fann, Uomoto & Katon, 2001; Khan-Bourne & Brown 2003). Tailoring a care-plan becomes complicated when the cause of an individual's difficulties is unclear. Brown (2004) highlighted the complexity of relationships between psychological disorder, cognitive function and performance in the assessment situation, listing three important questions relating to this issue. First, "Does the patient present with a psychological or psychiatric problem and how might this be assessed?" Second, "How might such a problem interact with, and impact on, cognitive function and test performance?" and third, "What are the consequences of any such changes for the accurate assessment of cognitive dysfunction resulting from the known or suspected brain disorder?" (P90). However, it has not yet been determined definitively, whether having depression further impacts on memory test performance after TBI and Brown (2004) stated that more research is needed into the interaction between neurological

and psychiatric symptoms on cognition. In addition, it is clear that the research on the relationship between depression and neuropsychological assessment of memory in TBI is often contradictory (Rohling et al, 2002). To this end, the present literature review evaluates the existing literature to determine whether depression affects performance on the neuropsychological assessment of memory after TBI.

Method

Literature searches were conducted in order to identify articles that considered the relationship between depression and memory in individuals with traumatic brain injury (TBI). The searches were run using four databases (Psycinfo, EMBASE, Ovid MEDLINE-R, and CINAHL-EBSCO) and were conducted between July 2011 and September 2012. The search included articles up to September 2012. Since initial literature searches on the subject had revealed no previous review in this area, the searches were not limited by a start-date. Other limits consisted of: articles in the English language, journal articles, human participants and participants aged eighteen or over. The inclusion criteria admitted articles that reported work with adults who had suffered: mild, moderate or severe traumatic brain injury (TBI), which also considered the relationship between depression and memory, and where memory was assessed using neuropsychological measures. Identified articles were excluded if they were: dissertation abstracts, if the participants were mainly children, older adults or individuals with learning disabilities; if the studies involved induced mood, post-partum/post-natal depression, bipolar depression, psychotic depression, psychiatric disorders such as schizophrenia or post-traumatic stress disorder; if the neuropsychological assessments did not involve neuropsychological tests of memory; if the focus was on treatment; if groups of injured and non-injured individuals were combined before exploring the relationship between memory and depression; and if the cause of brain injury included stroke, anoxia, cerebral vascular disease, alcoholism, tumours, degenerative diseases, infections, multiple sclerosis, other neurological or brain disorders, or other causes that were not traumatic brain injury.

An advanced search was run in each database using the terms ‘depression’, ‘neuropsychological assessment’, ‘memory’, and ‘traumatic brain injury’ and variations of

these terms (see Table 1), and where possible, a ‘Map Term to Subject Heading’ feature was used. The CINAHL (EBSCO) database ‘Map Term to Subject Heading’ feature suggested two headings under the Depression topic which were ‘Affect’ and ‘Mood disorders’, and two headings under the topic of TBI, which were ‘left hemisphere injuries’ and ‘right hemisphere injuries’. The EMBASE (Ovid) database ‘Map Term to Subject Heading’ feature suggested numerous headings for memory including ‘associative memory’, ‘information retrieval’, ‘auditory memory’, ‘declarative memory’, ‘memory consolidation’, ‘memory disorder’, ‘olfactory memory’, ‘reference memory’, ‘sensory memory’, ‘working memory’, ‘procedural memory’, ‘tactile memory’, ‘paired associate learning’, and ‘verbal memory’. These were incorporated into the search.

Table 1: Search terms used in the literature search and variations of those terms

"Depression"		**"Neuropsychological Assessment"**		**"Memory"**		**"Traumatic Brain Injury"**
Depression* OR Major Depression OR Depressive* OR Dysthymia OR Dysthymic Disorder OR Unipolar OR Mood* OR Depressive Disorder* OR Anhedonia OR Dysphoria OR Melancholic OR Melancholia OR Affective Disorder* OR Endogenous Depression OR Unipolar Depression	**AND**	Cognitive OR Cognitive defect OR Cognition OR Cog* OR Cognitive Ability OR Cognitive Abilities OR Cognitive function* OR Cognitive Impairment* OR Cognitive Assessment* OR Neuropsychological Assessment OR Neuropsychological Battery OR Neuropsychology OR Neuropsychological OR Neurological OR Neurocognitive OR Neurocognition OR IQ OR Intellect OR Intellectual OR Intelligence OR Intelligence Quotient OR Neuropsychological tests OR Aptitude test OR Mental test	**AND**	Memory OR Autobiographical Memory OR Episodic Memory OR Explicit Memory OR Immediate Memory OR Implicit Memory OR Long Term Memory OR LTM OR Short Term Memory OR STM OR Prospective Memory OR Retrospective Memory OR Semantic Memory OR Spatial Memory OR Verbal Memory OR Delayed Memory OR Visual Memory OR Visuospatial Memory OR Retention OR Recall OR Recognition OR Verbal learning OR Serial learning OR Pattern recognition OR Learning	**AND**	Traumatic Brain Injury OR Brain Injury OR Head Injury OR Brain Trauma OR Head Trauma OR TBI OR Open Head Injury OR Close Head Injury OR Craniocerebral Trauma

After the searches had returned identified articles, duplicated articles were removed. Following this the titles and abstracts were screened and articles which did not meet inclusion criteria were removed. The remaining articles were read in full and checked for eligibility. The reference lists of the shortlisted articles were then checked for additional eligible papers. Identified articles were added to the shortlist.

Quality of shortlisted articles

In order to assess the quality of the papers, Caldwell, Henshaw & Taylor's (2005) framework was chosen because it does not focus on any specific design and thus lends itself well to cohort surveys and case-control studies such as those yielded by the literature search for this review. The framework offers two paths, each for assessing the quality of either qualitative or quantitative studies. The shortlisted articles were all quantitative and so this path was used for all of them. In applying Caldwell et al's (2005) framework, three of the quality criteria questions ("Does the title reflect the content"?; "Are the authors credible"?; "Does the abstract summarise the key components"?),were removed in order to streamline the process for a more focused consideration of quality. Also, two of the questions were changed. The first was a two-part question ("Is an experimental hypothesis clearly stated"?; "Are the key variables clearly identified"?) which was split into two separate questions to aid and focus the evaluation of those concepts. The second ("Are the results generalizable"?) was phrased differently ("Generalizability of the results"?) for a better fit for the articles. This left 16 questions which were placed in a table. Two other papers (Downs & Black, 1998; and Ramos-Alvarez, Moreno-Fernandez, Valdes-Conroy, & Catena, 2008) were consulted, which offered detailed points to consider in relation to each of the questions in Caldwell et al's (2005) framework. These points were placed in

the table against the corresponding question from Caldwell et al's (2005) framework (Table 2).

Table 2: Criteria questions and other points to consider

Quality Criteria questions		Other Points to consider in relation to each question
1	Is the rationale for undertaking the research clearly outlined?	-Sets the context for the research. -Identifies gaps. -Cites enough background literature to justify the research problem and the need for the research.
2	Is the literature review comprehensive and up-to-date?	-Good topic introduction. -Covers relevant points. -Cites up-to-date literature. -There is evidence of critical review of the literature. -Cites a balance of previous work that agrees with the author's perspective and that offers alternative points of view.
3	Is the aim of the research clearly stated?	-The research problem/aims/objectives are clearly described. -The research question is clearly set.
4	Are all ethical issues identified and addressed?	-There is evidence of ethical approval for the research. -Ethical issues are discussed (e.g. adverse events are listed, measures, addressed; confidentiality and withdrawal etc are discussed). -Informed consent was sought from the participants.
5	Is the methodology identified and justified?	-There is clear rationale for the strategy chosen. -The strategy is appropriate for the aims of the study. -The description allows for replication.
6	Is the study design clearly identified, and is the rationale for choice of design evident?	-The design is stated (repeated measures/longitudinal/cross-sectional/quasi-experiment/cohort study/randomised/blinded/includes controlled/between-within/.one-way/multivariate/simple/complex etc). -Justification for the design is stated. -Measures have been taken to account for biases and experimenter expectations. - The design protects against contamination of groups/between groups
7	Is there an experimental hypothesis clearly stated?	-There are clear statements of the expected outcomes/predictions. -The hypotheses follow from the theory and rationale.
8	Are the key variables clearly defined?	-The main variables are listed, and clearly described.
9	Is the population identified?	-The source population and context is made clear.
10	Is the sample adequately described and reflective of the population?	-Participant characteristics and any idiosyncrasies are clearly described. -Inclusion/exclusion criteria are stated. -Method of recruitment/selection of participants is clearly described. -There is acknowledgement of any differences between the source population and those who agreed to participate. -Measures/diagnoses/treatments etc are representative of that which would be the case for the majority of individuals in the source population and there is acknowledgement if this is not the case. -Any differences between 'cases' and 'controls' are described.
11	Is the method of data-collection valid and reliable?	-The data-collection is current rather than retrospective. -Contaminations of any one group did not occur /was not possible / was accounted for. -Steps were taken to minimise confounding (e.g. similar diagnoses/recovery-stage/severity/'cases' and 'controls' recruited from the same population/over the same time-period and-or time since injury/same injury severity and –or aetiology/the same measures used for all groups/motivation or effort-testing carried out and accounted for/medication or other treatments accounted for/comorbidities controlled-for/engagement in litigation accounted for, appropriate definition, operationalization and measurement of constructs involved with appropriate consideration of timing, and potential impact) -There was adequate sample-size -n-sizes of groups were similar.

Quality Criteria questions		Other Points to consider in relation to each question
12	Is the method of data analysis valid and reliable?	-The statistical tests that were performed are clearly stated. -There is confirmation that the data met assumptions for the relevant statistical analyses before they were performed. -If the assumptions were not met, their use was justified. -The statistical procedures were appropriate. -There was adequate adjustment for confounding/extraneous variables were accounted/controlled-for. -There is evidence of statistics that were used (tables/charts/reporting of values, etc). -There is evidence of steps taken to avoid Type I and II errors. -There is sufficient power and sample-size
13	Are the results presented in a way that is appropriate and clear?	-There is clarity over what was actually done with the data. - All of the results are clearly explained.
14	Is the discussion comprehensive?	-The meaning of the results are clearly stated. -There is reference to hypotheses/predictions/aims. -The main findings are summarised. -The summary of the findings is presented in a balanced way. -Any ambiguous or questionable results are addressed in a balanced way. -The findings are discussed in a balanced way with reference to literature and alternative views/possible alternative conclusions.
15	Generalizability of the results?	-There is discussion of the generalizability of the results. -The results are generalised appropriately and not over-generalised.
16	Is the conclusion comprehensive?	-The conclusions are supported by the findings. -No findings are ignored or given unbalanced attention. -There is discussion of the implications of the findings (balanced) and strengths and limitations discussed.

In order to rate each article, the 16 questions from Caldwell et al's (2005) framework were considered in turn for each article and were given a rating of 'Y' (Yes, meets the criteria), 'N' (No, does not meet the criteria), or 'P' (Partially meets the criteria). A total number of 'Y's, 'N's and 'P's was provided for each article at the bottom of the scaffold to offer a perspective of the quality of the studies at a glance and in comparison with each other. The quality assessment scaffold with the ratings for each study is presented as part of the quality assessment below.

Findings

Results of the searches

Figure 1 shows how the final 11 articles were shortlisted.

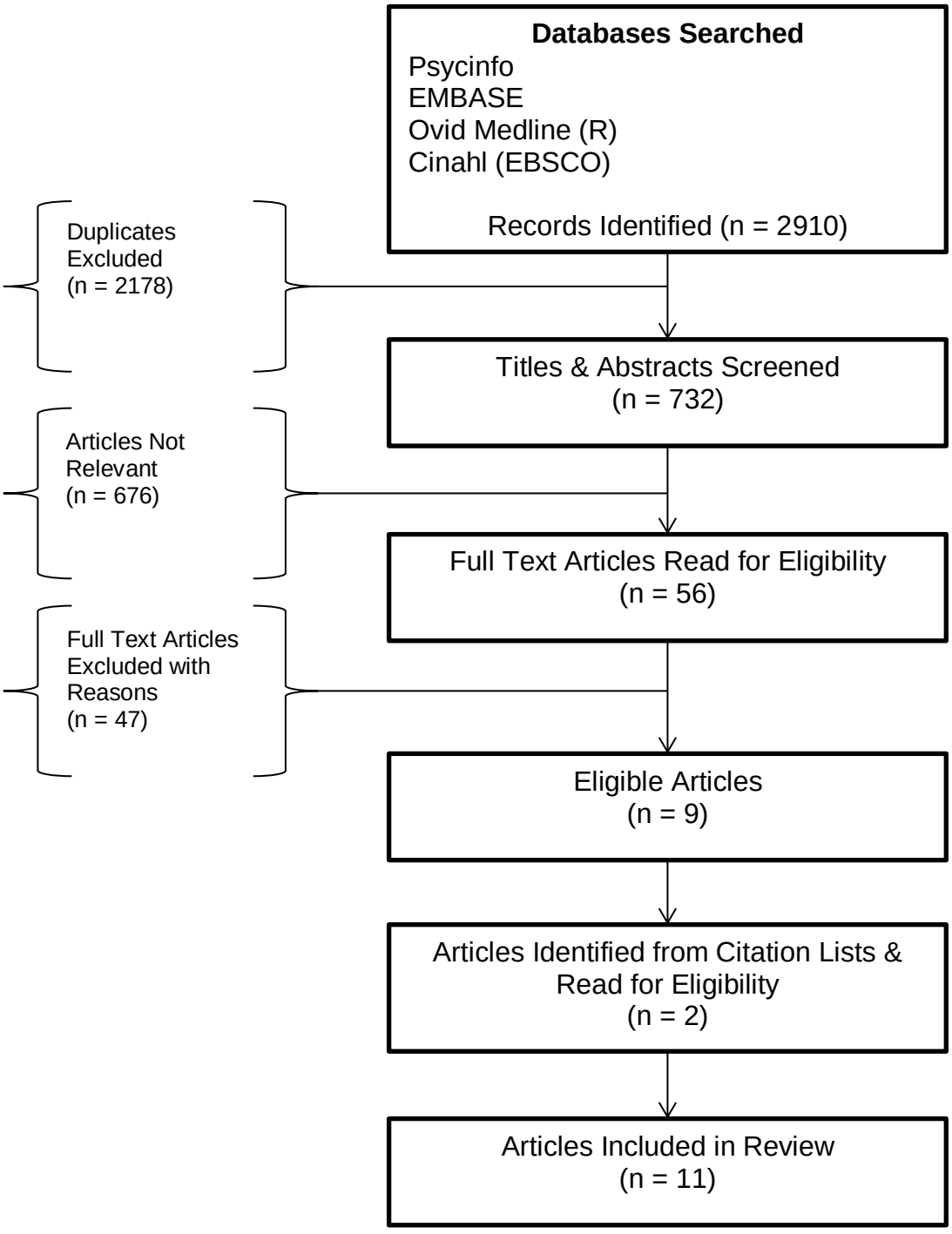

Figure 1: The shortlisting process

Brief description of the shortlisted articles

Eligible articles included 11 cohort-survey or case-control, studies carried out between 1986 and 2010 that (each to some level) considered the relationship between depression and neuropsychological assessment of memory in TBI. Of the 11 articles, three explored relationships (Atteberry-Bennett, Barth, Loyd & Lawrence, 1986; Ruttan & Heinrichs, 2003; Alfano, 2006), six studies explored differences between groups (Cicerone & Kalmar, 1997; Sherman, Strauss, Slick & Spellacy, 2000; Rapoport, McCullagh, Shammi & Feinstein, 2005; Chamelian & Feinstein, 2006; Preece & Geffen, 2007; Rao, Munro, Rosenberg, Ward, Bertrand, Degoankar, Horska, Pham, Yousem & Barker, 2010), and two employed both approaches (Satz, Forney, Zaucha, Asarnow, Light, McCleary, Levin, Kelly, Bergsneider, Hovda, Martin, Namerow, & Becker,1998; Keiski, Shore & Hamilton, 2007). One of the studies (Keiski et al, 2007) had memory test performance as the main focus, whilst the rest included assessment of memory as part of an evaluation of cognitive functions in general in relation to depression, as well as other points of focus such as behavioural functioning or pain-related factors. Most of the articles used a variety of measures to meet the requirements of their research questions, but all of them used neuropsychological assessments to measure memory, as required by the inclusion criteria for the review. All of the studies included adult participants who had mild, moderate or severe TBI (as determined by the diagnostic assessments used in each paper) and participants who had depression (as determined by the depression assessments used in each paper) and had a mix of males and females in their samples. Table 3 offers an overview of the studies. Further details are presented throughout the review.

Table 3: Overview of the studies

Study	Sample	Injury severity and Time since injury	Assessment of depression	Neuropsychological assessment of memory	Focus of study, approach to analysis and results
Atteberry-Bennett, Barth, Loyd & Lawrence. (1986)	Total = 37 Male = 23 Female = 14	Injury severity: MTBI Time since injury = 1.7 months	Beck Depression Inventory (BDI) Author coded individuals with scores of 10 or more as depressed. Beck's classification: 0-9=normal 10-15=mildly depressed 16-23=moderately depressed 24and above=severely depressed.	Tests used: Selective Reminding Test Recall condition studied: Learning (2 analyses)	This study explored relationships between variables. It focused on the relation between cognitive and behavioural functioning and depression. <u>Approach 1:</u> Multiple regression analyses that included demographic variables were conducted with the depression measure and measures of memory and other cognitive functions. <u>Approach 2:</u> Simple correlations were conducted between the memory measures and depression scores. Both of the analyses indicated an association between depression and learning.
Cicerone & Kalmar (1997)	Total = 40 Male = 8 Female = 32 Depression group = 20 Non-depressed group = 20	Injury severity: MTBI Time since injury = At least 3 months. Depressed group: Mean= 20.95 months(SD=20.12) Non-depressed group: Mean=12.9 months (SD=8.66).	Clinical diagnosis from medical records. Pre-existing history of depression based on a record of clinical diagnosis and professional treatment for depression at some time during the three years preceding injury. (Some were being treated for depression, including antidepressant medication, at the time their injuries occurred. Some had history of remote depression (depressive episodes which had resolved prior to injury.)	Tests used: Logical Memory Rey Complex Figure Test (RCFT) California Verbal Learning Test (CVLT) Recall condition studied: Immediate recall (2 analyses) Delayed recall (1 analysis) Learning (1 analysis) Working memory (1 analysis)	This study explored differences between groups. It focused on the influence of pre-existing depression on subjective cognitive complaints and neuropsychological performance. In multivariate ANOVAs with other memory measures, performance was compared between a group of depressed individuals and a group of nondepressed individuals. 4 analyses indicated no impact of depression on memory performance. 1 analysis indicated a negative

Study	Sample	Injury severity and Time since injury	Assessment of depression	Neuropsychological assessment of memory	Focus of study, approach to analysis and results
			All depressed participants had been treated for their depression as outpatients and none had psychotic features associated with their depression.		impact of depression on memory performance.
Satz, Forney, Zaucha, Asarnow, Light, McCleary, Levin, Kelly, Bergsneider, Hovda, Martin, Namerow, & Becker. (1998)	Total = 130 TBI group = 100 TBI group Male = 83% Female =17% Other injury controls (OIC) = 30 Male = 73.3% Female =26.7% In some analyses: Group1 = 17 (moderate & severe disability and depression) Group 2 = 47 (moderate & severe disability, no depression) Group 3 (minus 2 individuals) = 64 (good recovery, no depression and non TBI, no depression)	Injury severity: Mix of moderate-to-severe TBI Time since injury = 6 months	Symptom Checklist 90-Revised (SCL90-R): 'Cases' of depression were identified by a deviation score of more than 2SD. Item 13 of the NBRS (NRS-13): 'Cases' of depression were identified by a score of 4 or more.	Tests used: Rey Auditory Verbal Learning Test (RAVLT) Word List Memory Total Correct Recall condition studied: Immediate (4 analyses) Delayed (4 analyses) Learning (8 analyses)	This study explored relationships between variables as well as differences between groups. It focused on determining the association between depressive symptomatology and performance in neuropsychological & functional assessments. <u>Approach 1:</u> This approach explored differences. The sample was split into three groups according to recovery/disability status and depression status. In Group 1 were individuals with moderate and severe disability with depression. In Group 2 there were individuals with moderate and severe disability without depression. In Group 3 there were individuals with good recovery and non-TBI individuals, both without depression. MANCOVAs compared performance between groups, controlling for age and education. <u>Approach 2:</u> This approach explored relationships. Two correlations were conducted, the first between the memory measures and the SCL90-R measure of depression; and the second between the memory measures and the NRS-13 measure of depression (age and education were not controlled for).

Study	Sample	Injury severity and Time since injury	Assessment of depression	Neuropsychological assessment of memory	Focus of study, approach to analysis and results
					Approach 3: Multiple linear regression analyses were then computed with the SCL90-R controlling for age, education and recovery/disability status to determine the unique effect of depression on memory performance (and 13 other variables). Criteria for statistical significance was set at p<0.004 to account for numerous analyses and reduce the likelihood of Type-1 error. 13 analyses indicated no impact of depression on memory. 3 analyses indicated a negative impact of depression on memory performance.
Sherman, Strauss, Slick & Spellacy (2000)	Total =175 Male = 91 Female = 84 Mild Head Injury = 114 Mod-to-severe Head Injury = 61 Group 1 (Mild HI-low depression) = 78 Group 2 (Mild HI-high dep) = 36 Group 3 (Mod-to-severe HI-low dep) = 39 Group 4 (Mod-to-severe HI-high dep) = 22	Injury severity: Mix of MTBI and moderate-to-severe TBI Time since injury = Approximately 2 years: Mean=2.52 (SD=2.02)	Minnesota Multiphasic Personality Inventory (MMPI) Depression content scale: A T-score of 65 or more indicated significant elevation on the Depression scale. Individuals reaching this score were considered as being in the clinical range and were coded as a 'hi depression. Those with T-scores less than 65 were coded as 'low depression.'	Tests used: Logical Memory Rey-Osterrieth Complex Figure Test (RCFT) Recall condition studied: Immediate (2 analyses) Delayed (2 analyses) Working memory (2 analyses)	This study explored differences between groups. It focused on the relation between depressive status and neuropsychological functioning. Approach 1: All neuropsychological data were converted to norm-based z-scores. z-score differences on the memory measures between the high-depression and low-depression groups were inspected. Approach 2: To explore the clinical significance of group differences further, for each participant, a calculation was made of the percentage of neuropsychological tests on which they had impaired performance. Contingency coefficients then compared the percentage of individuals in each group who had scores in the

Study	Sample	Injury severity and Time since injury	Assessment of depression	Neuropsychological assessment of memory	Focus of study, approach to analysis and results
					impaired range. 5 analyses indicated no impact of depression on memory performance. 1 analysis indicated a negative impact of depression on memory performance.
Ruttan & Heinrichs (2003)	Total = 122 Sample 1 = 72 Male = 30 Female = 42 Sample 2 = 50 Male = 16 Female = 34	Injury severity: MTBI Time since injury = Sample 1=39.7 months (3.3 years) (SD=25.6 months) Sample 2=20.4 months (1.7 years) (SD=18.4 months)	Sample 1: Millon Clinical Multiaxial Inventory (MCMI) Dysthymia scale Sample 2: Minnesota Multiphasic Personality Inventory-2 (MMPI) Depression Content Scale Dysthymia Scale Harris-Lingoes Depression Scales	Tests used: Brown-Peterson Consonant Trigrams Test (sample 1 only) Logical Memory (both samples) Visual Reproduction (both samples) Recall condition studied: Delayed Recall (12 analyses) Working memory (1 analysis)	This study explored relationships between variables It focused on the relationship between depression and performance on neuropsychological tests. This study conducted analyses using two different samples, different measures of memory and several approaches to the measurement of depression. **Sample 1:** Depression was measured by the *Dysthymia* scale of the *MCMI-2*. Hierarchical regression procedures were conducted with different measures of memory. **Sample 2:** Approach 1: Depression was measured by the *Depression* scale of the *MMPI-2*. Hierarchical regression procedures were conducted. Approach 2: The authors highlighted that the Depression scale contained 'neurological' items which may have interfered with the results. Therefore, analyses were rerun with the neurological items removed. Approach 3: Depression was

Study	Sample	Injury severity and Time since injury	Assessment of depression	Neuropsychological assessment of memory	Focus of study, approach to analysis and results
					measured by the *Dysthymia* scale of the *MMPI-2*. Hierarchical regression procedures were conducted. Approach 4: The authors highlighted that the Dysthymia scale contained 'neurological' items which may have interfered with the results. Therefore, analyses were rerun with the neurological items removed. This procedure using the four approaches was performed for each memory task. One additional depression scale was used and employed in one set of analyses for sample 2: Approach 5: Depression was measured by the *Harris Lingoes* depression scales. A correlation was performed between these scales and one memory measure (Visual Reproduction). Approach 6: The authors highlighted that the Harris Lingoes depression scales contained 'neurological' items which may have interfered with the results. Therefore, correlations were rerun with the neurological items removed. 12 analyses indicated no association between depression and memory performance. 1 analysis indicated a relationship between higher depression scores and poorer memory performance.

Study	Sample	Injury severity and Time since injury	Assessment of depression	Neuropsychological assessment of memory	Focus of study, approach to analysis and results
Rapoport, McCullagh, Shammi & Feinstein (2005)	Total = 74 Participants without major depression = 53 Participants with major depression = 21	Injury severity: Mix of MTBI and moderate-to-severe TBI Time since injury = Mean=200.43 days (6.5 months) Range = 122-467 days (4months and 1.3 years)	Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) Assessed by a psychiatrist (who was blind to the cognitive data). If criteria were met, 'cases' were coded as 'depressed'. If criteria were not met, cases were coded as 'not depressed'.	Tests used: Logical Memory California Verbal Learning Test (CVLT) Brief Visuospatial Memory Test (BVMT) Recall condition studied: Delayed (4 analyses) Learning (4 analyses) Working memory (2 analyses)	This study explored differences between groups. It focused on the relationship between depression and cognition. <u>Approach 1:</u> In analyses of variance, scores on memory measures were compared between a group of individuals with major depression and a group of individuals with no depression. Criterion for statistical significance was set at $p \leq 0.006$ and for statistical trend at $p \leq 0.05$. Bonferroni corrections were used. Age and past history of depression were controlled for. <u>Approach 2:</u> Percentile cut-offs were used to determine the percentage of the groups that would be considered impaired on each of the measures and these percentages were compared (Fisher's exact test). 5 analyses indicated an impact of depression on memory performance. 5 analyses indicated a trend towards poorer performance in depression.
Alfano (2006)	Total = 53 Male = 42 Female = 11	Injury severity: MTBI Time since injury = Mean=12.9 months (SD11.3)	Centre for Epidemiological Studies Depression scale (CESD) Personality Assessment Screener (PAS Symptom Checklist-90 (SCL90-R)	Tests used: Babcock Story Recall Hopkins Verbal Learning Test (HVLT) Rey-Osterrieth Complex Figure Test (RCFT) Recall condition studied: Delayed (6 analyses) Working memory (3 analyses)	This study explored relationships between variables. It focused on emotion and pain-related factors on neuropsychological functioning. Correlations were conducted between memory performance (on two tasks) and depression scores (on three measures).

Study	Sample	Injury severity and Time since injury	Assessment of depression	Neuropsychological assessment of memory	Focus of study, approach to analysis and results
					7 analyses indicated no relationship between depression and memory performance. 2 analyses indicated that higher depression scores was associated with poorer performance.
Chamelian & Feinstein (2006)	Total = 63 Male = 55.6% Female = 44.4% Group 1 = 29 (46%) Group 2 = 34 (54%)	Injury severity: Mix of MTBI and moderate-to-severe TBI Time since injury = 6 months	Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I). Assessed by the clinic's neuropsychiatrist who was blind to the cognitive data. If criteria were met, 'cases' were coded as 'with depression'. If criteria were not met, cases were coded as 'without depression'.	Tests used: Wechsler Adult Intelligence Scale (WAIS-3) Working Memory Wechsler Adult Intelligence Scale (Wais-3) Verbal Memory California Verbal Learning Test (CVLT) Brief Visuospatial Memory Test (BVMT) Recall condition studied: Delayed Recall (1 analysis) Recognition (1 analysis) Learning (1 analysis) Working memory (1 analysis)	This study explored differences between groups. It focused on the effect of depression on cognitive complaints and neuropsychological tests. Scores on the memory measures were compared using MANCOVAs between a group of individuals with subjective cognitive complaints and a group who did not have subjective complaints. In the no complaints group there were no individuals with depression whereas 18.5% of the complaints group had depression. Depression was included as a covariate, revealing results which indicated whether or not it had impacted on performance. 2 analyses indicated no impact of depression on memory performance. 2 analyses indicated a negative impact of depression on memory performance.

Study	Sample	Injury severity and Time since injury	Assessment of depression	Neuropsychological assessment of memory	Focus of study, approach to analysis and results
Keiski, Shore & Hamilton (2007) (PAI)	Total = 53 Non-depressed = 19 Depressed = 24	Injury severity: Mix of MTBI and moderate-to-severe TBI Time since injury = Mean=17.8 months (1.5 years) (SD=16.8)	Personality Assessment Inventory Individuals with depression scores of at least 70 were coded as depressed Individuals with at most 60 were coded as non-depressed	Tests used: Verbal Paired Associates Logical Memory California Verbal Learning Test (CVLT) Recall condition studied: Immediate Recall (3 analyses) Delayed Recall (15 analyses) Recognition (12 analyses) Learning (3 analyses)	This study explored relationships between variables as well as differences between groups. It focused on the relationship between depression and memory. <u>Approach 1:</u> Using t-tests (or Mann-Whitney-U tests), performance was compared between individuals with high depression and low depression scores. <u>Approach 2</u>: Using ANCOVAs, performance was compared between individuals with high depression and low depression scores. To control for 'motivation', analyses used symptom validity test scores as a covariate. This approach was applied in the delayed recall and recognition conditions only. <u>Approach 3</u>: Level of impairment was also controlled for. Quantification of impairment/severity was achieved by calculating, for each individual, average T scores on several neuropsychological measures (excluding memory). The composite score was labelled as 'Average Performance Rating' (APR). Using ANCOVAs, performance was compared between individuals with high depression and low depression scores. To control for level of impairment, the APR score was included as a covariate. This approach was applied in the delayed recall and recognition conditions only.

Study	Sample	Injury severity and Time since injury	Assessment of depression	Neuropsychological assessment of memory	Focus of study, approach to analysis and results
					Approach 4: A correlation was conducted between memory performance and depression. Approach 5: A partial correlation was conducted between memory performance and depression, controlling for impairment and motivation. 20 analyses indicated no impact of depression on memory performance. 13 analyses indicated a negative impact of depression on memory performance.
Preece & Geffen (2007)	Total = 109 Male = 64 Female = 45 MTBI depressed = 30 Male = 24 Female = 6 MTBI not-depressed = 30 Male = 24 Female = 6 Control depressed = 19 Male = 6 Female = 13 Control not depressed = 30 Male = 10 Female = 20	Injury severity: MTBI Time since injury = Within 24 hours	'Some' individuals reported having received a diagnosis of depression in the past 6 months. The rest were classified as depressed or not depressed on the basis of the Depression Anxiety Stress Scales - Depression Scale (DASS-Dep) Reported diagnosis in the last 6 months OR DASS-Dep score of 14 or higher were coded as depressed group. Preece cites Lovibond & Lovibond (1995), saying that:"A score of 14 designates at least a moderate level of depression."	Tests used: Hopkins Verbal Learning Test (HVLT) Recall condition studied: Delayed Recall (1 analysis) Recognition (1 analysis) Learning (1 analysis)	This study explored differences between groups. It focused on the effect of pre-existing depression on the cognitive sequelae of MTBI. ANCOVAs compared memory performance between individuals who had pre-existing depression and those without pre-existing depression. Blood Alcohol Content (BAC) was controlled for. 2 analyses indicated no impact of depression on memory performance. 1 analysis indicated a negative impact of depression on memory performance.

Study	Sample	Injury severity and Time since injury	Assessment of depression	Neuropsychological assessment of memory	Focus of study, approach to analysis and results
Rao, Munro, Rosenberg, Ward, Bertrand, Degoankar, Horska, Pham, Yousem & Barker (2010)	Total = 17 Depressed = 10 Not-depressed = 7	Injury severity: Mix of MTBI and moderate-to-severe TBI Time since injury = Between 3 and 60 months (3 months - 5 years)	Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) 'Cases' were coded as depressed where criteria were met for a major depressive episode after TBI and to never have met the criteria prior to TBI. Where criteria was never met for a major depressive episode, individuals were coded as 'comparison subjects'	Tests used: Brief Visuospatial Memory Test (BVMT) Hopkins Verbal Learning Test (HVLT) Recall condition studied: Delayed Recall (2 analyses) Learning (2 analyses)	This study explored differences between groups. It was a pilot study reporting preliminary results. It focused on cognitive and neuroanatomical correlates of post-TBI depression. t-tests explored differences in performance between groups of individuals with and without depression. Criteria for statistical significance was set at $p \leq 0.05$ and statistical trend at $p \leq 0.10$. 1 analysis indicated no impact of depression on memory performance. 1 analysis indicated a negative impact of depression on memory performance. 2 analyses indicated a trend towards poorer performance in depression.

The reviewed studies often employed multiple approaches. For example, seven studies used two or more memory assessments of a single recall condition (see below); two studies (Satz et al,1998; Keiski et al, 2007) explored differences between groups on the basis of depression status ('depressed' vs. 'non-depressed', or 'high depression' vs. 'low depression') as well as exploring relationships between depression and memory test performance; one study repeated full sets of analyses with two separate samples (Ruttan & Heinrichs, 2003); and four studies (Satz et al,1998; Ruttan & Heinrichs, 2003; Alfano, 2006; Preece and Geffen, 2007) conducted analyses with two or more measures of depression. Due to the multiple approaches employed, the studies generated 107 results.

According to the authors' interpretations of their findings, overall, four papers observed no associations between depression and memory test performance (Satz et al, 1998; Sherman et al, 2000; Ruttan & Heinrichs, 2003; Alfano, 2006) while three papers obtained results indicating that depression had impacted on memory test performance (Atteberry-Bennett et al, 1986; Rapoport et al, 2005; Rao et al, 2010). The results of four studies were not definitive but the authors drew attention to either a below-significance tendency towards poorer memory performance in depression, or indicated the possibility of an effect of depression that was specific to one recall condition or memory test (Cicerone & Kalmar, 1997; Chamelian & Feinstein, 2006; Keiski et al, 2007; Preece & Geffen, 2007). However, there were methodological weaknesses in all of the studies – to different extents - which are identified later in the review.

Population Characteristics

All of the studies had a mix of male and female participants, whose mean ages ranged from 24 to 52 and whose mean number of years of education ranged from 10.8

years to 14.8 years. There was variation in the studies in respect of the timing of participation, ranging from within-24-hours to five years following injury and only two studies used the same time-window of six months (Satz et al, 1998; Chamelian & Feinstein, 2006)

There was variation in the inclusion criteria and the severity of injuries that were selected for investigation. Traumatic brain injury can range from mild impacts that leave no trace of structural damage, physiological effects or lasting effects on behaviour or cognitive function, to impacts that leave the recipient in a coma or permanently vegetative state with extreme damage to many areas of the brain. Thus TBI is typically split into three ratings of mild, moderate and severe (Lezak et al, 2012).

Figure 2 presents the diagnostic criteria for MTBI. All of the studies used either Glasgow Coma Scale (GCS) scores, loss of consciousness (LOC), post traumatic amnesia (PTA), computer tomography (CT) scan, alteration in mental status - or most commonly a combination of these - to determine severity (see Table 4).

Diagnostic Criteria for mild traumatic brain injury requires at least one of the following:

- Glasgow Coma Scale (GCS) rating of 13-15
- Any Loss of Consciousness (LOC) but not exceeding 30 minutes
- Any Post Traumatic Amnesia (PTA) but not exceeding 24 hours
- Any alteration in mental state
- Any focal neurological deficit

Criteria set by The Mild Traumatic Brain Injury Committee of the Head Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine (Kay, Harrington, Adams, Anderson, Berrol, Cicerone, Dahlberg, Gerber, Goka, Harley, Hilt, Horn, Lehmkuhl & Malec, 1993)

Figure 2: Diagnostic criteria for mild TBI

It is possible that MTBI is different to moderate and severe TBI in relation to impact on cognitive functioning, if so, it is preferable to study MTBI independently. This is because depression may impact on memory performance when the injuries are fairly mild, but where injury is greater, the effect of depression may not be detected against the background of increased injury effects (Sherman et al, 2000).

Five papers studied mild traumatic brain injury (Ateberry-Bennett et al, 1986; Cicerone & Kalmar, 1997; Ruttan & Heinrichs, 2003; Alfano, 2006; Preece & Geffen, 2007), one paper studied moderate-to-severe TBI (Satz et al, 1998) and five papers studied a mix of MTBI and moderate-to-severe TBI (Sherman et al, 2000; Rapoport et al, 2005; Chamelian & Feinstein, 2006; Keiski et al, 2007; Rao et al, 2010). The inclusion of a mix of participants could present a confounding issue (although, one of these studies did control for impairment in some analyses, Keiski et al, 2007, see Table 3). Another potential confounding issue is repeated TBIs. These can have a cumulative effect on cognition (Lezak, Howieson, Bigler & Tranel (2012) and is therefore a factor that should

be accounted-for in TBI studies by way of exclusion criteria. One of the studies (Chamelian & Feinstein, 2006) reported including individuals who had sustained more than one TBI.

Table 4: Criteria employed by each study to determine TBI severity

Study	TBI Severity	Criteria for determining severity
Atteberry-Bennett, et al (1986)	Mild	Glasgow Coma Scale (GCS) score = 13 or above
Cicerone & Kalmar (1997)	Mild	With or without Loss of Consciousness(LOC) (if with, then: ≤30 minutes) With or without Post Traumatic Amnesia (PTA) (if with, then: ≤24 hours) Alteration in mental status
Ruttan & Heinrichs (2003)	Mild	Used Criteria of the Mild Traumatic Brain Injury Committee of the Head Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine (Kay et al, 1993): GCS: 13-15; LOC: Any (not exceeding 30 minutes); PTA: Any (Not exceeding 24 hours); Alteration in mental status: Any; Focal neurological deficit: Any;
Alfano (2006)	Mild	Used Criteria of the Mild Traumatic Brain Injury Committee of the Head Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine (Kay et al, 1993): GCS: 13-15; LOC: Any (not exceeding 30 minutes); PTA: Any (Not exceeding 24 hours); Alteration in mental status: Any; Focal neurological deficit: Any;
Preece & Geffen (2007)	Mild	Glasgow Coma Scale (GCS) 13 to 15 Clear Computer Tomography (CT) scan
Satz et al (1998)	Mix of moderate-to-severe	Initial Glasgow Coma Scale (GCS) ≤12 (if ≥13, they were only included if abnormalities were noted on CT scan or if condition deteriorated to <13 prior to discharge)
Sherman et al (2000)	Mix of mild and moderate-to-severe	Used Kay et al (1993) criteria for MTBI but LOC=1 hour (instead of 30 minutes); PTA<24 hours If exceeded, the individual was classed as Moderate-to-Severe
Rapoport et al (2005)	Mix of mild and moderate-to-severe	Used Kay et al (1993) criteria for MTBI Classed as moderate TBI if: GCS = 9 to 12 and if PTA >24 hours but <1 week
Chamelian & Feinstein (2006)	Mix of mild and moderate-to-severe	Glasgow Coma Scale (GCS) = 13 to 15 for MTBI GCS = 9 to 12 for moderate TBI LOC MTBI<20 minutes PTA MTBI<24 hours Moderate>24 hours but <1 week
Keiski et al (2007)	Mix: At least Mild	Used Kay et al (1993) criteria to establish that individuals had sustained 'at least' a mild TBI but since the study included a mix, the limits could be exceeded
Rao et al (2010)	Mix of mild and moderate-to-severe	States that severity was determined using GCS, but cut-offs not specified

The criteria employed to determine the severity of TBI varied and the cut-offs differed between the studies. It is possible to see from Table 4 that only four studies based their participant selection on the same criteria (Ruttan & Heinrichs, 2003; Alfano, 2006; Rapoport et al, 2005; Keiski et al, 2007). Thus inclusion and exclusion criteria differed between the studies for example, Cicerone & Kalmar's (1997) study included participants with MTBI using a cut-off time for LOC of 30 minutes whereas Sherman et al's (2000) study used a cut-off time for LOC of 60 minutes for MTBI. This means that the studies potentially investigated slightly different populations although they were purported to be the same.

In summary, across the studies, the TBI populations were fairly diverse, with possible implications for generalizability and coherence of the findings. When reviewing the literature, the demographic and injury variables are important to bear in mind because it is not always possible to compare like for like. This is particularly relevant to studies including individuals who have injuries of differing severity, and this will reduce the strength of these studies. Therefore, from this perspective, (although the issue of different inclusion criteria between the studies persists) the strongest papers are those which studied a single severity-level, (Ateberry-Bennett et al, 1986; Cicerone & Kalmar, 1997; Ruttan & Heinrichs, 2003; Alfano, 2006; Preece & Geffen, 2007) since this would have reduced the potential confounding effects of injury severity on memory performance – although Keiski et al (2007) did control for impairment.

Neuropsychological assessment of Memory

Across the studies, a total of sixteen memory tests were used (see Table 3). Many of the reported measures are not based on different psychological models of memory but

rather the indices are based on recall conditions of the tests, which are typically divided into immediate, delayed and recognition memory. Some of the tests also report indices of learning across multiple trials. Some of the studies also report performance on tests of working memory. In tests of immediate recall the respondent is required to freely recall information immediately following a single presentation of verbal or visual material, for example in the immediate recall condition of the Rey Complex Figure Test (Rey, 1941). In tests of delayed recall the respondent is required to recall information after a period of delay, with or without a distraction task, for example in the delayed recall condition of the Logical Memory story recall (Wechsler 1987; 1997). In tests of recognition the respondent is required to recognise visual or verbal stimuli in a multiple choice or cued format, for example in the recognition condition of the Logical Memory story recall. In tests of learning the respondent is required to recall information across multiple trials, for example in the Rey Auditory Verbal Learning Test (Rey, 1964). In tests of working memory the respondent is required to retain information and manipulate it before giving a response, for example in the digit span test (Wechsler 1987; 1997).

Many tests often have multiple indices that relate to more than one of the recall conditions. Where possible, this review discusses the results of the studies according to the broad recall conditions, and presents the results under each condition. To simplify and organise the results, the studies employing each test are presented later in tables for each recall condition. In the case of one study, the author reported on the use of a measure but did not state which specific task was employed. In this case, since the outcome reported is not identified by recall condition, the results are presented for the selected measure in a subsequent section labelled ‘Tests not specified’.

Measures of Depression

Table 5 shows that 11 different measures for assessing depression were used across the studies and three studies used two or more approaches to the assessment of depression.

Table 5: Methods of assessing depression

Assessment of depression	
Depression assessment Used	**Studies employing the method**
Structured Clinical Interview for DSM-IV Axis-I Disorders (SCID-IV) First, Spitzer, Gibbon & Williams (1996) Gold Standard Diagnostic interview	Rapoport et al (2005) Chamelian and Feinstein (2006) Rao et al (2010)
Reported clinical diagnosis and/or information of clinical diagnosis and treatment obtained from medical records	Preece and Geffen (2007) Cicerone and Kalmar (1997).
Beck Depression Inventory (BDI) Beck, Ward, Mendelson, Mock, & Erbaugh, (1961) Self-report measure of depression	Atteberry-Bennett et al (1986)
Symptom Checklist-90, Revised (SCL-90-R) Derogatis (1983) Self-report measure of distress containing a depression scale	Alfano (2006) Satz et al (1998),
Depression Anxiety Stress Scales – Depression Scale (DASS-Dep) Lovibond & Lovibond (1995) Self-report measure of distress containing a depression scale	Preece and Geffen (2007)
Centre for Epidemiological Studies Depression Scale, CES-D Sawyer Radloff (1977) Self-report measure of distress containing a depression scale	Alfano (2006)
Personality Assessment Screener (PAS) Morey (1998) Self-report personality measure containing emotion scales	Alfano (2006)
Personality Assessment Inventory (PAI) Morey (1991) Self-report personality measure containing emotion scales	Keiski et al (2007)
Minnesota Multiphasic Personality Inventory second edition (MMPI-II) Butcher, Dahlstom, Graham, Tellegen, & Daemmer (1989) Self-report personality measure containing emotion scales	Ruttan and Heinrichs (2003) Sherman et al (2000)
Millon Clinical Multiaxial Inventory, Second Edition (MCMI-II) Millon (1987) Self-report personality measure containing emotion scales	Ruttan and Heinrichs (2003)
Neurobehavioural Rating Scale (NBRS) Item 13, (NRS-13) Examiner-rated instrument for assessing behaviour, containing a single item for rating depressed mood	Satz et al (1998)

Table 5 shows that three studies used the highly regarded gold standard, DSM-IV diagnostic structured clinical interview (SCID-IV) (Nordhus, 2008) and two studies used clinical diagnosis as reported by participants (see below). Four studies used self-report measures of depression (see below). One of these was a specific measure of depression, while the other three were general self-report measures of distress which contained depression scales. Four studies used personality measures which contained scales of depression and dysthymia (see below); and one study used an examiner-rated measure of behaviour which contained a single item for rating depressed mood.

Since the SCID-IV and clinical diagnosis are more likely to appropriately identify cases of depression (Nordhus, 2008), studies employing these methods to determine depression status and allocation to groups on this basis were the strongest of the shortlisted studies in this respect (Cicerone & Kalmar, 1997; Rapoport et al, 2005; Chamelian & Feinstein, 2006; Preece & Geffen, 2007; Rao et al, 2010). However, the groups in Cicerone and Kalmar's (1997) and Preece and Geffen's (2007) study, individuals had been allocated on the basis of depression status as determined by clinical diagnosis that was established from clinical records and participants' self-reports of diagnosis. There is no guarantee of the accuracy of those reports or of the quality of the original assessments used for diagnosis, reducing the strength of these studies. Moreover, Preece & Geffen (2007) also employed a self-report measure, to include cases where depression was yet undiagnosed; and Cicerone and Kalmar's (1997) sample was recruited on the basis of premorbid and in some cases 'remote' depression (past history of depression). Therefore, it is possible that individuals in the depression groups in these studies did not currently have depression. This reduces the strength of these studies further and emphasises some of the inconsistencies in the way depression is operationalized and studied in the literature.

Assessing depression in TBI can be complex because numerous factors need to be taken into account that may not be applicable in other populations. For example, depression can present differently in brain injury (Raskin & Stein, 2000). Also, self-report instruments in particular may place too much emphasis on non-affective symptoms, such as lack of motivation, and this can lead to overestimation of depressive symptoms since these are often also associated with brain injury. A number of measures used in the shortlisted studies have been examined by various authors following concerns regarding their potential to result in elevated scores in TBI populations, as a result of increased endorsement of such symptoms (BDI, Homaifar, Brenner, Gutierrez, Harwood, Thompson, Filley, Kelly and Adler, 2009; SCL90-R, Woessner & Caplan, 1995; CES-D, Bush, Novack, Schneider & Madan 2004; PAI, Demakis, 2007). Moreover, there is evidence to suggest that cut-off scores in such measures are not appropriate for use in TBI populations and that higher cut-off scores should be used. For example, Homaifar et al (2009) suggested that the cut-off score on the BDI be increased from 10 (for the non-TBI population) to at least 19 (for the TBI population). Woessner and Caplan (1995) highlighted that over-diagnosis is an upshot of using psychological measures that were normed on physically healthy populations. In research, authors risk allocating non-depressed individuals into the wrong group. Moreover, in all cases, the literature is clear that the measures were not designed for diagnosis and that clinical interview is still necessary for the diagnosis of depression.

Similarly, the MMPI and MCMI personality inventories have taken some criticism for producing elevations on the depression scales because they contain ‘neurological items’. In an attempt to reduce the bias, Gass and Russell (1991) removed the questionable

items in the MMPI-II and Ruttan and Heinrichs (2003) followed suit as a way of increasing confidence in their results with regard to their second sample. In their first sample, however, the authors did not do this. In addition, they chose to use the Dysthymia scale of the MCMI-II to assess depression instead of using the Depression scale, since Wetzler and Marlowe (1993) had reported its greater efficiency in diagnosing depression. Piersma (1991) had also shown that the MCMI Dysthymia scale functioned slightly better as a predictor of major depression than did the major depression scale. Interestingly, in one of Ruttan and Heinrichs' (2003) regression procedures, Dysthymia contributed significantly to the prediction of memory performance. In 2011, Saulsman found that the MCMI Dysthymia scale was poor at discriminating depressed/dysthymic patients from anxious patients. This reduces confidence in the ability of the scale to pick out depressed individuals for allocation into groups. It may be that Ruttan and Heinrichs' (2003) sample was also anxious. This is important to consider as a confounding factor, given that Alfano (2006) found an association between anxiety and poorer memory performance. The MMPI-2 also has a dysthymia scale and in 2000, Klonsky compared individuals with diagnosed Dysthymia and Depression using their MMPI-2 scores and found that depression is more severe and has more physical/somatic symptoms.

The DSM-IV characterises Dysthymic Disorder by "at least 2 years of depressed mood for more days than not, accompanied by additional depressive symptoms that do not meet criteria for Major Depressive Episode." The main differences between these two disorders are that Major Depressive Disorder consists of discrete episodes, while Dysthymic Disorder is chronic, less severe and has been present for a period of years. This raises the question of what is actually being measured by all of these different scales and highlights the importance of operationalizing depression in research. Whether or not

‘neurological’ items are removed, it is still possible that these measures also overestimate the presence of clinical depression. When considering comparability between the studies, there appears to be variation between them in the construct that is being assessed.

Quality assessment of the shortlisted articles

The quality assessment scaffold based on 16 questions from Caldwell et al’s (2005) framework is presented in Table 6. It shows the ratings for each study. Although all of the questions were a useful aid for determining the quality of the studies, they did not all carry equal weight. The questions concerning study design (Question 6), method of data collection (Question 11) and method of data analysis (Question 12) were the most informative of study quality. Interestingly, all of the studies partially met the criteria for these questions. This suggests that they were all of moderate quality, as none were of high enough quality to meet all of the criteria, but likewise, none of the studies were of very poor quality.

Table 6: Ratings for each study using a quality assessment scaffold based on 16 questions from Caldwell et al's (2005) framework

Question	Atteberry-Bennett, Barth, Loyd & Lawrence. (1986)	Cicerone & Kalmar (1997)	Satz, Forney, Zaucha, Asarnow, Light, McCleary, Levin, Kelly, Bergsneider, Hovda, Martin, Namerow, & Becker. (1998)	Sherman, Strauss, Slick & Spellacy (2000)	Ruttan & Heinrichs (2003)	Rapoport, McCullagh, Shammi & Feinstein (2005)	Alfano (2006)	Chamelian & Feinstein (2006)	Keiski, Shore & Hamilton (2007)	Preece & Geffen (2007)	Rao, Munro, Rosenberg, Ward, Bertrand, Degoankar, Horska, Pham, Yousem & Barker (2010)
1	Y	P	Y	Y	Y	P	Y	Y	Y	Y	Y
2	Y	P	Y	Y	Y	P	P	Y	Y	Y	P
3	Y	P	Y	Y	Y	Y	Y	Y	Y	Y	Y
4	N	N	P	N	N	P	N	P	N	N	N
5	P	P	P	P	P	P	P	P	Y	Y	P
6	P	P	P	P	P	P	P	P	P	P	P
7	N	Y	Y	Y	N	Y	N	N	Y	Y	N
8	N	P	P	P	P	P	P	P	P	P	P
9	N	Y	Y	Y	P	P	N	Y	Y	P	Y
10	P	P	Y	P	Y	P	P	P	Y	Y	P
11	P	P	P	P	P	P	P	P	P	P	P
12	P	P	P	P	P	P	P	P	P	P	P
13	P	P	P	P	P	P	P	P	Y	P	P
14	P	P	Y	Y	Y	Y	P	Y	Y	Y	Y
15	P	P	P	Y	Y	P	P	P	Y	Y	P
16	P	P	Y	Y	P	Y	P	Y	Y	Y	Y
Y	3	2	8	8	6	4	2	6	11	9	5
P	9	13	8	7	8	12	11	9	4	6	9
N	4	1	0	1	2	0	3	1	1	1	2

Litigation status and symptom validity testing

Taking account of litigation status and symptom validity testing are important because of the risk of individuals performing worse than would be expected for their actual neuropsychological status – either wittingly, to achieve a secondary gain (e.g. compensation) or unwittingly, for other reasons (e.g. preoccupation with suicidal thoughts impeding the respondent's ability to participate fully in the assessment process) (Lezak et al, 2012; Rohling et al, 2002). Only three studies commented on litigation. In two of these (Sherman et al, 2000; Keiski et al, 2007), participants were involved in legal proceedings. Symptom validity tests were used to either exclude individuals failing the tests or to control for this in their analyses. In the other study (Cicerone and Kalmar, 1997) it was unclear as to whether or not their participants were actually involved in proceedings. Symptom validity tests were not used. Three studies did not comment on litigation, but did employ symptom validity tests. Alfano, (2006) and Chamelian and Feinstein (2006) reported acceptable test performance, and Ruttan and Heinrichs (2003) only included individuals passing the tests. Preece and Geffen (2007) recruited participants within 24 hours of injury; therefore it is unlikely that they would have been involved in litigation and the authors did not report on the use of a symptom validity test. The strongest papers in this regard were Sherman et al (2000), Ruttan and Heinrichs (2003), Alfano (2006), Chamelian & Feinstein (2006), Keiski et al (2007) and Preece and Geffen (2007).

Medication

Medication is another possible confounding factor. For example, Fann, Uomoto and Katon (2001) found that individuals with TBI and co-morbid depression who took antidepressant medication over an eight-week period significantly improved their performance on tasks of immediate recall, delayed recall and learning. Also, it may be

possible that psychotropic and analgesic medication have the potential to impair cognition as a result of their central nervous System (CNS) depressant properties (Chamelian & Feinstein, 2006). Therefore, it is important to take account of medication in these studies and exclude those on medication. However, only three studies mentioned medication or treatment (Cicerone and Kalmar, 1997; Preece and Geffen, 2007; Chamelian & Feinstein, 2006) and none of them excluded individuals on medication. In this respect, all of the studies had equal weighting and none emerged as stronger than the others.

Comorbidity

Comorbidity is another potential confounding factor since numerous conditions have the potential to impair memory, including epilepsy, alcohol abuse, substance use and psychiatric diagnoses (Lezak, Howieson, Bigler & Tranel, 2012). Indeed, one of the current papers (Alfano, 2006) included a measure of anxiety and found that anxiety, rather than depression, was associated with poorer performance in delayed recall. Therefore, it is important to take account of comorbidities in these studies to enable identification of the factors that impact on impairment and to exclude such cases (or to ensure the incidence of these factors is equal across groups). However, four studies did not mention comorbidity (Atteberry-Bennett et al, 1986; Cicerone & Kalmar, 1997; Sherman et al, 2000; Rao et al, 2010). Six studies mentioned comorbidity factors but did not exclude cases (Satz et al, 1998; Ruttan & Heinrichs, 2003; Rapoport et al, 2005; Alfano, 2006; Chamelian & Feinstein, 2006; Keiski et al, 2007). Only one study appeared to take account of these issues and used inclusion/exclusion criteria (Preece & Geffen, 2007). The authors also matched participants on blood alcohol content, which was later controlled for, making this the strongest paper in this regard.

Design and Statistics

In Satz et al's (1998) study, the sample was split into three groups: individuals with moderate and severe disability who also had depression; individuals with moderate and severe disability and no depression; and individuals with no depression but who had sustained a TBI and had good recovery or who had suffered other injuries. The first weakness was the third group, which contained individuals with as well as without TBI. Second, there were only 17 participants with depression (all in group 1), in comparison to the 47 individuals and 64 individuals without depression (in Groups 2 and 3 respectively). Third, depression – as measured by the NRS-13 measure – was associated with poorer memory test performance on two occasions, but the authors noted they had not controlled for age, education and importantly, recovery/disability status. They attempted to address this by using a regression procedure. However, the regression procedure was run using a different depression measure (SCL90-R).

In Rao et al's (2010) study, the 'depressed' group also had less severe brain injury. This may have resulted in smaller differences between groups. Individuals who were diagnosed with depression were also significantly older. The authors commented that this could have resulted in larger differences between groups since the performance of older individuals would be expected to be worse than that of younger individuals. However, age differences should not impact on results where age-scaled scores were used.

Chamelian & Feinstein's (2006) study compared memory test performance between groups of individuals with vs. without subjective cognitive complaints, where 18.5% of individuals in the complaints condition had comorbid depression and none in the

no-complaints group had depression. The authors only explored the impact of depression on memory test performance by partialling out its effect using MANCOVAs.

In Sherman et al's (2000) study, one set of results did not employ statistical procedures. Instead, a visual inspection of z-scores scores between groups was conducted. Second, the primary aim of this study related to cognition and not memory specifically. The authors reduced the dependent variables to a smaller number of factors (two of which included memory measures alongside other measures). This left few statistical procedures that directly addressed the association between depression and memory; the remaining ones consisted of comparing the number of individuals in each group (based on depression status) with memory test scores in the impaired range. Rapoport et al (2005) also used this approach in some analyses. Although this is an appropriate method, there may be individuals with depression whose memory scores were reduced but not impaired. Had there been any such instances, these analyses would not have detected them.

When exploring relationships, Pallant (2005) pointed out that partial correlations are preferable to simple correlations when confounding factors are present. Atteberry-Bennett et al (1986), Satz et al (1998), and Alfano (2006) used simple correlations, reducing the strength of these results in comparison to others. Regression procedures also explore relationships and were used by Atteberry-Bennett et al (1986), Satz et al (1998) and Ruttan and Heinrichs (2003). Tabachnick & Fidel (2001) suggest a formula for the minimum sample size: N=>50+8m (where m=number of independent variables). Only Satz et al's (1998) samples reached the appropriate size. It is possible that the results of the other two studies are specific to their samples.

When analysing differences between groups, Pallant (2005) pointed out that group-sizes of N=20 are small and analyses may be insufficiently powered to detect differences (if they exist). Some studies had group-sizes equal to this or smaller (Cicerone & Kalmar, 1997; Rapoport et al, 2005; Keiski et al, 2007; Rao et al, 2010), reducing confidence in findings that did not detect difference (since the possibility may remain). Pallant (2005) also stressed the importance of equal numbers when comparing groups, however, in Rapoport et al's (2005) study, one group was less than half the size of the other.

In terms of design and statistical procedures Preece and Geffen (2007) appears to be the strongest with no marked weaknesses in this respect, followed by Keiski et al (2007) since this study had memory performance as the main focus.

Impact of depression on different types of memory assessment

Impact of depression on Immediate Recall

Table 7 shows that four measures of immediate recall were used by four studies. One study employed two immediate recall tasks.

Table 7: Immediate Recall tasks used

Immediate Recall	
Memory Test Used	**Studies employing the test**
Rey-Osterrieth Complex Figure Test (RCFT) (Rey, 1941) Visual task	Cicerone and Kalmar (1997)
Rey Auditory Verbal Learning (RAVLT) (Rey, 1964) Initial trial	Satz et al (1998)
California Verbal Learning Test (CVLT) (Delis, Kramer, Kaplan & Ober, 1987) Initial trial	Keiski et al (2007)
Logical Memory – Story Recall Wechsler Memory Scale (WMS) (Wechsler, 1987; 1997) Verbal task	Cicerone & Kalmar (1997) Sherman et al (2000)

Eleven results were produced from the four studies with respect to the impact of depression on immediate recall. Of the 11 results, nine revealed no association between depression and immediate recall, (Cicerone & Kalmar, 1997; Satz et al,1998; Keiski et al, 2007) one set of results did not employ statistical procedures, but indicated there was no impact of depression on memory test performance (Sherman et al, 2000), and one suggested poorer memory test performance in depression (Sherman et al, 2000) (see Appendix 3 for details of each of the 11 analyses). In light of the discussions above, with reference to the papers' strengths and weaknesses (see Appendix 4 for a visual comparison), Keiski et al (2007) emerged as the strongest paper assessing the impact of depression on immediate recall, followed by Cicerone and Kalmar (1997).

Impact of depression on Delayed Recall

Table 8 shows that eight measures of delayed recall were used by 10 studies. Four studies used two delayed recall tasks and one study used three delayed recall tasks.

Table 8: Delayed Recall tasks used

Delayed Recall	
Memory Test Used	**Studies employing the test**
Rey-Osterrieth Complex Figure Test (RCFT) (Rey, 1941) Visual task	Sherman et al (2000) Alfano (2006)
Visual Reproduction Wechsler Memory Scale (WMS) (Wechsler, 1987; 1997) Visual task	Ruttan & Heinrichs (2003)
Brief Visuospatial Memory Test (BVMT) (Benedict, 1997) Visual task	Chamelian & Feinstein (2006) Rao et al (2010)
Logical Memory – Story Recall Wechsler Memory Scale (WMS) (Wechsler, 1987; 1997) Verbal task	Cicerone & Kalmar (1997) Ruttan & Heinrichs (2003) Rapoport et al (2005) Keiski et al (2007)
California Verbal Learning Test (CVLT) (Delis, Kramer, Kaplan & Ober, 1987) Delayed trial	Rapoport et al (2005) Keiski et al (2007)
Verbal Paired Associates Wechsler Memory Scale (WMS) (Wechsler, 1987; 1997)	Keiski et al (2007)
Rey Auditory Verbal Learning (RAVLT) (Rey, 1964) Delayed trial	Satz et al (1998)
Hopkins Verbal Learning Test (HVLT) (Brandt, 1991) Delayed trial	Rao et al (2010) Preece and Geffen (2007) Alfano (2006)

Forty eight results were produced with respect to the impact of depression on delayed recall. Of the 48 results, 33 revealed no association between depression and delayed recall (Cicerone & Kalmar, 1997; Satz et al, 1998; Sherman et al, 2000; Ruttan & Heinrichs, 2003; Alfano, 2006; Chamelian & Feinstein, 2006; Keiski et al, 2007; Preece and Geffen, 2007), one set of results did not employ statistical procedures but indicated there was no impact of depression on memory test performance (Sherman et al, 2000), 11 suggested poorer memory test performance in depression (Satz et al, 1998; Ruttan &

Heinrichs, 2003; Rapoport et al, 2005; Keiski et al, 2007) although in one of these the authors concluded that it was a chance finding (Ruttan & Heinrichs, 2003), and four revealed trends for depression to impair recall (Rapoport et al, 2005; Rao et al, 2010) (see Appendix 5 for details of each of the 48 analyses). In light of the discussions above, with reference to the papers' strengths and weaknesses (see Appendix 4), Preece and Geffen (2007) emerged as the strongest paper assessing the impact of depression on delayed recall, followed by Keiski et al (2007).

Impact of depression on Recognition

Table 9 shows that four measures of recognition were used by three studies. One study used three recognition measures.

Table 9: Recognition tasks used

Recognition	
Memory Test Used	**Studies employing the test**
Logical Memory – Story Recall Wechsler Memory Scale (WMS) (Wechsler, 1987; 1997) Verbal task	Keiski et al (2007)
Verbal Paired Associates Wechsler Memory Scale (WMS) (Wechsler, 1987; 1997)	Keiski et al (2007)
Hopkins Verbal Learning Test (HVLT) (Brandt, 1991) Recognition trial	Preece & Geffen (2007)
California Verbal Learning Test (CVLT) (Delis, Kramer, Kaplan & Ober, 1987) Recognition trial	Chamelian & Feinstein (2006) Keiski et al (2007)

Fourteen results were produced with respect to the impact of depression on recognition. Of the 14 results, 10 revealed no association between depression and recognition (Chamelian & Feinstein, 2006; Keiski et al, 2007), while four suggested poorer recognition in depression (Keiski et al, 2007; and Preece & Geffen, 2007) (see Appendix 6

for details of each of the14 analyses). In light of the discussions above, with reference to the papers' strengths and weaknesses (see Appendix 4), Preece and Geffen (2007) emerged as the strongest paper assessing the impact of depression on recognition, followed by Keiski et al (2007).

Impact of depression on Learning

Table 10 shows that six measures were used by eight studies. Three studies used two learning measures.

Table 10: Learning tasks used

Learning	
Memory Test Used	**Studies employing the test**
Brief Visuospatial Memory Test (BVMT) (Benedict, 1997) Visual task	Rapoport et al (2005) Chamelian & Feinstein (2006) Rao et al (2010)
Rey Auditory Verbal Learning (RAVLT) (Rey, 1964)	Satz et al (1998)
California Verbal Learning Test (CVLT) (Delis, Kramer, Kaplan & Ober, 1987)	Keiski et al (2007) Cicerone & Kalmar (1997) Rapoport et al (2005)
Hopkins Verbal Learning Test (HVLT) (Brandt, 1991)	Rao et al (2010) Preece & Geffen (2007)
Selective Reminding Test Buschke & Fuld (1974) Consistent Long Term Recall (CLTR)	Atteberry-Bennett et al (1986)
Word List Memory Asarnow, Satz, Light et al (1995)	Satz et al (1998)

Twenty two results were produced with respect to the impact of depression on learning. Of the 22 results, eight revealed no association between depression and learning (Satz et al, 1998; Preece & Geffen, 2007; Rao et al, 2010), while 10 suggested poorer learning in depression (Atteberry-Bennett et al, 1986; Satz et al, 1998; Rapoport et al, 2005; Chamelian & Feinstein, 2006; Keiski et al, 2007; Rao et al, 2010) and four revealed trends for poorer learning in depression (Cicerone & Kalmar, 1997; Rapoport et al, 2005)

(see Appendix 7 for details of each of the 22 analyses). In light of the discussions above, with reference to the papers' strengths and weaknesses (see Appendix 4), Preece and Geffen (2007) emerged as the strongest paper assessing the impact of depression on learning, followed by Keiski et al (2007).

Impact of depression on Working Memory

Table 11 shows that three working memory measures were used by six studies.

Table 11: Working Memory tasks used

Working Memory	
Memory Test Used	**Studies employing the test**
Digit Span Wechsler Memory Scale (WMS) (Wechsler, 1987; 1997)	Cicerone & Kalmar (1997) Sherman et al (2000) Alfano (2006)
Brown-Peterson Consonant Trigrams (Peterson & Peterson, 1959)	Ruttan & Heinrichs (2003)
Working Memory task Wechsler Adult Intelligence Scale – Third Edition (WAIS-III) (Wechsler, 1997)	Rapoport et al (2005) Chamelian & Feinstein (2006)

Ten results were produced with respect to the impact of depression on working memory. Of the ten results, four revealed no association between depression and working memory (Cicerone & Kalmar, 1997; Sherman et al, 2000; Ruttan & Heinrichs, 2003; Alfano, 2006), one set of results did not employ statistical procedures but indicated there was no impact of depression on memory test performance (Sherman et al, 2000) and five suggested poorer memory test performance in depression (Rapoport et al, 2005; Alfano, 2006; Chamelian & Feinstein, 2006) (see Appendix 8 for details of each of the 10 analyses). In light of the discussions above, with reference to the papers' strengths and weaknesses (see Appendix 4), four papers emerged with equal weighting regarding the

impact of depression on working memory (Cicerone & Kalmar, 1997; Ruttan & Heinrichs, 2003; Rapoport et al, 2005; Alfano, 2006).

Tests not specified

Alfano (2006) reported using a measure with multiple recall conditions (Babcock Story Recall, Babcock, 1940) but did not specify which recall condition was employed. No association was found between depression and the Babcock Story Recall measure.

Overview of studies

Within studies, only two did not have conflicting results across recall conditions (Atteberry-Bennett et al,1986; Rapoport et al, 2005). Moreover, five studies had conflicting results within the same recall condition (Satz et al, 1998; Sherman et al, 2000; Ruttan & Heinrichs, 2003; Alfano, 2006; Keiski et al, 2007).

Four studies found no associations between depression and performance on neuropsychological tests of memory (Satz et al, 1998; Sherman et al, 2000; Ruttan & Heinrichs, 2003; Alfano, 2006). In these papers, any results to the contrary were either dismissed as relatively modest group differences in the context of the large number of tests they had used, or they were discounted as a chance finding, or in one case (Satz et al, 1998), the significant finding was an initial correlation in which other factors had not been controlled-for and was therefore not applicable or appropriate on which to base the conclusions. Three studies found that depression had impacted on performance on neuropsychological assessment of memory (Atteberry-Bennett et al, 1986; Rapoport et al, 2005; Rao et al, 2010). In the two former cases in particular, there were no results to contradict the conclusions. Cicerone and Kalmar (1997) and Chamelian and Feinstein

(2006), in their conclusions, acknowledged their conflicting findings and commented on the suggestion from their data that poorer performance may have been linked to depression. Keiski et al (2007) and Preece and Geffen (2007) noted the possibility of an effect of depression that is specific to one recall condition or task. Preece and Geffen (2007) suggested that the effect of depression may be specific to recognition, stating that this reflects the pattern reported in the literature, where depression impacts negatively on some memory tasks and not others, citing articles included in this review as well as a treatment study (Fann, 2001) and trauma studies (Gfeller, Chibnall & Duckro, 1994; Levin et al 2001). Keiski et al (2007) concluded that depression may exert a relatively specific effect on memory processes that are measured by the CVLT, since their results showed that depression had impacted on list-learning as well as delayed recall of the list and recognition of the list items. Indeed, in studies outside the field of TBI, the CVLT has also been found to be sensitive to depression (Zakzanis, Leach & Kaplan, 1998). In summary, the balance of evidence leans marginally in favour of a possible impact of depression, although the effect may be specific to one recall condition or task. This was also the conclusion of the strongest quality papers (Keiski et al, 2007; Preece & Geffen, 2007).

Delayed recall was explored the most (48 results), followed by Learning (22), Recognition (14), Immediate recall (11) and Working Memory (10). In three recall conditions (Immediate, delayed, recognition) a higher proportion of results suggested depression was not related to task performance. However, results in the working memory condition were evenly split. In contrast, in the learning condition, a higher proportion of results indicated a possible impact of depression on learning.

In response to the observations above regarding the CVLT, closer inspection was carried out regarding individual tests and their results across the studies in this review (see Appendix 9). There were more results indicating poorer performance in depression on the CVLT than any other measure. It was used on 22 occasions, and results suggested an association between depression and memory performance on 16 of these occasions. These results occurred across the delayed recall, recognition and learning conditions. As a comparison, the Logical Memory test was used in 21 analyses and yielded only four results suggestive of an association with depression. On closer inspection of the frequency of test usage and relative number of results indicating an association between depression and test performance, four of the six other learning tasks did suggest more links between depression and performance, but did not produce the same balance of results as the CVLT.

Discussion

This paper reviewed the literature considering whether or not depression impacts on neuropsychological assessment of memory in individuals who have sustained a traumatic brain injury (TBI). Issues concerning the quality of the studies were highlighted and results from the shortlisted studies were presented in relation to the types of tasks used in neuropsychological assessment of memory; specifically the five recall conditions of immediate recall, delayed recall, recognition, learning and working memory.

The literature searches returned 2910 articles which were shortlisted to 11. Across the studies the TBI populations were fairly diverse and the studies investigated different populations (differing TBI severity) at different times (time-since-injury) and in different ways. In many instances, the reviewed studies employed multiple approaches to assess the impact of depression on memory test performance, generating a total of 107 results.

As was the case with the studies in Burt, Zembar and Niederehe's (1995) review, the studies in the present review also had weaknesses. They consisted of problems in relation to the measurement of depression, confounding factors, design issues and weaknesses in data analysis. However, on balance between the papers, some were stronger than others. Keiski et al (2007) did not address comorbidity or medication-use and used a self-report measure of depression. However, this paper had memory performance as the main focus and the authors controlled for symptom validity test failure and degree of impairment. Thus more confidence could be placed in the findings of this paper. This paper had noted an effect of depression that was specific to processes measured by the CVLT. Preece and Geffen (2007) did not address medication-use. However, this paper did not have any marked statistical weaknesses. Also, the authors recruited participants from a

single severity-level, they had a non-litigating sample, and comorbidities were excluded or controlled-for. They also used records of diagnosis to determine depression status. This appears to be the strongest study, attracting more confidence in its results. This paper noted an effect of depression that was specific to recognition on a learning measure.

In the immediate, delayed and recognition conditions, a higher proportion of results suggested depression was not related to task performance. Results in the working memory condition were evenly split. In contrast, in the learning condition, a higher proportion of results indicated a possible impact of depression on learning.

Overall, the learning measures did produce a higher proportion of results that indicated poorer performance in depression. It is possible that depression exerted a negative impact on learning. More specifically, more results showed poorer performance in depression on the CVLT than any other measure, emphasising the point raised by Keiski et al (2007). One possible reason for the sensitivity of the CVLT might be the category composition of the word list. The CVLT is not an assessment of learning per se, but rather it is a measurement of how effectively learning strategies are used, based on concept formation. The respondent is expected to recognise the category composition of the list and use it to help them recall the words (Lezak, Howieson, Bigler & Tranel, 2012). It is possible that depression impacts on the ability to either recognise the category composition of the list or to use the list to facilitate recall.

In considering the question posed by the title of this review, (does depression affect performance on neuropsychological assessment of memory after TBI?), currently, the balance of evidence lies in favour of a possible impact of depression on learning and

specifically, processes measured by the CVLT. However, the studies reviewed in the present paper were of moderate quality and all except one were not set up to answer this question directly.

Nevertheless, these findings appear to differ from the picture presented by Rohling et al (2002) in that depression did appear to impact on memory in some cases, even after taking symptom validity failures into account. The authors of the 2002 paper had asserted that depression did not impact on memory test performance. Moreover, they maintained that once symptom validity testing was accounted for, any effect of depression would be nullified.

TBI can cause changes in affect and lead to disorders including major depression (Taylor, 2007). The focus of this review was narrow and confined to conceptualising the relationship between depression and memory test performance as causal in nature, leading to the evaluation of the impact of depression on memory performance in a single direction. However, this was a weakness of the review. TBI can result in cognitive deficits such as memory impairment (Taylor, 2007). It is possible for an individual to develop depression in response to their loss of cognitive abilities. This demonstrates a relationship that is associative in nature, where causality is possible in both directions.

In order to address the weaknesses raised in this review and those raised by Rohling et al (2002), future research on this question should focus on recruiting individuals from a single severity-level. To increase comparability between studies, authors could employ similar inclusion and exclusion criteria. To minimise confounding, non-medicated samples should be used. It would also be preferable for samples to be free

from cases of epilepsy, alcohol abuse, other comorbidities and repeated TBI. Research designs with TBI samples should use larger sample-sizes and incorporate symptom validity testing, as well as narrowing the focus of the research to explore memory test performance directly rather than indirectly or alongside other cognitive processes. Furthermore, groups of individuals should be allocated on the basis of clinically diagnosed depression using the SCID-IV Gold Standard and would ideally be compared with groups of matched individuals without depression. Therefore, this literature review agrees with Brown (2004) in expressing that more research is required which explores the interaction between neurological and psychiatric symptoms on cognition, and specifically the interaction between traumatic brain injury and depression on memory test performance in TBI. For the reasons stated, the results of this review cannot be definitive, and so until the weaknesses inherent in the research are addressed, the question remains unanswered for the time-being.

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DO INDIVIDUALS IN MENTAL HEALTH NEUROLOGICAL OUTPATIENT AND NON-CLINICAL POPULATIONS HAVE DISTINCT PROFILES ON THE COMMON COGNITIVE COMPLAINTS CHECKLIST (CCCC)?

EMPIRICAL PAPER

Abstract

Objectives: To use the Common Cognitive Complaints Checklist to provide base-rate data of common cognitive complaints in non-clinical individuals; and to identify common cognitive complaints that discriminate between three populations: non-clinical, mental health, mixed-neurological.

Methods: 133 volunteers, recruited from three populations (non-clinical, mental health, mixed-neurological), completed measures of psychological distress, cognitive complaints and intellectual functioning.

Results: The mental health group reported significantly higher levels of distress, and individuals with higher levels of distress tended to report more cognitive complaints. Base-rate data was established by calculating patterns of endorsement in the non-clinical group, providing a profile of 'normal' reporting. Three discriminant function analyses were applied, which performed excellently, revealing 26 items that maximally discriminated between the groups.

Conclusions: The base-rate data revealed that it was unusual for individuals in the non-clinical group to report cognitive complaints occurring very frequently. These data could help clinicians determine whether or not the frequency of any complaint is 'normal'. The calculated discriminant functions for the 26 identified items could be used to plot probabilities of responses falling within each of the three populations, helping clinicians determine the population in which their patients' responses are likely to fall. Strengths and limitations are discussed along with suggestions for future research.

Keywords: Common Cognitive Complaints, Subjective Cognitive Errors, Cognitive Failures, Mental Health, Brain Injury, Neuropsychological Assessment.

Introduction

In many areas of healthcare, patients communicate their mental and physical state to healthcare professionals by directly reporting their symptoms or complaints. These may be physical, behavioural, affective or cognitive (Gordon, Haddad, Brown, Hibbard & Sliwinski, 2000). The phrase ‘common cognitive complaints’ refers to everyday occurrences of absent-mindedness, slips of memory and attention and failures of action processing. Such everyday experiences include occurrences like forgetting appointments, forgetting names, failing to see items despite them being in plain sight, ‘tip of the tongue’ experiences and similar events. These experiences are common and not in themselves indicative of neurocognitive difficulties (Mitchell, 2008). However, in some instances, such cognitive complaints can constitute early neurocognitive signs of neurodegenerative processes or be markers to other organic or psychological pathologies (Portet, Ousset, Visser, Frisoni, Nobili, Scheltens, Vellas, & Touchon, 2006).

Research on Common Cognitive Complaints

Common cognitive complaints have been perceived as potentially important indicators of neuropsychological functioning (Carter, Rourke, Murji, Shore & Rourke, 2003). Stulmeijer, Vos, Bleijenberg and van der Werf (2007) tested the assumption that cognitive complaints reflect underlying cognitive impairments in individuals with mild traumatic brain injury (MTBI). Interestingly, their results indicated that reporting of cognitive complaints was not related to cognitive impairment or performance on neuropsychological tests, but instead had stronger associations with emotional factors. Their results were similar to those found by Rohling, Green, Allen and Iverson (2002), who found no relationship between cognitive complaints and actual performance on neuropsychological tests. Significantly more cognitive complaints were reported in

individuals with high depression scores than those with low depression scores on a measure of emotional distress. This revealed that reporting of cognitive complaints was associated with emotional distress rather than impairment of the underlying cognitive abilities. Duits, Munnecom, van Heugten and Oostenbrugge (2008) had similar findings.

Similar results have been found in research with other populations such as older adults (Weaver Cargin, Collie, Masters & Maruff, 2008), epilepsy patients (Hall, Isaac & Harris, 2009) and individuals with HIV infection (Carter, Rourke, Murji, Shore & Rourke, 2003). In each case, reporting of cognitive complaints distinguished between healthy individuals and those experiencing emotional distress, but did not distinguish between those with and without actual impairment. Research has also been carried out with individuals from mental health populations, revealing similar findings (e.g. Wagle, Berrios & Ho, 1999). Sullivan and Payne (2007), who investigated reports of cognitive complaints in seasonal affective disorder and major depression, found that individuals with both types of disorder reported higher rates of cognitive complaints than individuals without diagnosed mental health problems.

The literature suggests that the reporting of common cognitive complaints is highly influenced by emotional state in both cognitively impaired and intact respondents. Such findings highlight the problems concerning self-reports of cognitive errors and the problematic attribution from self-reported complaints to putative neurocognitive deficits.

The tools available currently for measuring common cognitive complaints are sensitive to emotional state and therefore conflate the effects of emotional distress in the attribution of neurological impairment. Accordingly, it is necessary to first discriminate

between those common cognitive complaints that may be indicative of neurological insult from the base-line of commonly experienced cognitive complaints and, second, to differentiate between those complaints that are commonly experienced by emotionally distressed individuals and those complaints that are endorsed by the person experiencing neurological insult. Currently available measures of common cognitive complaints (e.g. Cognitive Failures Questionnaire, CFQ, Broadbent, Cooper, Fitzgerald & Parkes, 1982; and Rivermead Post Concussion Symptoms Questionnaire, RPCSQ, King, Crawford, Wenden, Moss & Wade, 1995) measure only the frequency of cognitive complaints.

There are further drawbacks to the current measures of common cognitive complaints. First, items can be too vague, for example, the RPCSQ asks the respondent if they "suffer from forgetfulness or poor memory" since their accident. Moreover, such items require additional judgements, requiring respondents to tally such occurrences and then compare their current presentation with their premorbid state, which can be difficult and risks inaccurate reporting. More specific items that require fewer judgements before responding might reduce biases. Second, measures fail to capture the breadth of complaints that can occur from benign items of lapses of attention and memory that may be relatively frequent in neurologically intact populations through to more unusual and severe cognitive pathology that may be indicative of organic impairment. A questionnaire that included a broader range of items would be preferable. Third, measures tend to be relatively short, which means that endorsement of items may be specific to the experience of individual events on the list, rather than an experience of cognitive complaints. For example, the CFQ is a short measure listing 25 items. It asks the respondent to indicate the frequency with which each item applies to them. One item refers to the experience of failing to notice signposts on the road. Such an item may not apply to someone who does

not drive and they may not endorse this item. There may be other questions that do not apply to the respondent and s/he might then receive a low score. However, this does not mean that the individual experiences fewer cognitive complaints. It means that the listed items do not apply to them. A longer questionnaire could contain a wider variety of experiences that apply to more individuals.

Determining if cognitive complaints fall within the 'normal' range of experiences

The relationship between self-report of cognitive complaints and emotional distress creates considerable challenges for neuropsychological assessment. Of all the reasons for neuropsychological referral in outpatient settings, cognitive complaints may be the most frequent (Lezak, Howieson, Bigler & Tranel, 2012). However, some individuals reporting cognitive complaints are judged to be cognitively intact following neuropsychological tests, but nevertheless continue to report such complaints (Mahoney, Dalby & King, 1998). Establishing what is both indicative of actual cognitive impairment and what is within the 'normal range' for cognitive complaints can be difficult for the neuropsychologist (see below). Furthermore, when there is a mismatch between reporting of cognitive complaints and actual impairment, authors such as Poliakoff and Smith-Spark (2008) have raised the issue of the poor ecological validity of neuropsychological tests. This leaves neuropsychologists in the difficult position of attempting to determine whether or not an underlying organic condition exists, based on their clinical experience. The situation is most difficult in cases where cognitive performance does not fall into the impaired range based on neuropsychological tests, and in cases where scores are lower than expected but who do not show absolute deficits relative to their neurologically intact peers (or estimates of premorbid functioning). In such cases there remains the possibility that there is actual underlying cognitive impairment. In these cases it would be useful clinically to know

whether the cognitive complaints and related distress are occurring as a result of neurological impairment; or if the root relates to mental health difficulties (Goldstein & McNeil, 2004). Once this is determined, options – such as referral to a mental health professional – can follow.

Even when the assessing clinician administers a self-report measure of cognitive complaints (such as those used in the research cited above) s/he still needs to ascertain whether or not the type and frequency of cognitive complaints reported by his/her patients lie within the boundaries of 'normality'. It would be useful clinically to compare the type and frequencies of reports of cognitive complaints from referred patients with those from the 'normal' range of cognitive complaints in the general population. Having said this, the 'normal' range of cognitive complaints is not yet known. Although emotion may have a confounding effect on the reporting of common cognitive complaints, it could also be used to an advantage if both frequency of cognitive complaints and the amount of associated distress could be established in the general population. The Common Cognitive Complaints Checklist (CCCC) (Jones, 2010) (see below) is a new measure that enables these data to be gathered.

In the absence of base-rate data regarding the 'normal' frequency and quality of common cognitive complaints it may be extremely difficult, or indeed impossible, to attribute self-reported neurocognitive symptoms as pathognomic of organic dysfunction.

The Common Cognitive Complaints Checklist (CCCC) (Appendix 10) is a new measure of cognitive complaints. It addresses the problems inherent in the existing measures. For example, it includes items of differing cognitive severity, from everyday

lapses of attention and memory that may be relatively frequent in neurologically intact populations through to more unusual and severe cognitive pathology that may be indicative of organic impairment. Therefore, unlike the previous measures, this checklist can be used with a broader range of individuals and it captures a broader range of complaints, increasing the possibility of differentiating between populations. In addition, the CCCC requires indications of whether or not each listed complaint is experienced, but it also includes scales of frequency and distress for each item. Therefore, unlike the previous measures, this checklist captures information on an additional dimension that is likely to reveal more information about the different populations. For example, it is known that individuals in mental health populations experience more distress than those in the non-clinical population (e.g. Derogatis,1994; Zigmond & Snaith, 1983). Based on previous research on patterns of endorsement in other self-report measures of cognitive complaints, the increased distress experienced by those in mental health populations would impact on their reporting of complaints. It is sensible to conclude that these individuals would also be more likely to experience increased distress in response to their benign cognitive complaints than those in the non-clinical population. A fuller description of the CCCC is provided later in a list of the measures used in this research.

For the reasons stated, the CCCC appears to be a more appropriate measure for determining patterns of endorsement and discriminating between populations. There also exists the possibility that different populations produce a distinct CCCC profile. If so, the responses/profiles of individuals could be analysed with the possibility of determining the likelihood of their profile falling within a normal range, within a mental health range or within an impaired range. The clinical goal of these ideas relates to the afore-mentioned patients who report distress but whose neuropsychological tests indicate no impairment or

those whose scores are lower than expected but who do not show absolute deficits relative to their neurologically intact peers or estimates of premorbid functioning. It is hoped that their CCCC profiles would enable clinicians to determine the population in which their profiles are likely to fall, to understand the root of their reports and distress, and to treat accordingly. In line with these goals, and taking into account the issues raised above, there were two aims of the present research. First to provide base-rate data on endorsement of cognitive complaints in neurologically intact individuals by calculating the number of individuals endorsing each item and producing an endorsement profile; and second, to identify items that would discriminate between neurologically intact individuals, patients attending neuropsychological assessment services and those attending mental health facilities.

Method

Participants

Volunteers (N=133) of working age (M=34.9, SD=16.1) were recruited from three sources:

- Mixed-neurological (N=29): Persons attending an outpatient neuropsychology department for neuropsychological assessment at the request of a Consultant Neurologist or Neurosurgeon. Participants were excluded if there was a history of substance abuse.
- Mental health (N=30): Persons attending mental health services with no history of brain injury.
- Non-clinical (N=74): Undergraduate students who were not in receipt of mental health or Neuroscience services.

All participants were required to be fluent in English. They did not receive rewards or incentives for their participation, other than the comparison group who were undergraduates and received Research Participation Credits as part of their university's Research Participation Scheme for their course of study.

Measures

Measures of psychological distress

Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983) (Appendix 11).

The HADS is a 14 item self-report measure used to estimate the presence of anxiety and/or depression. The total score for each of the two scales can range from '0' to '21'. Low, medium and high scores indicate low, moderate or severe states of anxiety or depression respectively. Cronbach's alpha for the measure is reported as α=0.93 for

anxiety and α=0.90 for depression, indicating a high degree of internal consistency (Moorey, Greer, Watson, Gorman, Rowden, Tunmore, Robertson, & Bliss, 1991).

Symptom Check List 90 – Revised (SCL90-R) (Derogatis, 1994) (Appendix 12).

The SCL90-R is a 90 item self-report measure of psychological distress on nine clinical dimensions (somatisation; obsessive-compulsive tendencies; interpersonal sensitivity; depression; anxiety; hostility; phobic anxiety; paranoid ideation; and psychoticism) and three indices of severity (global severity; positive symptom total and the positive distress index). The SCL90-R has normative data on populations of adolescent and adult non-patients; and adolescent and adult psychiatric in-patients and outpatients. Internal consistency has been calculated for each subscale and index and has been reported in the manual as well as various studies; with Cronbach's alpha ranging from α=0.77 to α=0.90; indicating good internal reliability (Derogatis, 1994) .

Measure of cognitive complaints

Common Cognitive Complaints Checklist (CCCC) (Jones, 2010) (Appendix 10).

The CCCC is a self-report measure of the frequency of cognitive complaints and the distress they cause. The measure contains 136 multiple choice items describing common lapses of attention and memory. The measure requires the respondent to rate whether or not each item applies to them by ticking a 'yes'/'no' response. A negative response results in a score of '0'. If an item is left 'blank', it is assumed that it 'does not apply' to the respondent and is also scored '0'.

If the respondent gives an affirmative response/endorses an item, they are then required to indicate how often that event occurs (frequency) on a five-point Likert-type

scale, ranging from ‘1 = Less than weekly’ to ‘5 = Several times a day’ (see example in Figure 3). Similarly, the respondent is required to indicate the level of distress they suffer as a result of the event (distress) on the five-point Likert-type scale. The advantages of this measure were discussed above.

		Yes / No			Frequency						Distress				
					Less than weekly	Once a week	Several times a week	Once or twice a day	Several times a day		Not at all distressing	A little distressing	Quite distressing	Very distressing	Extremely distressing
46	Forgetting where I live														
103	Forget passwords?														

Figure 3: Example of two items in the CCCC questionnaire

Measures of intellectual functioning

Wechsler Test of Adult Reading (WTAR) (PsychCorp, 2001).

The WTAR works on the premise that word recognition tends to remain relatively stable despite injury or illness. This stability permits the application of reading skills that have been retained. It measures word familiarity which has previously been highly correlated with the verbal component of general intellectual functioning (Crawford, 2004). The stability of word recognition allows a tool such as this to estimate the level of premorbid intellectual ability when other abilities have been lost.

The measure requires an individual to read aloud 50 words that have irregular pronunciations. Scores represent the number of correctly pronounced words and can range from ‘0’ to ‘50’. The more correct pronunciations, the higher the estimated level of intellectual ability. Demographic data such as gender, age, number of years in education

and level of education attained are accounted for and contribute to the final estimate. The scores are converted to standard scores providing a predicted IQ. An estimated memory quotient (MQ) is also provided. The measure is primarily used post-injury or illness to estimate the premorbid/baseline level of intellectual functioning. This test is normed with a sample matched to the UK population. The test is also normed with the Wechsler Adult Intelligence Scale, Third Edition (WAIS-III, Wechsler, 1997a) and Wechsler Memory Scale, Third Edition (WMS-III, Wechsler, 1997b). In addition, the WTAR has been shown to be a valid measure of premorbid IQ in the following groups: Alzheimer's disease, Huntingdon's disease, Parkinson's disease, Korsakoff's syndrome and traumatic brain injury.

In this study, the WTAR measure was employed as a brief measure of *estimated current* intellectual functioning in the non-clinical group and mental health group to provide IQ and Memory estimates, and as a measure of *estimated premorbid* functioning in the mixed-neurological group.

Demographics estimated IQ

For those individuals where the WTAR measure of premorbid intellectual functioning was not available, their premorbid intellectual functioning was estimated via known demographic variables (which participants provided on their consent form, CF3).

Previous research has demonstrated a relationship between demographic variables and IQ (Crawford, Millar & Milne, 2001), therefore a different measure was used which enabled an estimated level of intellectual functioning to be established for these individuals, based on their demographics (Age, Number of years in education, social class

- coded 1: professional to 5: unskilled - estimated from current occupation or previous occupation if currently unemployed.

Crawford, Millar & Milne's (2001) formula was employed:

Predicted FSIQ= 87.14 – (5.21 x class) + (1.78 x years of education) + (0.18 x age)

Neuropsychological measures

Participants in the mixed-neurological group completed various neuropsychological tests as part of a routine assessment. They consisted of measures of IQ, memory function and executive function.

IQ

Wechsler Adult Intelligence Scale (WAIS): either WAIS-III (Wechsler, 1997) or WAIS-IV (PsychCorp, 2008). If the WAIS-III was used then the scores were converted to WAIS-IV equivalents in order to control for the effect of shifts in normative data (Flynn, 1987).

Memory

Wechsler Memory Scale (WMS): either WMS-III (Wechsler, 1997) or WMS-IV (PsychCorp, 2009). If the WMS-III was used then the scores were converted to WMS-IV equivalents in order to control for the effect of shifts in normative data (Flynn, 1987).

Executive function

Delis-Kaplan Executive Function System (DKEFS, Delis, Kaplan & Kramer, 2001).

Since these tests were part of the routine assessment for referrals, as with those for IQ and memory, the subtests were employed at the discretion of the clinician and were determined by clinical need.

Procedure

The process of data-collection was different for each group. A description is given here but for clarity, Figure 4 provides a representation of the process.

Mixed-neurological group

Individuals attending the service for an appointment were given a research pack containing an introductory letter (IL1) (Appendix 13a), an information sheet (IS1) (Appendix 13b), a consent form (CF1) (Appendix 13c) and psychological distress measures (HADS; SCL90-R). When they attended the outpatient's clinic for their neuropsychological assessment, they submitted their consent form and the completed measures of psychological distress. Participants were then given the measure of cognitive complaints (CCCC) and could choose to complete it either at the clinic or at home. If participants chose to take the CCCC home, they had the option to return it when they attended for their next appointment or by post in a stamped, addressed envelope (SAE) (see Figure 4).

Mental-Health sample (three methods of recruitment):

Method 1: Advertising.

Copies of the information sheet (IS2) (Appendix 14a) were printed as posters and leaflets and placed in National Health Service (NHS) clinics. These served as advertisements of the research and contained contact details. Participants were given the

opportunity to contact the researcher to make an appointment. At this time, they attended an individual session at an NHS location to complete the consent form (CF2) (Appendix 14b), the test of intellectual functioning (WTAR) and the three self-report measures (HADS, SCL90-R & CCCC) (see Figure 4).

Method 2: Introduction by mental health Teams and IAPT staff.

NHS clinicians working in mental health Teams and Psychological Therapies/Healthy Minds services served as agents who introduced the research and invited their clients to participate. Volunteers were then introduced to the researcher (on site) and after reading the information sheet (IS3) (Appendix 15a) completed the consent form (CF2) (Appendix 15b) along with the measure of intellectual functioning (WTAR). Participants were then given the three self-report measures (HADS, SCL90-R & CCCC) with the option of completing them at the clinic or at home. If participants chose the second option, they could return them when they attended for their next appointment or by post (SAE) (see Figure 4).

Method 3: Postal Survey.

NHS clinicians working in mental health Teams and Psychological Therapies/Healthy Minds services served as agents who introduced the research and invited clients to participate. Volunteers were given a research pack (either via post or handed to them by their clinician) containing an introductory letter (IL2) (Appendix 16a); information sheet (IS4) (Appendix 16b); consent form (CF3) (Appendix 16c); the three self-report measures (HADS; SCL90-R; CCCC); and a SAE. Participants returned consent forms and completed self-report measures by post. Postal survey volunteers did not complete the measure of intellectual functioning (WTAR) because they did not have

contact with the researcher. Hence the reason for supplying them with a different consent form, requiring demographic information for generating intellectual functioning estimates (see Figure 4).

Comparison group

The comparison group was recruited by undergraduates as part of their final year psychology project. Undergraduate students had been informed of the study via the advertising and participant information procedures which formed part of their university's Research Participation Scheme (RPS). In addition to undergraduate participants, friends and family of the undergraduate researchers also participated. Volunteers arranged to meet with the individuals collecting the data and completed a consent form. They were administered the measure of intellectual functioning (WTAR) and were then given two self-report measures (SCL90-R & CCCC). Measures were returned in accordance with the RPS procedures (see Figure 4).

This study received initial ethical approval from the National Research Ethics Service, Birmingham, East, North and Solihull Research Ethics Committee in January 2011(Appendix 17a) and ethical approval for a substantial amendment in February 2012 (Appendix 17b).

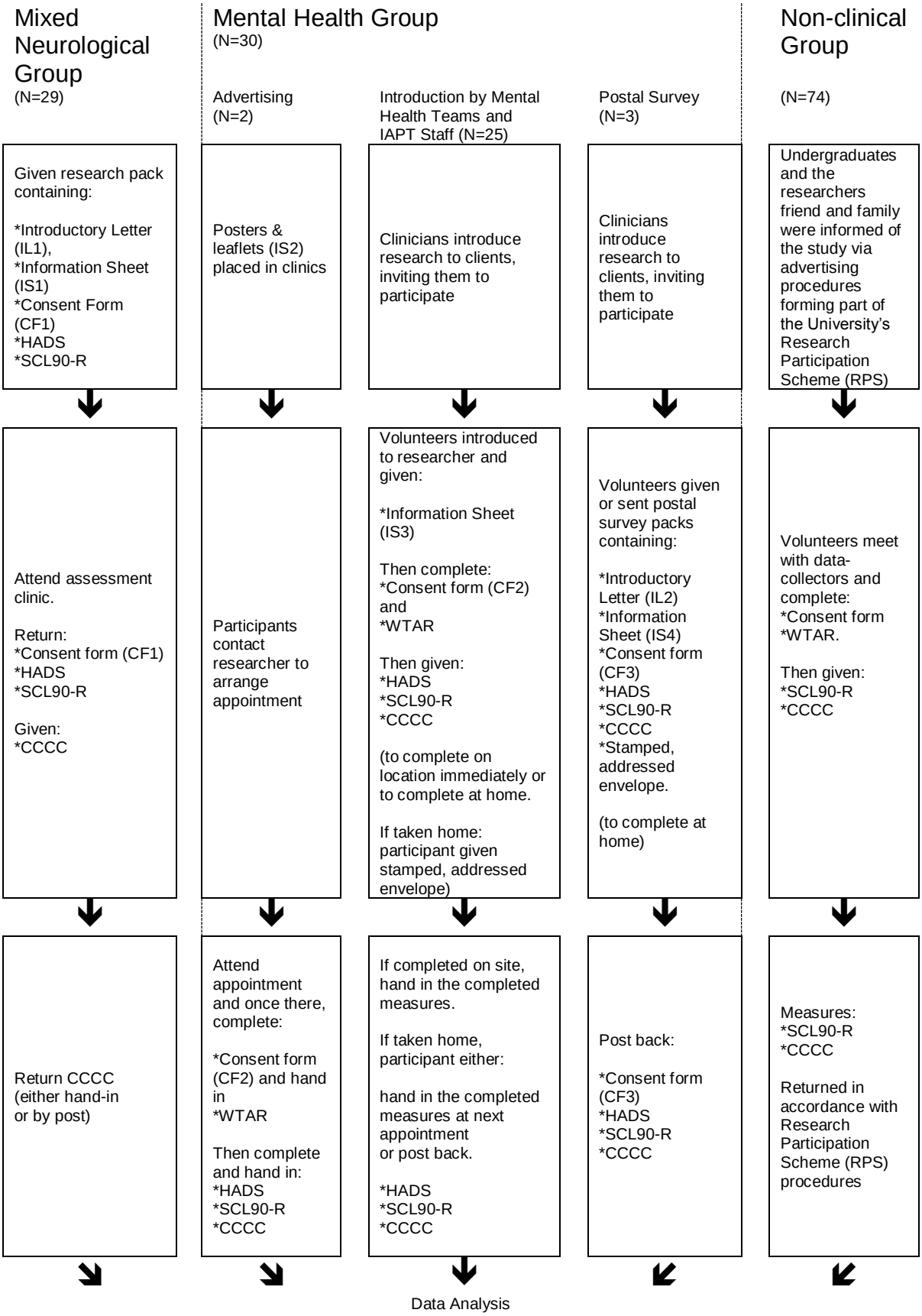

Figure 4: The data collection process

Results

Description of the sample

This section offers information about the three samples. For ease of reference throughout this section, Table 12 provides information on group details and any differences between groups. For the emotional measure SCL90-R, the mean scores for all subscales can be seen in Table 12 although only the anxiety and depression subscales are reported in the text.

Table 12: Group details and differences between the groups

	Non-Clinical Group (NC) (N=74)	Mental Health Group (MH) (N=30)	Mixed Neurological Group (MN) (N=29)	Differences between groups (Chi Square or Kruskal-Wallis)	Post-hoc tests	
					Group to group difference	Mann-Whitney U
Number of Females	57	19	14	$\chi^2(2)=8.061$*		
Number of Males	17	10	15			
Mean age	30 *SD*=15.5 (N=74)	38 *SD*=13.9 (N=29)	45 *SD*=14.9 (N=29)	$\chi^2(2)=25.99$*	NC Group to MH Group Mean age difference = 7.6	U=569.00, z=-3.73*
					NC Group to MN Group Mean age difference = 14.7	U=494.50, z=-4.28*
					-	-
Mean Estimated Full scale Intelligence Quotient (Premorbid IQ in Mixed Neurological group)	108 *SD*=4.9 (N=74)	105 *SD*=8.6 (N=24)	97 *SD*=9.6 (N=28)	$\chi^2(2)=38.15$*	-	-
					NC Group to MN Group Mean IQ point difference = -11.3	U=211.00, z=-6.20*
					MH Group to MN Group Mean IQ point difference = -8.5	U=146.50, z=-3.49*
Mean Estimated Full scale Intelligence Quotient (Actual IQ in Mixed Neurological Group)	As above	As above	94 *SD*=14.1 (N=23)	$\chi^2(2)=28.59$*	-	-
					NC Group to MN Group Mean score difference = -14.14	U=235.00, z=-5.24*
					MH Group to MN Group Mean score difference = -11.34	U=115.50, z=-3.42*
Mean Estimated Immediate Memory score (Premorbid Immediate Memory score in Mixed Neurological Group)	105 *SD*=3.6 (N=74)	104 *SD*=6.7 (N=20)	98 *SD*=5.5 (N=25)	$\chi^2(2)=25.22$*	-	-
					NC Group to MN Group Mean score difference = -6.8	U=285.00, z=-5.17*
					MH Group to MN Group Mean score difference = -5.5	U=136.00, z=-2.61*
Mean Estimated Immediate Memory score (Actual Immediate Memory score in Mixed Neurological Group)	As above	As above	90 *SD*=17.1 (N=29)	$\chi^2(2)=29.53$*	-	-
					NC Group to MN Group Mean score difference = -14.93	U=347.50, z=-5.34*
					MH Group to MN Group Mean score difference = -13.61	U=113.00, z=-3.61*
Mean Estimated Delayed Memory score (Premorbid Delayed Memory score in Mixed Neurological Group)	107 *SD*=3.2 (N=74)	105 *SD*=6.0 (N=20)	99 *SD*=6.0 (N=25)	$\chi^2(2)=26.38$*	-	-
					NC Group to MN Group Mean score difference = -7.3	U=282.50, z=-5.20*
					MH Group to MN Group Mean score difference = -5.8	U=128.00, z=-2.79*

	Non-Clinical Group (NC) (N=74)	Mental Health Group (MH) (N=30)	Mixed Neurological Group (MN) (N=29)	Differences between groups (Chi Square or Kruskal-Wallis)	Post-hoc tests	
					Group to group difference	**Mann-Whitney U**
Mean Estimated Delayed Memory score (Actual Delayed Memory score in Mixed Neurological Group)	As above	As above	91 *SD*=19.4 (N=29)	$\chi^2(2)=25.13$*	-	-
					NC Group to MN Group Mean score difference = -15.09	U=401.50, z=-4.94*
					MH Group to MN Group Mean score difference = -13.54	U=139.50, z=-3.07*
SCL90-R Mean Somatisation subscale score	52.7 *SD*=14.7 (N=74)	68.7 *SD*=12.5 (N=29)	62.2 *SD*=12.1 (N=28)	$\chi^2(2)=25.40$*	NC Group to MH Group Mean score difference = 16.0	U=454.50, z=-4.55*
					NC Group to MN Group Mean score difference = 9.5	U=621.00, z=-3.12*
					MH Group to MN Group Mean score difference = -6.5	U=284.50, z=-1.96*
SCL90-R Mean Obsessive-Compulsive Subscale Score	57.7 *SD*=12.6 (N=74)	69.7 *SD*=9.2 (N=29)	68.8 *SD*=9.7 (N=28)	$\chi^2(2)=29.29$*	NC Group to MH Group Mean score difference = 12.1	U=472.50, z=-4.41*
					NC Group to MN Group Mean score difference = 11.2	U=475.00, z=-4.22*
					-	-
SCL90-R Mean Interpersonal Sensitivity Subscale Score	54.4 *SD*=11.7 (N=74)	72.5 *SD*=7.4 (N=29)	59.7 *SD*=13.0 (N=28)	$\chi^2(2)=40.03$*	NC Group to MH Group Mean score difference = 18.1	U=230.00, z=-6.20*
					NC Group to MN Group Mean score difference = 5.3	U=772.00, z=-1.98*
					MH Group to MN Group Mean score difference = -12.8	U=160.00, z=-3.95*
SCL90-R Mean Depression Subscale Score	54.7 *SD*=12.6 (N=74)	73.7 *SD*=7.2 (N=29)	64.6 *SD*=11.2 (N=28)	$\chi^2(2)=44.25$*	NC Group to MH Group Mean score difference = 19.0	U=228.50, z=-6.21*
					NC Group to MN Group Mean score difference = 9.9	U=565.00, z=-3.54*
					MH Group to MN Group Mean score difference = -9.1	U=210.00, z=-3.17*
SCL90-R Mean Anxiety Subscale Score	52.7 *SD*=15.0 (N=74)	70.5 *SD*=9.3 (N=29)	58.8 *SD*=13.6 (N=28)	$\chi^2(2)=27.19$*	NC Group to MH Group Mean score difference = 17.8	U=386.50, z=-5.06*
					-	-
					MH Group to MN Group Mean score difference = -11.7	U=212.00, z=-3.12*
SCL90-R Mean Hostility Subscale Score	52.0 *SD*=12.4 (N=74)	63.9 *SD*=10.7 (N=29)	59.1 *SD*=10.3 (N=28)	$\chi^2(2)=21.47$*	NC Group to MH Group Mean score difference = 11.9	U=496.50, z=-4.25*
					NC Group to MN Group Mean score difference = 7.1	U=665.50, z=-2.80*
					-	-
SCL90-R Mean Phobic Anxiety Subscale Score	53.5 *SD*=12.9 (N=74)	66.7 *SD*=12.6 (N=29)	55.2 *SD*=12.0 (N=28)	$\chi^2(2)=20.65$*	NC Group to MH Group Mean score difference = 13.1	U=494.00, z=-4.33*
					-	-
					MH Group to MN Group Mean score difference = -11.5	U=206.50, z=-3.22*

	Non-Clinical Group (NC) (N=74)	Mental Health Group (MH) (N=30)	Mixed Neurological Group (MN) (N=29)	Differences between groups (Chi Square or Kruskal-Wallis)	Post-hoc tests	
					Group to group difference	Mann-Whitney U
SCL90-R Mean Paranoid Ideation Subscale Score	49.8 *SD*=11.8 (N=74)	66.9 *SD*=9.6 (N=29)	57.5 *SD*=12.7 (N=28)	$\chi^2(2)=34.31$*	NC Group to MH Group Mean score difference = 17.1	U=324.50, z=-5.62*
					NC Group to MN Group Mean score difference = 7.7	U=667.00, z=-2.86*
					MH Group to MN Group Mean score difference = -9.3	U=227.50, z=-2.86*
SCL90-R Mean Psychoticism Subscale Score	53.7 *SD*=12.3 (N=74)	70.3 *SD*=10.4 (N=29)	61.5 *SD*=11.1 (N=28)	$\chi^2(2)=33.60$*	NC Group to MH Group Mean score difference = 16.6	U=357.50, z=-5.36*
					NC Group to MN Group Mean score difference = 7.7	U=626.00, z=-3.16*
					MH Group to MN Group Mean score difference = -8.9	U=219.50, z=-3.00*
SCL90-R Mean GSI Score	54.9 *SD*=16.1 (N=68)	73.5 *SD*=8.1 (N=29)	64.8 *SD*=10.7 (N=28)	$\chi^2(2)=33.55$*	NC Group to MH Group Mean score difference = 18.5	U=300.50, z=-5.42*
					NC Group to MN Group Mean score difference = 9.9	U=584.50, z=-2.97*
					MH Group to MN Group Mean score difference = -8.6	U=218.50, z=-3.03*
SCL90-R Mean Positive Symptom Total Score	54.7 *SD*=14.1 (N=74)	70.5 *SD*=6.4 (N=29)	62.4 *SD*=9.8 (N=28)	$\chi^2(2)=31.46$*	NC Group to MH Group Mean score difference = 15.9	U=370.50, z=-5.15*
					NC Group to MN Group Mean score difference = 7.7	U=660.00, z=-2.82*
					MH Group to MN Group Mean score difference = -8.2	U=198.50, z=-3.32*
SCL90-R Mean PSDI Score	51.9 *SD*=12.3 (N=72)	68.2 *SD*=10.0 (N=29)	63.0 *SD*=10.0 (N=28)	$\chi^2(2)=36.68$*	NC Group to MH Group Mean score difference = 16.4	U=331.00, z=-5.36*
					NC Group to MN Group Mean score difference = 11.1	U=482.50, z=-4.04*
					-	-

*$p<0.05$

Non-clinical group

There were 74 individuals in the non-clinical group (57=females), with a mean age of 30 (*SD*=15.5) and a mean WTAR estimated full scale Intelligence Quotient (IQ) of 108 (*SD*=4.9). The mean WTAR estimated Immediate Memory and Delayed Memory scores were 105 (*SD*=3.6) and 107 (*SD*=3.2) respectively. The mean score on the depression and anxiety subscales were 54.7 (*SD*=12.6) and 52.7 (*SD*=15.0) respectively.

Mental health group

There were 30 individuals in the mental health group (19=females), with a mean age of 38 (*SD*=13.9) and a mean WTAR estimated IQ of 105 (*SD*=8.6). The mean WTAR estimated Immediate Memory and Delayed Memory scores were 104 (*SD*=6.7) and 105 (*SD*=6.0) respectively. The mean score on the depression and anxiety subscales of the SCL90-R, were 73.7 (*SD*=7.2) and 70.5 (*SD*=9.3) respectively.

Mixed-neurological group

There were 29 individuals in the mixed-neurological group (14=females), with a mean age of 45 (*SD*=14.9) and a mean WTAR estimated premorbid IQ of 97 (*SD*=9.6). The mean WTAR estimated premorbid Immediate Memory and Delayed Memory scores were 98 (*SD*=5.5) and 99 (SD=6.0) respectively. The mean score on the depression and anxiety subscales of the SCL90-R, were 64.6 (*SD*=11.2) and 58.8 (*SD*=13.6) respectively.

Mixed-neurological group WTAR estimated premorbid and actual scores.

Individuals in the mixed-neurological group completed the WTAR measure which estimated their premorbid functioning. In order to establish the severity of cognitive impairment, their estimated premorbid scores were compared with their actual/current

scores achieved on WAIS-III, WAIS-IV, WMS-III and WMS-IV assessments and can be seen in Table 13.

Where the data were not normally distributed, or where assumptions were violated, non-parametric analyses were used to compare scores.

Table 13: Mixed-neurological group - Comparison between WTAR estimated premorbid scores and actual/current scores on the WAIS-III/IV and WMS-III/IV

Construct Measured	Rounded Premorbid Estimate	Rounded Actual/current Score	Score Difference	Wilcoxon Signed Rank Test / Paired Samples T-Test
Mean Full Scale IQ Score	96.55 *SD*=9.6 (N=28)	93.74 *SD*=14.1 (N=23)	-2.81	Z=-1.38
Mean Verbal Comprehension Index Score	95.00 *SD*=8.8 (N=24)	95.48 *SD*13.1 (N=23)	0.48	Z=-0.52
Mean Perceptual Organisation Index Score	99.25 SD=8.0 (N=24)	97.78 *SD*=14.8 (N=23)	-1.47	Z=-1.31
Mean Working Memory Index Score	97.42 *SD*=8.2 (N=24)	95.38 *SD*=15.8 (N=26)	-2.04	Z=-1.12
Mean Processing Speed Index Score	96.83 *SD*=5.3 (N=24)	88.77 *SD*=10.4 (N=26)	-8.06	Z=-2.67*
Mean Immediate Memory Score	98.28 *SD*=5.5 (N=25)	90.14 *SD*=17.1 (N=29)	-8.14	t(24)=2.16*
Mean General/Delayed Memory Score	99.16 *SD*=6.0 (n=25)	91.41 *SD*=19.4 (N=29)	-7.75	t(24)=1.67

*$p<0.05$

Table 13 shows a significant difference in Processing Speed between estimated premorbid scores and actual/current scores (Z=-2.67, $p<0.05$); and a significant difference in Immediate Memory (t(24)=2.16, $p<0.05$). All other differences were non-significant. This indicated that the mixed-neurological group were significantly impaired in Processing Speed and Immediate Memory in comparison to their estimated premorbid functioning.

Differences between groups

In order to detect any demographic differences between the three participant groups, Chi Square or Kruskal-Wallis tests were performed. These results are presented in Table 12.

Sex.

A chi-square test was performed to detect any difference between the groups and revealed a significant difference ($\chi^2(2) = 8.061$, $p < 0.05$) in the numbers of males to females between the three groups, with the non-clinical group having the highest proportion of females.

Age.

To test for differences in age between the groups, a Kruskal-Wallis test was carried out and revealed a significant age difference ($\chi^2(2) = 25.99$, $p < 0.05$). Post-hoc Mann-Whitney U tests revealed a significant difference in age (7.6 years) between the non-clinical group and the mental health group ($U=569.00$, $z=-3.73$, $p<0.05$). There was also a significant (14.7 years) age difference between the non-clinical group and the mixed-neurological group ($U=494.50$, $z=-4.28$, $p<0.05$). In summary, the non-clinical group was significantly younger than both the mental health and mixed-neurological groups; while the mental health and mixed-neurological groups did not differ significantly in age.

IQ.

The WTAR estimated IQ scores in the non-clinical and mental health groups were compared with the mixed-neurological group's WTAR estimated *premorbid* IQ scores. A

Kruskal-Wallis test showed a significant difference in the mean IQs between the groups ($\chi^2(2)=38.15$, $p<0.05$). Post-hoc Mann-Whitney U tests were performed on each pair revealing a significant difference in IQ points (11.3) between individuals in the non-clinical group, and the mixed-neurological group (U=211.00, z=-6.20, $p<0.05$). The tests also revealed a significant difference in IQ points (8.5) between the mental health group and the mixed-neurological group, (U=146.50, z=-3.49, $p<0.05$).

In summary, the mixed-neurological group had a significantly lower average estimated premorbid IQ than the WTAR estimated IQ of both the non-clinical and mental health groups; while the non-clinical and mental health groups did not differ significantly in WTAR estimated IQ scores.

Immediate Memory .

WTAR estimated Immediate Memory scores in the non-clinical and mental health groups were compared with the mixed-neurological group's WTAR estimated *premorbid* Immediate Memory scores. A Kruskal-Wallis test showed a significant difference in the mean estimated Immediate Memory scores between the groups ($\chi^2(2)=25.22$, $p<0.05$). Post-hoc Mann-Whitney U tests revealed a significant difference (6.8 points) in estimated/premorbid Immediate Memory scores between individuals in the non-clinical group, with a higher average score, in comparison to the mixed-neurological group (U=764.50, z=-2.82, $p<0.05$). Tests also revealed a significant difference (5.5 points) in estimated/premorbid Immediate Memory scores between the mental health group and the mixed-neurological group (U=136.00, z=-2.61, $p<0.05$).

In summary, the mixed-neurological group had significantly lower average WTAR estimated premorbid Immediate Memory scores than the WTAR estimated Immediate Memory scores of both the non-clinical and mental health groups; while the non-clinical and mental health groups did not differ significantly in their WTAR estimated Immediate Memory scores.

Delayed Memory .

WTAR estimated Delayed Memory scores in the non-clinical and mental health groups were compared with the mixed-neurological group's WTAR estimated *premorbid* Delayed Memory scores. A Kruskal-Wallis test showed a significant difference in the mean WTAR estimated/premorbid Delayed Memory scores between the groups ($\chi^2(2)=26.38$, $p<0.05$). Post-hoc Mann-Whitney U tests revealed a significant difference (7.3 points) in WTAR estimated/premorbid Delayed Memory scores between individuals in the non-clinical group, with a higher average score, in comparison to the mixed-neurological group ($U=282.50$, $z=-5.20$, $p<0.05$). Tests also revealed a significant difference (5.8 points) in WTAR estimated/premorbid Delayed Memory scores between individuals in the mental health group with a higher average score, in comparison to the mixed-neurological group ($U=128.00$, $z=-2.79$, $p<0.05$).

In summary, the mixed-neurological group had significantly lower average premorbid Delayed Memory scores than the WTAR estimated Delayed Memory scores of both the non-clinical and mental health groups; while the non-clinical and mental health groups did not differ significantly in their WTAR estimated Delayed Memory scores.

SCL90-R Depression subscale scores.

A Kruskal-Wallis Test was used to test for differences in depression scores between the three groups and showed a significant difference ($\chi^2(2)=44.25$, $p<0.05$). Post-hoc Mann-Whitney U tests revealed a significant difference (19 points) in depression scores between individuals in the non-clinical group and the mental health group (U=228.50, z=-6.21, $p<0.05$) and a significant difference (9.9 points) in depression scores between the non-clinical group and the mixed-neurological group (U=565.00, z=-3.54, $p<0.05$). In addition, there was a significant difference (9.1 points) in depression scores between the mental health group and the mixed-neurological group (U=210.00, z=-3.17, $p<0.05$). In summary, the depression scores of all three groups differed significantly from each other with the mental health group having the highest scores, followed by the mixed-neurological group and then the non-clinical group.

SCL90-R Anxiety subscale scores.

A Kruskal-Wallis Test was used to test for differences in anxiety scores between the three groups and showed a significant difference ($\chi^2(2)=27.19$, $p<0.05$). Post-hoc Mann-Whitney U tests were performed on each pair revealing a significant difference (17.8 points) in anxiety scores between individuals in the non-clinical group and the mental health group (U=386.50, z=-5.06, $p<0.05$) and a significant difference (11.7 points) in anxiety scores between the non-clinical group and the mixed-neurological group (U=212.00, z=-3.12, $p<0.05$). In summary, the mental health group had significantly higher anxiety scores than both the non-clinical and mixed-neurological groups; while the non-clinical and mixed-neurological groups did not differ significantly in their anxiety scores.

CCCC Scales

In order to establish the internal consistency for the CCCC measure, Cronbach's alpha was calculated for each of the scales (Frequency α=0.99; Distress α=0.99) demonstrating excellent internal reliability. However, the alpha coefficient tends to inflate as a function of the number of items within the scale (Clark and Watson, 1995). With the large numbers of items in the CCCC scale (136) the reported alpha coefficient may represent an overestimate of the actual internal reliability of the scale. In such circumstances it may be preferable to convert alpha coefficients into mean inter-item correlations (Clark and Watson, 1995). The alpha coefficient of 0.99 for the total CCCC scale would therefore equate to a mean inter-item correlation of 0.42. Values of the mean inter-item correlation vary widely with the topic area under investigation and the nature of research, but seldom exceed 0.50 (McKennell, 1978). Clark and Watson (1995) recommended a mean inter-item correlation within the range of 0.15 to 0.20 for scales that measure broad psychological characteristics and between 0.40 and 0.50 for those measuring relatively narrowly defined constructs. The observed alpha coefficient of 0.99, when controlled for the number of items in the analysis (mean inter-item correlation=0.42), indicates a good degree of internal consistency.

The Distress and Frequency ratings of the CCCC were correlated to assess the amount of co-linearity between these scales. As the data werenot normally distributed, a Spearman's Rank Order Correlation was used. The correlation between the Distress and Frequency ratings revealed a significant positive relationship (rho=0.90, n=133, $p<0.001$). This indicated that high scores on the Frequency scale were strongly associated with high scores on the Distress scale. As these scales are highly co-linear, subsequent analyses were conducted on the Frequency Scale alone.

Relationships with other variables

In each of the three groups, correlations were calculated between participants' total Frequency score on the CCCC and their age, estimated IQ, estimated memory and emotional functioning, respectively. For the mixed-neurological group, their actual IQ and memory scores were used in place of estimated scores. As the data were not normally distributed, Spearman's Rank Order Correlations were performed.

Age

A Spearman's Rank Order Correlation for the non-clinical group revealed a significant negative association between participants' ages and their total Frequency score on the CCCC (rho=-0.38, n=74, $p<0.01$). However, no association was found between participants' ages and their total Frequency score on the CCCC in either the mental health group (rho=-0.14, n=29, $p=0.47$) nor the mixed-neurological group (rho=0.31, n=29, $p=0.10$).

IQ.

Spearman's Rank Order Correlations found no associations between participants' total Frequency score on the CCCC and their estimated IQ in the non-clinical group (rho=-0.08, n=74, $p=0.49$), the mental health group (rho=-0.11, n=24, $p=0.61$) nor the mixed-neurological group (rho=0.25, n=23, $p=0.26$).

Immediate Memory.

Spearman's Rank Order Correlations found no associations between participants' total Frequency score on the CCCC and their WTAR estimated Immediate Memory scores

in the non-clinical group (rho=-0.11, n=74, *p*=0.36) nor the mental health group (rho=-0.27, n=20, *p*=0.24). Likewise, in the mixed-neurological group there was no association between participants' total Frequency score on the CCCC and their actual Immediate Memory scores (rho=0.29, n=29, *p*=0.13).

Delayed Memory.

Spearman's Rank Order Correlations found no associations between participants' total Frequency score on the CCCC and their WTAR estimated Delayed Memory scores in the non-clinical group (rho=-0.10, n=74, *p*=0.42) nor the mental health group (rho=-0.38, n=20, *p*=0.10). Likewise, in the mixed-neurological group there was no association between participants' total Frequency score on the CCCC and their actual Delayed Memory scores (rho=0.21, n=29, *p*=0.28).

Anxiety.

A Spearman's Rank Order Correlation for the non-clinical group revealed a significant positive association between participants' anxiety scores on the SCL90-R and their total Frequency score on the CCCC (rho=0.68, n=74, $p<0.01$). Similarly, a significant positive correlation was found in the mental health group between participants' anxiety scores on the SCL90-R and their total Frequency score on the CCCC (rho=0.64, n=29, $p<0.01$). However, the correlation between participants' anxiety scores on the SCL90-R and their total Frequency score on the CCCC for the mixed-neurological group failed to reach significance (rho=0.37, n=28, *p*=0.053).

Depression.

A Spearman's Rank Order correlation for the non-clinical group revealed a significant positive association between participants' depression scores on the SCL90-R and their total Frequency score on the CCCC (rho=0.67, n=74, $p<0.01$). Similarly, a significant positive correlation was found in the mental health group between participants' depression scores on the SCL90-R and their total Frequency score on the CCCC (rho=0.65, n=29, $p<0.01$). However, in the mixed-neurological group, there was no association between participants' depression scores on the SCL90-R and their total Frequency score on the CCCC (rho=0.29, n=28, $p=0.14$).

Together, these analyses indicated that in the non-clinical group, individuals who were younger, and those experiencing higher levels of psychological distress tended to report more cognitive complaints, whereas WTAR estimated IQ and memory did not appear to impact on individuals' patterns of reporting. In the mental health group, the analyses indicated that individuals with higher levels of psychological distress tended to report more cognitive complaints, whereas age, IQ, and memory appeared to have no effect on patterns of reporting of cognitive complaints. In the mixed-neurological group, the analyses indicated that participants' age, IQ, memory functioning and emotional distress did not impact on their reporting of cognitive complaints. However, the correlation between the total Frequency score on the CCCC and anxiety scores on the SCL90-R came close to the threshold for significance, suggesting a marginally non-significant trend where higher levels of anxiety might influence reporting of cognitive complaints on the CCCC.

Endorsement of items in the normal population

The base-rate for endorsement of each of the CCCC items within the non-clinical group can be seen in Appendix 18. The item most endorsed by individuals in the non-clinical group was item 53 ("Read through a paragraph and realised you have not taken it in"), where 64 out of 74 individuals endorsed this item to at least the first level (less than weekly). The cumulative frequencies presented in Appendix 18, allow a clinician to assess whether the frequency of experiencing the item is commensurate with the non-clinical population. For example, 39 (52.70%) individuals reported experiencing item 53 once a week or more. This reduced to 2.70% as the occurrences increased to several times a day and therefore, the daily experience of this complaint could not be considered to fall within the range.

The items least endorsed by individuals in the non-clinical group were items 122 ("I talk to people on the phone and then call them back minutes later without memory of the first call") and item 46 ("Forgetting where I live"). Appendix 18 demonstrates that the percentage of individuals from this population endorsing these items, to any level, is very low, ranging from 2.7% (at less than weekly) to 0% (at several times a day).

It is evident that the percentage of overall endorsement at the higher levels is low, even for the most frequently endorsed item. This pattern of fewer endorsements at the higher levels is one that would be expected from a non-clinical population reporting cognitive complaints, since it is likely that few of these individuals would report complaints in excess of 'once or twice a day'.

Discriminant Function Analyses

A series of forward stepwise discriminant function analyses were undertaken in order to identify whether the CCCC could distinguish between non-clinical, mental health and mixed-neurological populations. In each of these analyses the frequency items of the CCCC were entered as potential discriminant variables. A forward stepwise discriminant function analysis was then undertaken to identify a scale of items that maximally discriminated between two dependent populations at a time. Having identified the items that contribute towards the discriminant function, a jackknifed cross-validation procedure[1] was undertaken to estimate how well the discriminant function equation would classify population membership for data that have not been used in order to derive the discriminant functions themselves.

[1] Procedure for jackknifed cross-validation: The equation that permits categorisation of individuals into either one of two groups is sensitively dependent upon the data from which it is derived. As a result, there may be idiosyncrasies within the data, which serve to produce an equation that is able to discriminate between groups within the current sample but would poorly classify data from another sample. In order to avoid such 'over-fitting' a 'leave-one-out classification' was undertaken. This removes each case in turn and re-runs the analysis (based on the remaining cases) in order to determine the classification function. Each datum point is therefore classified on the basis of the classification function derived from a dataset that does not include itself. This method reduces inherent bias within the results by effectively providing the analysis with a new sample of participants to categorise.

Non-clinical – mental health

A discriminant function analysis was conducted to ascertain whether the CCCC could predict non-clinical participants and those who had been recruited from mental health Services. The predictor variables were the frequency items of the CCCC measure.

The stepwise analysis was completed in 13 steps, resulting in a discriminant function equation containing 11 variables by the final iteration of the procedure. These 11 items were included as variables in the analysis as each was identified as adding some predictive power to the discriminant function. The DFA revealed a canonical correlation (0.75), which accounted for 56% of the variance between the non-clinical and the mental health groups (Wilks' Lambda=0.44; $p<0.01$). Table 14 shows the 11 items along with their standardised canonical discriminant function coefficients, which provide an indication of the importance of each predictor and the direction of the relationship.

Table 14: Standardised canonical discriminant function coefficients and unstandardized canonical discriminant function coefficients

Item	Standardised Canonical Discriminant Function Coefficients	Un-standardised Canonical Discriminant Function Coefficients
CCCC Frequency Question 2:Difficulty remembering the content of conversations and/ or meetings	0.423	0.360
CCCC Frequency Question 12: Forget to pass on messages (e.g., phone messages)	-0.471	-0.480
CCCC Frequency Question 14: Forgetting something from the shops that you explicitly went to get	0.441	0.443
CCCC Frequency Question 26: Problems stopping myself doing something even though I know it will get me into trouble or offend people I care about	0.441	0.485
CCCC Frequency Question 34: Not able to cook a meal such that all of the ingredients are ready at the same time	-0.478	-0.465
CCCC Frequency Question 44: Forgetting to add detergent to the washing machine or dishwasher	-0.629	-0.874
CCCC Frequency Question 50: Minutes or hours pass by and I have no idea what I have done	0.449	0.409
CCCC Frequency Question 103: Forget passwords	-0.533	-0.452
CCCC Frequency Question 105: Forgetting where your car is parked	-0.565	-0.769
CCCC Frequency Question 117: Difficulty holding things in mind for a short time (e.g., remembering a telephone number)	0.730	0.636
CCCC Frequency Question 136: Absent mindedly placed things in unintended locations (e.g., milk in a cupboard)	0.615	0.621

Following the stepwise analysis, the Discriminant Function was calculated. The groups' centroids showed that the non-clinical participants had a function mean of -0.71 while the mental health participants produced a function mean of 1.76. The mean of the two centroids (0.52) was used as the cut-off to classify participants as representative of the non-clinical or mental health groups. An individual's discriminant score equal to or less

than the cut-off was classed as ‘non-clinical’ and a discriminant score greater than the cut-off, was classed as ‘mental health’.

Classification accuracy: Original grouped cases.

Table 15 shows that of those individuals in the non-clinical group, 73 individuals (98.6%) were correctly classified as being in the non-clinical group; and 1 individual (1.4%) was incorrectly classified as being in the mental health group.

Of those in the mental health group, 20 individuals (66.7%) were correctly classified as being in the mental health group; and 10 individuals (33.3%) were incorrectly classified as being in the non-clinical group.

It could be concluded that non-clinical cases were classified with slightly better accuracy (98.6%), than mental health cases (66.7%), although both were acceptable hit ratios. It is important to bear in mind that this difference is a matter of percentage values and the mental health group was smaller.

Table 15: Classification results of original grouped cases

		Predicted group membership		
		Non-clinical	Mental Health	Total
Actual group membership	Non-clinical	73 (98.6%)	1 (1.4%)	74 (100%)
	Mental Health	10 (33.3%)	20 (66.7%)	30 (100%)

The classification results revealed that 89.4% of original grouped cases were classified correctly into ‘non-clinical’ or ‘mental health’ groups.

Classification accuracy: Cross-validated grouped case.

Table 16 shows that of those individuals in the non-clinical group, 70 individuals (94.6%) were correctly classified as being in the non-clinical group; and 4 individuals (5.4%) were incorrectly classified as being in the mental health group.

Of those in the mental health group, 20 individuals (66.7%) were correctly classified as being in the mental health group; and 10 individuals (33.3%) were incorrectly classified as being in the non-clinical group.

Non-clinical cases were classified with slightly better accuracy (94.6%) than mental health cases (66.7%), although both were acceptable hit ratios. It is important to bear in mind that this difference is a matter of percentage values and the mental health group was smaller.

Table 16: Classification results of cross-validated grouped cases

		Predicted group membership		
		Non-clinical	Mental Health	Total
Actual group membership	Non-clinical	70 (94.6%)	4 (5.4%)	74 (100%)
	Mental Health	10 (33.3%)	20 (66.7%)	30 (100%)

After cross-validation, the number of individuals in the non-clinical group who were incorrectly classified only increased by three. The number of individuals in the mental health group who were correctly classified remained the same. Once cross-validation had taken place, 86.5% of cross-validated grouped cases were classified correctly into ‘non-clinical’ or ‘mental health’ groups.

With this information, it is possible to predict with reasonable accuracy the probability of an individual being classified into either of the two groups, based on their CCCC responses and resulting discriminant score. Figure 5 offers a visual demonstration of this concept. Here, it is possible to see that an individual who produces a discriminant score of -2.500000 has zero probability of being in a mental health group and virtual certainty (1.00000) of being in a non-clinical group. Whereas, an individual who produces a discriminant score of 5.00000 has zero probability of being in a non-clinical group and virtual certainty (1.00000) of being in a mental health group.

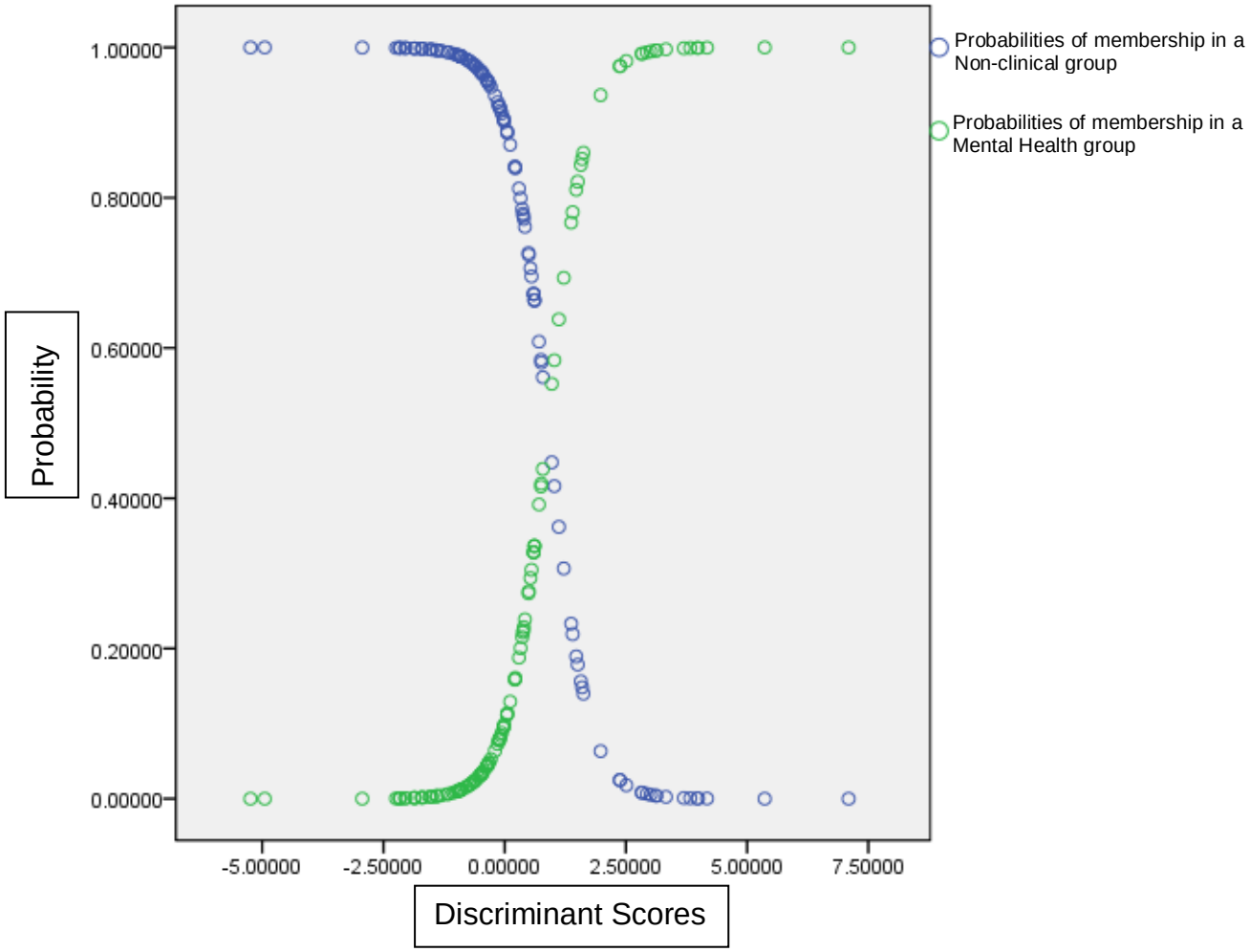

Figure 5: Scatter distribution of probability for membership in each of the non-clinical and mental health groups based on discriminant scores

Non-clinical – mixed-neurological

A second discriminant function analysis was conducted to ascertain whether the CCCC could predict non-clinical participants and those who had been recruited from the Neuropsychology Service. The predictor variables were the frequency items of the CCCC measure.

The stepwise analysis was completed in 18 steps, resulting in a discriminant function equation containing 14 variables by the final iteration of the procedure. These 14 items were included as variables in the analysis as each was identified as adding some predictive power to the discriminant function. The DFA revealed a canonical correlation of 0.88, which accounted for 78% of the variance between the non-clinical and the mixed-neurological groups (Wilks' Lambda=0.22; $p<0.01$). Table 17 shows the 14 items along with their standardised canonical discriminant function coefficients, which provide an indication of the importance of each predictor and the direction of the relationship.

Table 17: Standardised canonical discriminant function coefficients and unstandardized canonical discriminant function coefficients

Item	Standardised Canonical Discriminant Function Coefficients	Un-standardised Canonical Discriminant Function Coefficients
CCCC Frequency Question 2:Difficulty remembering the content of conversations and/ or meetings	1.105	0.899
CCCC Frequency Question 119: Getting confused if you are trying to concentrate when there is background noise	-0.980	-0.694
CCCC Frequency Question 41: Forgetting what someone said half an hour ago	0.894	0.719
CCCC Frequency Question 11: Do you have difficulty remembering to arrive at appointments on time	-1.558	-1.566
CCCC Frequency Question 56: You go to phone, text or email someone but then forget what you were going to say	-0.850	-0.716
CCCC Frequency Question 85: Inability to find words for familiar everyday objects	0.942	1.019
CCCC Frequency Question 86: Forgetting to regularly perform chores such as laundry, cleaning, putting bins out	0.863	1.017
CCCC Frequency Question 133:Do you forget to turn the stove off when you are done with it	-1.180	-1.391
CCCC Frequency Question 125: Can't remember important events in my life	0.612	0.805
CCCC Frequency Question 124: Find you can't quite remember something even though it is on the tip of your tongue	-0.524	-0.421
CCCC Frequency Question 127: Difficulty reaching for object without missing them or knocking them over	0.729	0.812
CCCC Frequency Question 17: Difficulty remembering your train of thought as you are speaking	0.638	0.476
CCCC Frequency Question 100: Go back to check if you have done something or not (e.g., turning out lights, locking doors)	0.460	0.324
CCCC Frequency Question 94: Begin one task and get distracted into doing something else	-0.469	-0.378

Following the stepwise analysis, the discriminant function was calculated. The groups' centroids showed that the non-clinical participants had a function mean of -1.17 while the mixed-neurological participants produced a function mean of 2.99. The mean of the two centroids (0.91) was used as the cut-off to classify participants as representative of

the non-clinical or mixed-neurological groups. An individual's discriminant score equal to or less than the cut-off was classed as 'non-clinical' and a discriminant score greater than the cut-off, was classed as 'mixed-neurological'.

Classification accuracy: Original grouped cases.

Table 18 shows that of those individuals in the non-clinical group, 73 individuals (98.6%) were correctly classified as being in the non-clinical group; and 1 individual (1.4%) was incorrectly classified as being in the mixed-neurological group.

Of those in the mixed-neurological group, 27 individuals (93.1%) were correctly classified as being in the mixed-neurological group; and 2 individuals (6.9%) were incorrectly classified as being in the non-clinical group.

It could be concluded that non-clinical cases were classified with slightly better accuracy (98.6%), than mixed-neurological cases (93.1%), although both were acceptable hit ratios. It is important to bear in mind that this difference is a matter of percentage values and the mixed-neurological group was smaller.

Table 18: Classification results of original grouped cases.

		Predicted group membership		
		Non-clinical	Mixed Neurological	Total
Actual group membership	Non-clinical	73 (98.6%)	1 (1.4%)	74 (100%)
	Mixed Neurological	2 (6.9%)	27 (93.1%)	29 (100%)

The classification results revealed that 97.1% of original grouped cases were classified correctly into 'non-clinical' or 'mixed-neurological' groups.

Classification accuracy: Cross-validated grouped cases.

Table 19 shows that of those individuals in the non-clinical group, 73 individuals (98.6%) were correctly classified as being in the non-clinical group; and 1 individual (1.4%) was incorrectly classified as being in the mixed-neurological group.

Of those in the mixed-neurological group, 26 individuals (89.7%) were correctly classified as being in the mixed-neurological group; and 3 individuals (10.3%) were incorrectly classified as being in the non-clinical group.

Non-clinical cases were classified with slightly better accuracy (98.6%), than mixed-neurological cases (89.7%), although both were acceptable hit ratios. It is important to bear in mind that this difference is a matter of percentage values and the mixed-neurological group was smaller.

Table 19: Classification results of cross-validated grouped cases

		Predicted group membership		
		Non-clinical	Mixed Neurological	Total
Actual group membership	Non-clinical	73 (98.6%)	1 (1.4%)	74 (100%)
	Mixed Neurological	3 (10.3%)	26 (89.7%)	29 (100%)

After cross-validation, the number of individuals in the non-clinical group who were correctly classified remained the same. The number of individuals in the mixed-neurological group who were incorrectly classified only increased by one. Once cross-validation had taken place, 96.1% of cross-validated grouped cases were classified correctly into ‘non-clinical’ or ‘mixed-neurological’ groups.

With this information, it is possible to predict with reasonable accuracy the probability of an individual being classified into either of the two groups, based on their CCCC responses and resulting discriminant score. Figure 6 offers a visual demonstration of this concept. Here, it is possible to see that an individual who produces a discriminant score of -3.00000 has zero probability of being in a mixed-neurological group and virtual certainty (1.00000) of being in a non-clinical group. Whereas, an individual who produces a discriminant score of 5.00000 has zero probability of being in a non-clinical group and virtual certainty (1.00000) of being in a mixed-neurological group.

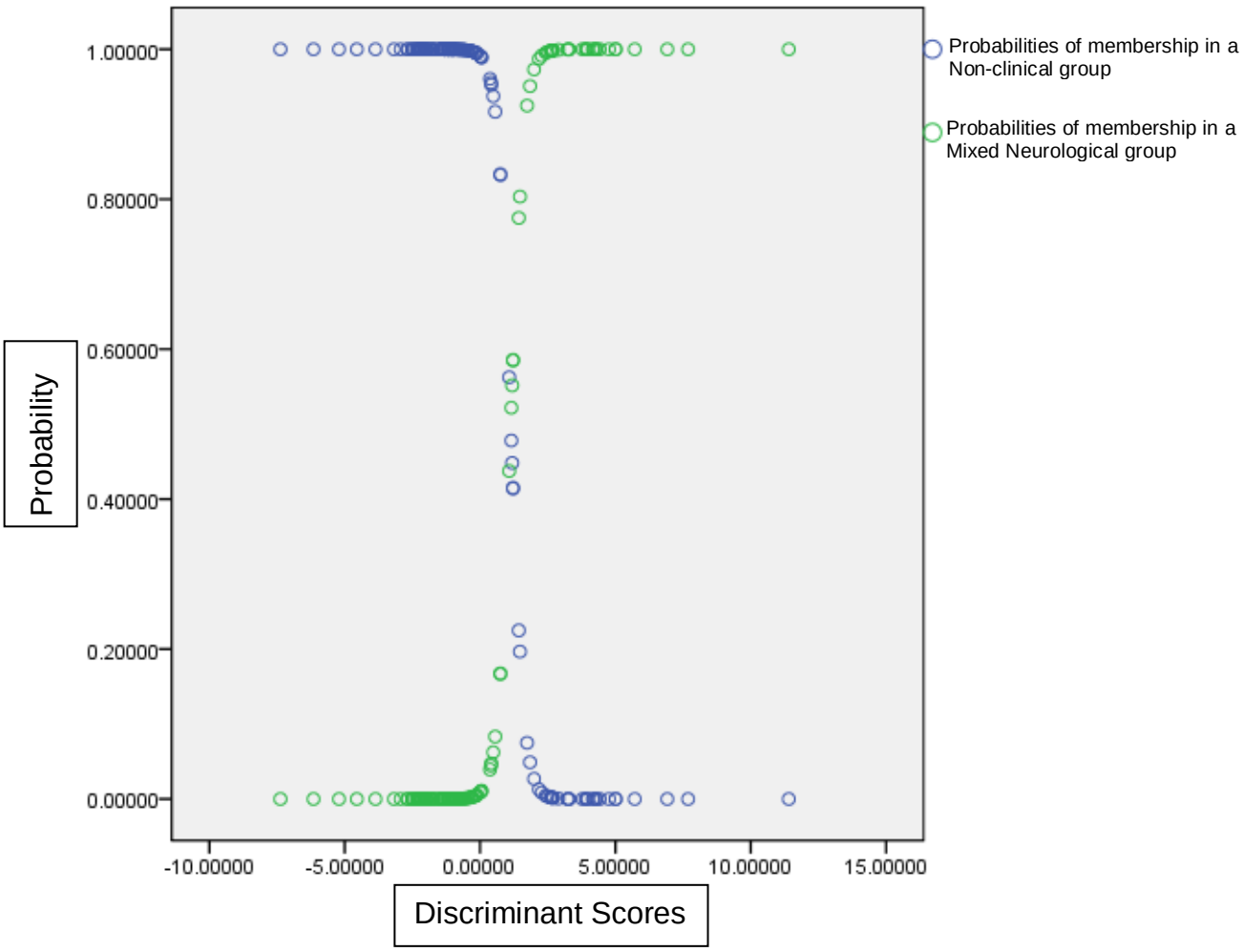

Figure 6: Scatter distribution of probability for membership in each of the non-clinical and mixed-neurological groups based on discriminant scores

Mental health – mixed-neurological

A third discriminant function analysis was conducted to ascertain whether the CCCC could predict mental health participants and those who had been recruited from the Neuropsychology Service. The predictor variables were the frequency items of the CCCC measure.

The stepwise analysis was completed in four steps, resulting in a discriminant function equation containing four variables by the final iteration of the procedure. These four items were included as variables in the analysis as each was identified as adding some predictive power to the discriminant function. The DFA revealed a canonical correlation of 0.65, which accounted for 42.5% of the variance between the mental health and the mixed-neurological groups (Wilks' Lambda=0.58; $p<0.01$). Table 20 shows the 4 items along with their standardised canonical discriminant function coefficients, which provide an indication of the importance of each predictor and the direction of the relationship.

Table 20: Standardised canonical discriminant function coefficients and unstandardized canonical discriminant function coefficients

Item	Standardised Canonical Discriminant Function Coefficients	Un-standardised Canonical Discriminant Function Coefficients
CCCC Frequency Question 12: Forget to pass on messages (e.g., phone messages)	0.937	0.867
CCCC Frequency Question 49: Forgetting to do things someone has asked you to do	0.705	0.511
CCCC Frequency Question 99: I can be in the middle of something and have no idea what I was just doing	-0.623	-0.449
CCCC Frequency Question 136: Absent mindedly placed things in unintended locations (e.g., milk in a cupboard)	-0.676	-0.591

Following the stepwise analysis, the Discriminant Function was calculated. The groups' centroids showed that the mental health participants had a function mean of -0.83 while the mixed-neurological participants produced a function mean of 0.86. The mean of the two centroids (0.015) was used as the cut-off to classify participants as representative of the mental health or mixed-neurological groups. An individual's discriminant score equal to or less than the cut-off was classed as 'mental health' and a discriminant score greater than the cut-off, was classed as 'mixed-neurological'.

Classification accuracy: Original grouped cases.

Table 21 shows that of those individuals in the mental health group, 26 individuals (86.7%) were correctly classified as being in the mental health group; and four individuals (13.3%) were incorrectly classified as being in the mixed-neurological group.

Of those in the mixed-neurological group, 23 individuals (79.3%) were correctly classified as being in the mixed-neurological group; and six individuals (20.7%) were incorrectly classified as being in the mental health group.

It could be concluded that mental health cases were classified with slightly better accuracy (86.7%), than mixed-neurological cases (79.3%), although both were acceptable hit ratios. It is important to bear in mind the size of the groups and that the difference in the hit ratio between the groups can appear large when viewed as percentages when in fact there was only a difference of two incorrectly classified cases when the groups are compared.

Table 21: Classification results of original grouped cases

		Predicted group membership		
		Mental Health	Mixed Neurological	Total
Actual group membership	Mental Health	26 (86.7%)	4 (13.3%)	30 (100%)
	Mixed Neurological	6 (20.7%)	23 (79.3%)	29 (100%)

The classification results revealed that 83.1% of original grouped cases were classified correctly into ‘mental health’ or ‘mixed-neurological’ groups.

Classification accuracy: Cross-validated grouped cases.

Table 22 shows that of those individuals in the mental health group, 26 individuals (86.7%) were correctly classified as being in the mental health group; and 4 individuals (13.3%) were incorrectly classified as being in the mixed-neurological group.

Of those in the mixed-neurological group, 22 individuals (75.9%) were correctly classified as being in the mixed-neurological group; and 7 individuals (24.1%) were incorrectly classified as being in the mental health group.

Mental health cases were classified with slightly better accuracy (86.7%), than mixed-neurological cases (75.9%), although both were acceptable hit ratios. It is important to bear in mind the size of the groups and that the difference in the hit ratio between the groups can appear large when viewed as percentages when in fact there was only a difference of three incorrectly classified cases when the groups are compared.

Table 22: Classification results of cross-validated grouped cases

		Predicted group membership		
		Mental Health	Mixed Neurological	Total
Actual group membership	Mental Health	26 (86.7%)	4 (13.3%)	30 (100%)
	Mixed Neurological	7 (24.1%)	22 (75.9%)	29 (100%)

After cross-validation, the number of individuals in the mental health group who were correctly classified remained the same. The number of individuals in the mixed-neurological group who were incorrectly classified only increased by one. Once cross-validation had taken place, 81.4% of cross-validated grouped cases were classified correctly into ‘mental health’ or ‘mixed-neurological’ groups.

With this information, it is possible to predict with reasonable accuracy the probability of an individual being classified into either of the two groups, based on their CCCC responses and resulting discriminant score. Figure 7 offers a visual demonstration of this concept. Here, it is possible to see that an individual who produces a discriminant score of -3.00000 has zero probability of being in a mixed-neurological group and virtual certainty (1.00000) of being in a mental health group. Whereas, an individual who produces a discriminant score of 3.00000 has zero probability of being in a mental health group and virtual certainty (1.00000) of being in a mixed-neurological group.

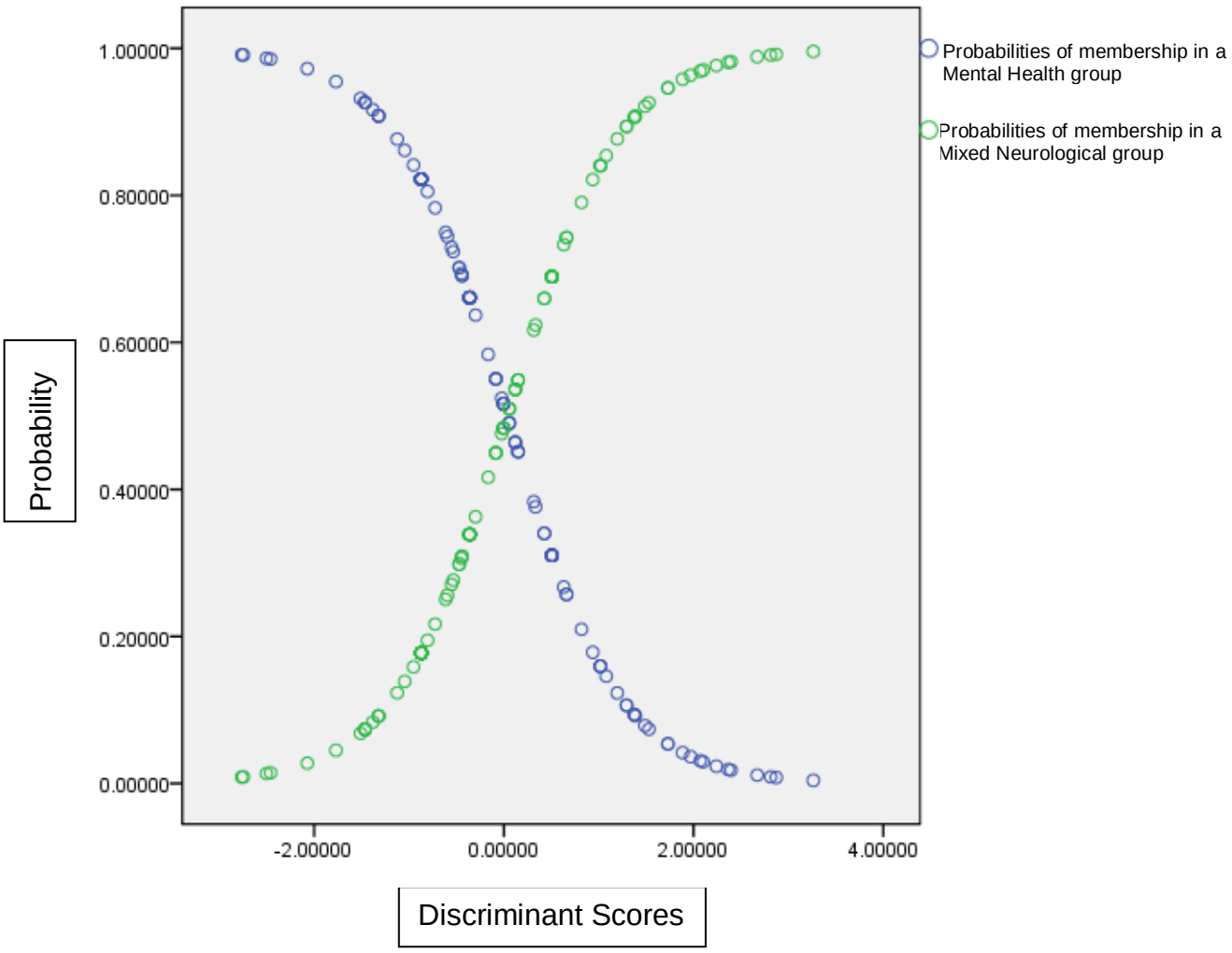

Figure 7: Scatter distribution of probability for membership in each of the mental health and mixed-neurological groups based on discriminant scores

Discussion

The present research was carried out with two aims. First, to provide base-rate data on endorsement of cognitive complaints in neurologically intact individuals by calculating the cumulative frequency of individuals endorsing each item and producing an endorsement profile; and second, to discriminate between neurologically intact individuals, patients attending neuropsychological assessment services and those attending mental health facilities, through the use of Discriminant Function Analyses.

In accordance with the aims of the study, the present research gathered data from 133 volunteers of working age from 3 sources (non-clinical, mental health, and mixed-neurological), who completed measures of cognitive complaints, psychological distress and intellectual functioning. Since the CCCC measure includes scales of frequency and distress, it was used in response to previous research on common cognitive complaints which found that reporting of such complaints was associated with emotional factors (Stulmeijer et al, 2007; Rohling et al, 2002; Duits et al, 2008; Weaver Cargin et al, 2008; Hall et al, 2009; Carter et al, 2003; Wagle et al, 1999; Sullivan & Payne, 2007). The CCCC was also used because it contains more items with a wide variety of experiences that apply to many individuals and because the items vary in terms of cognitive severity, capturing a broad range of complaints, making it applicable to different populations. For these reasons it was believed to be an appropriate measure for determining patterns of endorsement and discriminating between populations.

The samples of participants consisted of 74 individuals in the non-clinical group, 30 individuals in the mental health group and 29 individuals in the mixed-neurological group. In terms of age, the non-clinical group was significantly younger than the two

clinical groups. However, the age-range in each of the groups was fairly narrow and this may have had a bearing on the significant result obtained. The non-clinical sample included friends and family of the undergraduate researchers. The mean age (30) was higher than might be expected if the sample had consisted solely of undergraduate participants. However, when CCCC scores were correlated with age, no association was found between age and reporting of cognitive complaints for the two clinical groups, although increased age was associated with reporting of fewer cognitive complaints in the non-clinical group. However it should be noted, the current data did not report the performance of older adults (>65 years) and therefore it is not possible to comment upon the relationship between age and cognitive complaints in a more elderly population.

In terms of IQ and memory, the non-clinical and mental health groups did not differ in their estimated IQ or memory scores. The mean IQ (108) and memory scores (105 immediate; 107 delayed) of the non-clinical group were lower than might be expected if the non-clinical group had consisted solely of undergraduate participants. The mixed-neurological group had significantly lower average premorbid IQ and memory scores than the estimated IQ and memory scores of both the non-clinical and mental health groups. However, subsequent correlations found no association between reporting of cognitive complaints and IQ or memory.

In terms of emotional distress, as would be expected (Derogatis, 1994), the mental health individuals reported significantly higher levels of distress on both of the Depression and Anxiety scales of the SCL90-R than participants in the other two groups. The participants in the mixed-neurological group had lower depression scores than the mental health group, but were still significantly higher than those in the non-clinical group. This

might be expected on the basis of their clinical status, since psychological disorders such as depression and anxiety are common in individuals with neurological problems (Brown, 2004). Subsequent correlations revealed that individuals with higher levels of psychological distress tended to report more cognitive complaints. This is consistent with the previous research on common cognitive complaints and accompanying mental health difficulties (Wagle et al, 1999; Sullivan & Payne, 2007) as well as other research linking reports of cognitive complaints to emotional factors more generally (Stulmeijer et al, 2007; Rohling et al, 2002; Duits et al, 2008; Weaver Cargin et al, 2008; Hall et al, 2009; Carter et al, 2003).

Establishing base-rate data: Patterns of endorsement

Since the 'normal' range of common cognitive complaint experiences was not yet known, the first aim of the study was to provide base-rate data regarding the experience of common cognitive complaints (with a view to helping clinicians determine whether their patients' experiences fall outside the range of 'normal' levels of reporting). Providing base-rate data was done by calculating the number of individuals in the non-clinical group endorsing each item and producing an endorsement profile of cumulative frequencies. The pattern of endorsements indicated the use of the full range of the scale and provided percentages of individuals endorsing any specific item to any given level. Since there may be a need to know whether cognitive complaints occur as a result of neurological impairment or mental health difficulties (Goldstein & McNeil, 2004), this profile of endorsements had clinical applicability because the information would allow clinicians to 'get a feel' for their patients' responses and help them assess whether or not their patient fits a non-clinical profile. For example, for any given complaint reported by a referred patient, the base-rate data can offer an estimate of the likelihood of that complaint being

experienced by an individual in the 'normal' population and the 'normal' frequency to which it occurred. The clinician can check the reported frequency of any complaint against the base-rate and determine if the frequency to which the individual is experiencing the complaint is 'normal'. Moreover, the pattern of endorsement showed that it is unusual for an individual in this population to experience items occurring several times a day; and if one did, (in the context of other unusual levels of reporting) then a clinician may decide that it is necessary to explore their symptoms further.

Discriminant Function Analyses

There existed the possibility that different populations might present a qualitative and/or quantitative difference in their pattern of item endorsement on the CCCC, in that they might endorse different types of cognitive complaints or endorse the same cognitive complaints at different frequencies. Ultimately, these CCCC profiles could help clinicians to determine the population to which they belong, and to understand the basis for their reports and distress, and treat accordingly. To address this, the second aim of the present research was to use Discriminant Function Analysis (DFA) to identify CCCC items that would discriminate between the three groups of participants. The performance of the three discriminant functions was excellent and the CCCC continued to discriminate well between the groups even after jacknifed cross-validation procedures, with accuracies of 86.5% (non-clinical – mental health), 96.1% (non-clinical – mixed-neurological) and 81.4% (mental health – mixed-neurological). The Discriminant Function Analyses revealed 26 items that maximally discriminated between the groups.

Knowledge of the specific discriminating items and group patterns of endorsing on the new scale has clinical applicability. Some patients present with common cognitive

complaints; but their neuropsychological tests indicate no impairment or, their scores are lower than expected but they do not show absolute deficits relative to their neurologically intact peers nor estimates of their premorbid functioning. Nevertheless, these patients continue to report such complaints (Mahoney et al, 1998). In such cases there remains the possibility that there is actual underlying cognitive impairment. In these cases it would be useful clinically to know whether the cognitive complaints and related distress are occurring as a result of neurological impairment or underlying mental health difficulties (Goldstein & McNeil, 2004). Once this is determined, options – such as referral to a mental health professional – can follow. When the ecological validity of neuropsychological tests is in question (Poliakoff and Smith-Spark, 2008), neuropsychologists attempt to establish whether or not an underlying organic condition exists based on their clinical experience (which includes the occurrence of common cognitive complaints). Given the high accuracy with which the discriminant function analyses were able to classify cases, the calculated functions for the 26 identified items can be used to plot probabilities of responses falling within each of the three populations. These probabilities can be plotted on a graph. Clinicians could then check questionnaire responses against the graph and determine the population within which their patients are likely to fall (in conjunction with routine neuropsychological measures and their own clinical judgement).

Strengths, limitations and future research

As a strength, this study used a medium-to-large sample size of 74 individuals in the non-clinical group. On the other hand the use of undergraduates for the non-clinical group, the majority of whom were female, reduces the generalizability of the findings because they are a narrow range of individuals with idiosyncrasies that might have affected

their reporting of cognitive complaints. Future research could replicate this study using data from the wider non-clinical population.

Employing different methods of recruitment for the mental health group allowed access to a broader range of individuals, as well as increasing the sample size. Nevertheless, it was a small sample, as was the mixed-neurological group. Larger clinical groups would have been preferable for this research to increase confidence in the results obtained. Future research would benefit from larger clinical samples to increase confidence in the results obtained.

The high correlation between the Frequency and Distress scales was interesting. The results of previous research suggested an association between cognitive complaints and emotional state and the present findings showed that the mental health group had significantly higher scores on the emotional distress measures than the other two groups. Therefore it was expected that individuals in the mental health group would report higher levels of distress on the CCCC measure even when the Frequency of events was low. However, the colinearity between the scales suggested that where there were low Frequency scores, there were also low Distress scores. There are three possible explanations for this finding. It is possible that the sample size of the mental health group was too small, but it is also possible that the expected pattern does not exist in the mental health population. It may be the case that, since those in the mental health group were more distressed, they might have believed that they were in fact experiencing complaints more often. Alternatively, it may be that individuals with mental health problems do experience more complaints. In the present research, the high correlation between the Frequency and Distress scales of the CCCC led to the decision to exclude the Distress

scale from the analyses. However, even though analysis would require a more complicated process, future research could replicate this study employing both scales. Including both scales may provide more detailed information about patterns of endorsing/profiles in the different populations.

Despite employing a jacknifing cross-validation procedure, the small clinical samples and narrow range of individuals in the non-clinical sample may have produced results with an inherent bias or idiosyncrasies and therefore limiting the generalizability of the results. Further research is needed to increase confidence in the results obtained by classifying a new sample based on the discriminant functions obtained in the present research. Alternatively, to further reduce any bias, the research could be replicated with larger sample-sizes, a broader non-clinical sample, and a random selection of individuals from each population held aside for classification following the analyses.

Conclusion

In accordance with the first aim of the study, base-rate data were established by calculating patterns of endorsement in the non-clinical group, providing a profile of 'normal' reporting. These data provided clinically applicable information. To meet the second aim, Discriminant Function Analyses were used in three separate stages to discriminate between neurologically intact individuals, those attending mental health facilities and patients attending neuropsychological assessment services. The performance of the three discriminant functions was excellent and the functions provided useful information offering 26 items that maximally discriminated between the three groups, offering further clinically applicable information.

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Appendix 2: Public Domain Briefing Paper – Emotional Distress, Memory and Common Cognitive Complaints

Public Domain Briefing Paper

Emotional Distress, Memory and Common Cognitive Complaints

Karen Surridge

Literature Review

Does depression affect performance on neuropsychological assessment of memory after traumatic brain injury (TBI)?

Background

Some research has suggested that depression leads to poorer performance on neuropsychological assessments of memory (Burt, Zembar & Niederehe, 1995). However, some authors disagree (Rohling, Green, Allen & Iverson, 2002), pointing out that research in this area contains weaknesses which reduce confidence in the findings.

Similar research has been conducted which assessed the impact of depression on neuropsychological assessment of memory with individuals who have sustained traumatic brain injuries (TBI). This research is also contradictory. It is important to determine whether or not depression affects memory test performance after traumatic brain injury, so that proper treatment approaches can be offered (Evans, 2004). Therefore this paper reviewed the literature to determine whether depression affects performance on neuropsychological assessment of memory after traumatic brain injury.

Results

Eleven studies were reviewed. They employed multiple approaches, generating 107 results. There were weaknesses in all of the studies which consisted of problems in relation to the severity of TBI that was investigated, the method of assessing depression and weaknesses in design and data analysis. These were similar to the problems that had been highlighted by Rohling et al (2002). However, on balance some papers were of better

quality than others. Overall, 16 neuropsychological tests of memory were used to assess memory performance in five categories. The categories were: immediate recall, delayed recall, recognition, learning, and working memory.

Conclusions

The balance of evidence appears to suggest that depression in TBI might result in poorer performance on neuropsychological assessments of learning. It is possible that depression particularly affects performance on one specific learning measure (California Verbal Learning Test, CVLT, Delis, Kramer, Kaplan & Ober, 1987). However, the results are not definitive since the quality of the studies on which the review was based, was moderate, and often, the studies were not set up to answer the question directly. Therefore, the question remains unanswered until weaknesses in the literature are addressed.

Empirical Paper

Do individuals in mental health, neurological outpatient and non clinical populations have distinct profiles on the common cognitive complaints checklist (CCCC)?

Background

The phrase 'common cognitive complaints' refers to everyday occurrences of absent-mindedness, slips of memory and attention and failures of action processing. Such everyday experiences include occurrences like forgetting appointments, forgetting people's names, failing to see items despite them being in plain sight, beginning a task and (unintentionally) becoming distracted into engaging in a different activity, failing to remember something even though it is on the 'tip of the tongue' and other similar events. These experiences are common and are not in themselves indicative of neurocognitive difficulties (Mitchell, 2008). However, in some instances, such cognitive complaints may indicate deterioration, damage, or psychological problems (Portet, Ousset, Visser, Frisoni, Nobili, Scheltens, Vellas, & Touchon, 2006).

Common cognitive complaints have been perceived as potentially important indicators of neuropsychological functioning (Carter Rourke, Murji, Shore & Rourke, 2003). However, research has often found that reporting of cognitive complaints is not related to performance on neuropsychological tests or actual cognitive impairment. In fact, research has often shown that reporting of such complaints is highly influenced by emotional state in a number of populations, including those with mental health problems

(Stulmeijer et al, 2007; Rohling et al, 2002; Duits et al, 2008; Weaver Cargin et al, 2008; Hall et al, 2009; Carter et al, 2003; Wagle & Berrios, 1999; Sullivan & Payne, 2007).

Some individuals report cognitive complaints but their performance on neuropsychological tests shows that they are not impaired. Yet, they continue to report cognitive complaints (Mahoney, Dalby & King, 1998). In these cases, there remains the possibility that there is actual underlying cognitive impairment. However, given the influence of emotional state, it is difficult for neuropsychologists to establish whether or not the individual is impaired, based on their reporting of cognitive complaints. Therefore, it would be useful for clinicians to know what the 'normal' range of reporting is (i.e. a base-rate) with which to compare their patients' levels of reporting. It would also be useful to know which specific complaints can distinguish between individuals from the 'normal' population, a neurological population and those who access mental health services.

Questionnaires that are currently available to measure common cognitive complaints are affected by emotional state and have other drawbacks. To address the drawbacks of existing questionnaires, a new measure was introduced; the Common Cognitive Complaints Checklist (Jones, 2010). The measure was longer, contained a broad range of complaints, and included a scale for individuals to rate how often they experienced each complaint as well as rating their level of distress they experienced with each complaint.

The aims of the study were to provide base-rate information for the non-clinical population (to determine what is 'normal'), and to identify specific complaints which

would distinguish between non-clinical individuals, patients attending neuropsychological assessment services and those attending mental health facilities.

Methodology

Volunteers were recruited from three sources:

- 29 volunteers were individuals recruited from an outpatient neuropsychology department
- 30 volunteers were individuals recruited from mental health services
- 74 volunteers were a group of university students

All of the participants filled in questionnaires about their emotional state and their common cognitive complaints. Information about their estimated intellectual level and memory functioning was also obtained.

Findings

As would be expected, individuals in the mental health group reported significantly higher levels of distress (Derogatis, Rickels & Rock, 1976; Derogatis & Savitz, 1999). Individuals with higher levels of distress tended to report more cognitive complaints. This is consistent with the previous research on common cognitive complaints and accompanying mental health difficulties (Wagle & Berrios, 1999; Sullivan & Payne, 2007).

The first aim of the study (to provide base-rate information on 'normal' levels of reporting of cognitive complaints) was achieved. This information revealed that it was unusual for individuals in the non-clinical population to report cognitive complaints occurring very frequently. It was determined that the base-rate information would also be

helpful for clinicians to establish whether or not the frequency of their patient's reported cognitive complaints is 'normal'.

The second aim (to identify specific complaints that would distinguish between populations) was also achieved. The analyses that were used were able to classify individuals into the correct group with excellent accuracy and they revealed 26 common cognitive complaints that distinguished between the groups. The data from these calculations could be used to plot the probabilities of responses falling within each population. These probabilities can be plotted on a graph. Clinicians could then look up their patient's responses and determine the population within which they are likely to fall.

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Appendix 3: Impact of depression on immediate recall

Visual representation of the 11 results

Study	Immediate Recall Condition			
	Visual Task	Visual Learning Task	Verbal Task	Verbal Learning Task
Cicerone & Kalmar (1997)	×		×	
Satz et al (1998)				× × × ×
Sherman et al (2000)			✓ ×	
Keiski et al (2007)				× × ×

× = Found no association between depression and memory performance
✓ = Found poorer performance in depression

Details of each of the 11 analyses organised by study

Cicerone & Kalmar (1997)

In multivariate ANOVAs with other memory measures, scores on two measures of immediate recall were compared between a group of depressed individuals and a group of nondepressed individuals as determined by recorded clinical diagnosis and treatment.

Test	Details	Association with Depression
Logical Memory Immediate Recall	The difference between groups on this measure fell just below significance. Post hoc analyses were not performed. Inspection of Logical Memory immediate scores showed that they were fairly similar, indicating that depression had not affected immediate memory.	No
Rey-Osterrieth Complex Figure Test (RCFT) Immediate recall	The difference between groups on this measure fell just below significance. Post hoc analyses were not performed. Inspection of RCFT immediate scores showed that they were fairly similar, indicating that depression had not affected immediate memory	No

Satz et al (1998)

Approach 1: This approach explored differences. The sample was split into three groups according to recovery/disability status and depression status. In Group 1 were individuals with moderate and severe disability with depression. In Group 2 there were individuals with moderate and severe disability without depression. In Group 3 there were individuals with good recovery and non-TBI individuals, both without depression. MANCOVAs were used, controlling for age and education.
Approach 2: This approach explored relationships. Two correlations were conducted, the first between the immediate recall measure and the SCL90-R measure of depression; and the second between the immediate recall measure and the NRS-13 measure of depression.
Approach 3: Multiple linear regression analyses were then computed with the SCL90-R controlling for age, education and recovery/disability status to determine the unique effect of depression on immediate memory (and 13 other variables). Criteria for statistical significance was set at $p<0.004$ to account for numerous analyses and reduce the likelihood of type-1 error.

Test	Details	Association with Depression
Rey Auditory Verbal Learning Test (RAVLT) Immediate Recall	Approach 1 (MANCOVAs): Analyses revealed a non-significant difference between the groups on the immediate recall measure and therefore suggested that depression had not impacted on immediate recall.	No
	Approach 2 (correlation with SCL90-R): The correlation did not reach significance and therefore suggested that there was no association between depression, as measured by the SCL90-R, and immediate recall performance.	No
	Approach 2 (correlation with NRS-13): The correlation did not reach significance and therefore suggested that there was no association between depression, as measured by the NRS-13, and immediate recall performance.	No
	Approach 3 (Multiple regression with SCL90-R): Results showed no significant effects of depression on immediate recall.	No

Sherman et al (2000)

Approach 1: All neuropsychological data were converted to norm-based z-scores. z-score differences on one measure of immediate recall between the high-depression and low-depression groups were inspected.
Approach 2: To explore the clinical significance of group differences further, for each participant, a calculation was made of the percentage of neuropsychological tests on which they had impaired performance.

Test	Details	Association with Depression
Logical Memory Immediate recall	Approach 1 (z-score inspection): revealed lower scores for the depression group in immediate recall. In comparison to other tests, there was a large difference for immediate recall as measured by the Logical Memory task with a difference of 0.38 z-score units but the authors did not state whether this difference was statistically significant. However, they did highlight that from a clinical standpoint a difference of less than half a z-score unit was minimal.	No
	Approach 2 (percentage impaired): A significantly larger number of individuals in the high depression group had scores in the impaired range on the immediate recall task, indicating an association between depression and immediate memory performance.	Yes

Keiski et al (2007)

Approach 1: Using t-tests (or Mann Whitney U tests), performance was compared between individuals with high depression and low depression scores.
Approach 2: Using ANCOVAs, performance was compared between individuals with high depression and low depression scores, controlling for motivation (symptom validity test score). *This approach was not applied in the immediate recall condition.*
Approach 3: Using ANCOVAs, performance was compared between individuals with high depression and low depression scores, controlling for degree of impairment (APR score). *This approach was not applied in the immediate recall condition.*
Approach 4: A correlation was conducted between memory performance and depression.
Approach 5: A partial correlation was conducted between memory performance and depression, controlling for impairment and motivation.

Test	Details	Association with Depression
California Verbal Learning Test (CVLT)	Approach 1 (t-tests): Individuals in the depressed group performed equally well on the first learning trial. This indicated that depression had not impacted on immediate recall performance.	No
	Approach 4 (correlation): There was no association between scores on the CVLT and depression. This showed no association between depression and immediate recall performance.	No
	Approach 5 (partial correlation): There was no association between scores on the CVLT and depression, even after controlling for level of impairment and motivation. This showed no association between depression and immediate recall performance.	No

Appendix 4: Comparison of study quality based on strengths and weaknesses identified in the text

Comparison of study quality based on strengths and weaknesses identified in the text

Studies	Strengths Identified						Studies with considerable weaknesses
	TBI Severity	Assessment of depression	Symptom validity testing	Medication	Comorbidity	Design and statistics	
Atteberry-Bennett, et al (1986)	✓						
Cicerone & Kalmar (1997)	✓	✓**					
Satz et al (1998)							✓
Sherman et al (2000)			✓				✓
Ruttan & Heinrichs (2003)	✓		✓				
Rapoport et al (2005)		✓					
Alfano (2006)	✓		✓				
Chamelian & Feinstein (2006)		✓	✓				✓
Keiski et al (2007)	✓*		✓			✓	
Preece & Geffen (2007)	✓	✓**	✓***		✓	✓	
Rao et al (2010)		✓					

*Did not study a single severity level but did control for impairment in some analyses (see Table 3)
** Clinical diagnosis was established from clinical records (and self-reports of diagnosis) with the possibility that depression was not current
*** Recruited within 24 hours of injury so litigation is unlikely

Appendix 5: Impact of depression on delayed recall

Visual representation of the 48 results

Study	Delayed Recall Condition			
	Visual Task	Visual Learning Task	Verbal Task	Verbal Learning Task
Cicerone & Kalmar (1997)			×	
Satz et al (1998)				✓ × × ×
Sherman et al (2000)	× ×			
Ruttan & Heinrichs (2003)	× × × × × × ×		× × × × ✓	
Rapoport et al (2005)			✓ T	✓ T
Alfano (2006)	× × ×			× × ×
Chamelian & Feinstein (2006)		×		
Keiski et al (2007)			× × × × ×	✓ ✓ ✓ ✓ ✓ ✓ ✓ × × ×
Preece & Geffen (2007)				×
Rao et al (2010)		T		T

× = Found no association between depression and memory performance
✓ = Found poorer performance in depression
T = Trend towards poorer performance in depression

Details of each of the 48 analyses organised by study

Cicerone & Kalmar (1997)

In multivariate ANOVAs with other memory measures, scores on the delayed recall measure were compared between a group of depressed individuals and a group of nondepressed individuals as determined by recorded clinical diagnosis and treatment.

Test	Details	Association with Depression
Logical Memory Delayed Recall	The difference between groups fell just below significance. Post hoc analyses were not performed. Inspection of delayed recall scores showed that they were fairly similar, indicating that depression had not affected delayed recall.	No

Satz et al (1998)

Approach 1: This approach explored differences. The sample was split into three groups according to recovery/disability status and depression status. In Group 1 were individuals with moderate and severe disability with depression. In Group 2 there were individuals with moderate and severe disability without depression. In Group 3 there were individuals with good recovery and non-TBI individuals, both without depression. MANCOVAs were used, controlling for age and education.
Approach 2: This approach explored relationships. Two correlations were conducted, the first between the delayed recall measure and the SCL90-R measure of depression; and the second between the delayed recall measure and the NRS-13 measure of depression.
Approach 3: Multiple linear regression analyses were then computed with the SCL90-R, controlling for age, education and recovery/disability status to determine the unique effect of depression on delayed memory (and 13 other variables). Criteria for statistical significance was set at $p<0.004$ to account for numerous analyses and reduce the likelihood of type-1 error.

Test	Details	Association with Depression
Rey Auditory Verbal Learning Test (RAVLT) Delayed Recall	Approach 1 (MANCOVAs): Analyses revealed a significant difference between the groups on the delayed recall measure. However, on closer inspection, Group 1 (depression group) and Group 2 had similar delayed recall scores which were lower than those of Group 3. Therefore the difference was due to recovery/disability status and thus suggested that depression had not impacted on delayed recall.	No
	Approach 2 (correlation with SCL90-R): The correlation did not reach significance and therefore suggested that there was no association between depression, as measured by the SCL90-R, and delayed recall performance.	No
	Approach 2 (correlation with NRS-13): There was a significant negative correlation between delayed recall scores and the NRS-13 indicating an association between depression and poorer performance. (However, age, education and recovery/disability status were not controlled for here)	Yes
	Approach 3 (Multiple regression with SCL90-R): Results showed no significant effects of depression on delayed recall.	No

Sherman et al (2000)

Approach 1: All neuropsychological data were converted to norm-based z-scores. z-score differences on one measure of delayed recall between the high-depression and low-depression groups were inspected.
Approach 2: To explore the clinical significance of group differences further, for each participant, a calculation was made of the percentage of neuropsychological tests on which they had impaired performance.

Test	Details	Association with Depression
Rey-Osterrieth Complex Figure Test (RCFT) Delayed Recall	Approach 1 (z-score inspection): This revealed lower scores for the depression group in immediate recall. In comparison to other tests, there was a large difference for immediate recall as measured by the Logical Memory task with a difference of 0.38 z-score units but the authors did not state whether this difference was statistically significant. However, they did highlight that from a clinical standpoint a difference of less than half a z-score unit was minimal.	No
	Approach 2 (percentage impaired): Differences between the groups in the number of individuals with scores in the impaired range on the delayed recall task did not reach significance. Meaning that similar numbers of individuals in each of the depression groups had scores in the impaired range on the delayed recall task which would indicate no relationship between depression and delayed recall performance.	No

Ruttan & Heinrichs (2003)

This study conducted analyses using two different samples, two different measures of delayed recall and several approaches to the measurement of depression. This generated 12 results in relation to delayed recall. To simplify the results, they are presented for sample 1 and sample 2 separately below. Further to this, the results for sample 2 are presented separately for each of the delayed recall measures.

Sample 1:

Depression was measured by the *Dysthymia* scale of the *MCMI-2*.
Hierarchical regression procedures were conducted with two different measures of delayed recall.

Test	Details	Association with Depression
Logical memory Delayed Recall	**Sample 1:** Approach 1: Dysthymia scores contributed significantly to the prediction of delayed memory performance on the Logical Memory task, indicating an inverse relationship. (However, later the authors concluded that this was a chance finding due to the number of analyses performed, rather than an authentic association between depression and delayed memory)	Yes
Visual Reproduction Delayed recall	**Sample 1:** Approach 2: Dysthymia scores failed to predict delayed recall performance. This revealed no association between depression and delayed recall.	No

Sample 2: To simplify the results, they are presented for each of the delayed recall measures separately.
Logical Memory delayed recall task
Approach 1: Depression was measured by the *Depression* scale of the *MMPI-2*. Hierarchical regression procedures were conducted with the first measure of delayed recall (Logical Memory).
Approach 2: The authors highlighted that the Depression scale contains 'neurological' items which may have interfered with the results. Therefore, analyses were rerun with the neurological items removed.
Approach 3: Depression was measured by the *Dysthymia* scale of the *MMPI-2*. Hierarchical regression procedures were conducted with the first measure of delayed recall (Logical Memory).
Approach 4: The authors highlighted that the Dysthymia scale contains 'neurological' items which may have interfered with the results. Therefore, analyses were rerun with the neurological items removed.

Test	Details	Association with Depression
Logical Memory Delayed Recall	Approach 1: Depression scores failed to predict delayed memory performance on the Logical Memory task. The results revealed no association between depression and delayed recall.	No
	Approach 2 (neurological items removed): Depression scores failed to predict delayed memory performance on the Logical Memory task. The results revealed no association between depression and delayed recall.	No
	Approach 3: Dysthymia scores failed to predict delayed memory performance on the Logical Memory task. The results revealed no association between dysthymia and delayed recall.	No
	Approach 4 (neurological items removed): Dysthymia scores failed to predict delayed memory performance on the Logical Memory task. The results revealed no association between dysthymia and delayed recall.	No

Sample 2:
Visual Reproduction delayed recall task
Approach 1: Depression was measured by the *Depression* scale of the *MMPI-2*. Hierarchical regression procedures were conducted with the second measure of delayed recall (Visual Reproduction).
Approach 2: The authors highlighted that the Depression scale contains 'neurological' items which may have interfered with the results. Therefore, analyses were rerun with the neurological items removed.
Approach 3: Depression was measured by the *Dysthymia* scale of the *MMPI-2*. Hierarchical regression procedures were conducted with the second measure of delayed recall (Visual Reproduction).
Approach 4: The authors highlighted that the Dysthymia scale contains 'neurological' items which may have interfered with the results. Therefore, analyses were rerun with the neurological items removed.
Approach 5: Depression was measured by the *Harris Lingoes* depression scales. A correlation was performed between these scales and the second delayed recall measure (Visual Reproduction).
Approach 6: The authors highlighted that the Harris Lingoes depression scales contained 'neurological' items which may have interfered with the results. Therefore, correlations were rerun with the neurological items removed.

Test	Details	Association with Depression
Visual Reproduction Delayed Recall	Approach 1: Depression scores failed to predict delayed memory performance on the Logical Memory task. The results revealed no association between depression and delayed recall.	No
	Approach 2 (neurological items removed): Depression scores failed to predict delayed memory performance on the Logical Memory task. The results revealed no association between depression and delayed recall.	No
	Approach 3: Dysthymia scores failed to predict delayed memory performance on the Logical Memory task. The results revealed no association between dysthymia and delayed recall.	No
	Approach 4 (neurological items removed): Dysthymia scores failed to predict delayed memory performance on the Logical Memory task. The results revealed no association between dysthymia and delayed recall.	No
	Approach 5: Depression on the Harris-Lingoes scales was not significantly related to performance on the Visual Reproduction task.	No
	Approach 6 (neurological items removed): Depression on the Harris-Lingoes scales with neurological items removed was not significantly related to performance on the Visual Reproduction task.	No

Rapoport et al (2005)

Approach 1: In analyses of variance, scores on two measures of delayed recall were compared between a group of individuals with major depression and a group of individuals with no depression as determined by structured clinical interview. Criterion for statistical significance was set at $p \leq 0.006$ and for statistical trend at $p \leq 0.05$. Bonferroni corrections were used. Age and past history of depression were controlled for.
Approach 2: Percentile cut-offs were used to determine the percentage of the groups that would be considered impaired on each of the measures.

Test	Details	Association with Depression
Logical Memory Delayed Recall	Approach 1 (group comparisons): There was a significant difference between the groups, with worse performance in the major depression group. This indicated that major depression had affected delayed recall.	Yes
	Approach 2 (percentile cut-offs): There were statistical trends for those in the major depression group to be more likely impaired on the delayed recall task.	T
California Verbal Learning Test (CVLT) Delayed Recall	Approach 1 (group comparisons): There was a significant difference between the groups, with worse performance in the major depression group. This indicated that major depression had affected delayed recall.	Yes
	Approach 2 (percentile cut-offs): There were statistical trends for those in the major depression group to be more likely impaired on the delayed recall task.	T

Alfano (2006)

Correlations were conducted between memory performance (on two tasks) and depression scores (on three measures).

Test	Details	Association with Depression
Hopkins Verbal Learning Test (HVLT Delayed Recall	Depression Measure 1: A non-significant result with the CES-D revealed no association between depression and delayed recall.	No
	Depression Measure 2: A non-significant result with the PAS revealed no association between depression and delayed recall.	No
	Depression Measure 3: A non-significant result with the SCL90-R revealed no association between depression and delayed recall.	No
Rey-Osterrieth Complex Figure Test (RCFT) Delayed Recall	Depression Measure 1: A non-significant result with the CES-D revealed no association between depression and delayed recall.	No
	Depression Measure 2: A non-significant result with the PAS revealed no association between depression and delayed recall.	No
	Depression Measure 3: A non-significant result with the SCL90-R revealed no association between depression and delayed recall.	No

Chamelian & Feinstein (2006)

Scores on the delayed recall measure were compared using MANCOVAs between a group of individuals with subjective cognitive complaints (determined by questions on the Rivermead Postconcussion Questionnaire) and a group who did not have subjective complaints. In the no complaints group there were no individuals with depression whereas 18.5% of the complaints group had depression as determined by structured clinical interview.

Test	Details	Association with Depression
Brief Visuospatial Memory Test (BVMT) Delayed Recall	Individuals in the subjective complaints group performed significantly worse on the measure of delayed memory in comparison to the group who did not have subjective complaints. The difference remained significant even after depression was accounted for, indicating no association between participants' mood and performance, since their difficulties were not linked to co-morbid depression.	No

Keiski et al (2007)

Approach 1: Using t-tests (or Mann-Whitney U tests), performance was compared between individuals with high depression and low depression scores.
Approach 2: Using ANCOVAs, performance was compared between individuals with high depression and low depression scores, controlling for motivation (symptom validity test score).
Approach 3: Using ANCOVAs, performance was compared between individuals with high depression and low depression scores, controlling for degree of impairment (APR score).
Approach 4: A correlation was conducted between memory performance and depression.
Approach 5: A partial correlation was conducted between memory performance and depression, controlling for impairment and motivation.

Test	Details	Association with Depression
California Verbal Learning Test (CVLT) Delayed Recall	Approach 1 (t-test): Individuals in the depressed group performed significantly worse than those in the nondepressed group. This indicated that depression impacted on delayed recall.	Yes
	Approach 2 (ANCOVA - motivation): Individuals in the depressed group performed significantly worse than those in the nondepressed group, even after controlling for motivation. This indicated that depression impacted on delayed recall.	Yes
	Approach 3 (ANCOVA - impairment): Individuals in the depressed group performed significantly worse than those in the nondepressed group, even after controlling for impairment. This indicated that depression impacted on delayed recall.	Yes
	Approach 4 (correlation): As depression increased, delayed recall ability decreased. This revealed an association between depression and reduced delayed recall.	Yes
	Approach 5 (partial correlation): As depression increased, delayed recall ability decreased, even after controlling for impairment and motivation. This revealed an association between depression and reduced delayed recall.	Yes

Logical Memory Delayed Recall	Approach 1 (t-test): The difference between the groups did not reach significance. This indicated that depression did not impact on delayed recall as measured by the Logical Memory task.	No
	Approach 2 (ANCOVA - motivation): The difference between the groups did not reach significance even after controlling for motivation. This indicated that depression did not impact on delayed recall as measured by the Logical Memory task.	No
	Approach 3 (ANCOVA - impairment): The difference between the groups did not reach significance even after controlling for impairment. This indicated that depression did not impact on delayed recall as measured by the Logical Memory task.	No
	Approach 4 (correlation): A non-significant correlation showed no association between depression and delayed recall ability as measured by the Logical Memory task.	No
	Approach 5 (partial correlation): A non-significant partial correlation showed no association between depression and delayed recall ability after controlling for motivation and impairment, as measured by the Logical Memory task.	No
Verbal Paired Associates Delayed Recall	Approach 1 (t-test): Individuals in the depressed group performed significantly worse than those in the nondepressed group. This indicated that depression impacted on delayed recall.	Yes
	Approach 2 (ANCOVA - motivation): The difference between the groups did not reach significance even after controlling for motivation. This indicated that depression did not impact on delayed recall as measured by the Verbal Paired Associates task.	No
	Approach 3 (ANCOVA - impairment): The difference between the groups did not reach significance even after controlling for impairment. This indicated that depression did not impact on delayed recall as measured by the Verbal Paired Associates task.	No
	Approach 4 (correlation): As depression increased, delayed recall ability decreased. This revealed an association between depression and reduced delayed recall as measured by the Verbal Paired Associates task.	Yes
	Approach 5 (partial correlation): A non-significant partial correlation showed no association between depression and delayed recall ability after controlling for motivation and impairment, as measured by the Verbal Paired Associates task.	No

Preece & Geffen (2007)

ANCOVAs compared delayed recall performance in the first 24 hours after injury between individuals who had pre-existing depression and those without pre-existing depression, as determined by reports of previous diagnosis and short form Depression Anxiety Scales (DASS).

Test	Details	Association with Depression
Hopkins Verbal Learning Test (HVLT) Delayed Recall	Score differences between groups did not reach significance. MTBI and depression did not appear to interact to impair delayed recall in the first 24 hours after injury.	No

Rao et al (2010)

Using t-tests, differences on two measures of delayed recall were explored between groups of individuals with and without depression. Criteria for statistical significance was set at $p \leq 0.05$ and statistical trend at $p \leq 0.10$.

Test	Details	Association with Depression
Hopkins Verbal Learning Test (HVLT) Delayed Recall	There was a trend for individuals with depression to perform worse than those without depression on the delayed recall task.	T
Brief Visuospatial memory Test (BVMT) Delayed Recall	There was a trend for individuals with depression to perform worse than those without depression on the delayed recall task.	T

Appendix 6: Impact of depression on recognition

Visual representation of the 14 results

Study	Recognition Condition			
	Visual Task	Visual Learning Task	Verbal Task	Verbal Learning Task
Chamelian & Feinstein (2006)				×
Keiski et al (2007)			× × × × ×	× × × × ✓ ✓ ✓
Preece & Geffen (2007)				✓

× = Found no association between depression and memory performance
✓ = Found poorer performance in depression

Details of each of the 14 analyses organised by study

Chamelian & Feinstein (2006)

Scores on the recognition measure were compared using MANCOVAs between a group of individuals with subjective cognitive complaints (determined by questions on the Rivermead Postconcussion Questionnaire) and a group who did not have subjective complaints. In the no complaints group there were no individuals with depression whereas 18.5% of the complaints group had depression as determined by structured clinical interview.

Test	Details	Association with Depression
California Verbal Learning Test (CVLT) \recognition	Individuals in the subjective complaints group performed significantly worse on the measure of working memory in comparison to the group who did not have subjective complaints. The difference remained significant even after depression was accounted for, indicating no association between participants' mood and performance, since their difficulties were not linked to co-morbid depression.	No

Keiski et al (2007)

Approach 1: Using t-tests (or Mann-Whitney U tests), performance was compared between individuals with high depression and low depression scores.
Approach 2: Using ANCOVAs, performance was compared between individuals with high depression and low depression scores, controlling for motivation (symptom validity test score).
Approach 3: Using ANCOVAs, performance was compared between individuals with high depression and low depression scores, controlling for degree of impairment (APR score).
Approach 4: A correlation was conducted between memory performance and depression.
Approach 5: A partial correlation was conducted between memory performance and depression, controlling for impairment and motivation.

Test	Details	Association with Depression
California Verbal Learning Test (CVLT) Recognition	Approach 1 (t-test): Individuals in the depressed group performed significantly worse than those in the nondepressed group. This indicated that depression impacted on recognition.	Yes
	Approach 2 (ANCOVA - motivation): Individuals in the depressed group performed significantly worse than those in the nondepressed group, even after controlling for motivation. This indicated that depression impacted on recognition.	Yes
	Approach 3 (ANCOVA - impairment): Individuals in the depressed group performed significantly worse than those in the nondepressed group, even after controlling for impairment. This indicated that depression impacted on recognition.	Yes
	Approach 4 (correlation): A non-significant correlation showed no association between depression and recognition ability.	No
	Approach 5 (partial correlation): A non-significant partial correlation showed no association between depression and recognition ability after controlling for motivation and impairment.	No
Logical Memory Recognition	Approach 1 (t-test): The difference between the groups did not reach significance. This indicated that depression did not impact on recognition as measured by the Logical Memory task.	No
	Approach 2 (ANCOVA - motivation): The difference between the groups did not reach significance even after controlling for motivation. This indicated that depression did not impact on recognition as measured by the Logical Memory task.	No
	Approach 3 (ANCOVA - impairment): The difference between the groups did not reach significance even after controlling for impairment. This indicated that depression did not impact on recognition as measured by the Logical Memory task.	No
	Approach 4 (correlation): A non-significant correlation showed no association between depression and recognition ability as measured by the Logical Memory task.	No
	Approach 5 (partial correlation): A non-significant partial correlation showed no association between depression and recognition ability after controlling for motivation and impairment, as measured by the Logical Memory task.	No

Verbal Paired Associates Recognition	Approach 1 (Mann-Whitney U test): The difference between the groups did not reach significance. This indicated that depression did not impact on recognition as measured by the Verbal Paired Associates task. However, the range of scores on this task was limited and their distribution was skewed, which the authors attributed to a ceiling effect for this task and thus doubted the utility of the findings. They presumed that the level of difficulty and sensitivity of the task was too low to address the questions asked of their data. Due to these findings, ANCOVAs were not performed.	No
	Approach 4 (correlation): A non-significant correlation showed no association between depression and recognition ability as measured by the Verbal Paired Associates task. However, the range of scores on this task was limited and their distribution was skewed, which the authors attributed to a ceiling effect for this task and thus doubted the utility of the findings. They presumed that the level of difficulty and sensitivity of the task was too low to address the questions asked of their data. Due to these findings, partial correlations were not performed	No

Preece & Geffen (2007)

ANCOVAs compared recognition performance in the first 24 hours after injury between individuals who had pre-existing depression and those without pre-existing depression, as determined by reports of previous diagnosis and short form Depression Anxiety Scales (DASS).

Test	Details	Association with Depression
Hopkins Verbal Learning Test (HVLT) Delayed Recall	Individuals with depression performed significantly worse on the word recognition task than those without depression. The authors concluded that MTBI and depression interact to impair word recognition in the first 24 hours after injury.	Yes

Appendix 7: Impact of depression on learning

Visual representation of the 22 results

Study	Learning Condition	
	Visual Task	Verbal Task
Atteberry-Bennett et al (1986)		✓ ✓
Cicerone & Kalmar (1997)		T
Satz et al (1998)		× × × × × × ✓ ✓
Rapoport et al (2005)	T T	✓ T
Chamelian & Feinstein (2006)	✓	
Keiski et al (2007)		✓ ✓ ✓
Preece & Geffen (2007)		×
Rao et al (2010)	✓	×

× = Found no association between depression and memory performance
✓ = Found poorer performance in depression
T = Trend towards poorer performance in depression

Details of each of the 22 analyses organised by study

Atteberry-Bennett et al (1986)

Approach 1: Multiple regression analyses that included demographic variables were conducted with the depression measure and measures of memory and other cognitive functions.
Approach 2: Simple correlations were conducted between the memory measures and depression scores.

Test	Details	Association with Depression
The Selective Reminding Test Consistent Long Term Recall (CLTR) Learning	Approach 1 (multiple regression): Results indicated an association between depression and learning. Impairment was the most predictive of depression and scores on the learning measure made a significant unique contribution to the variance in BDI scores.	Yes
	Approach 2(correlation): There was a high negative correlation between scores on the learning measure and scores on the BDI. As CLTR scores decreased, depression increased.	Yes

Cicerone & Kalmar (1997)

In multivariate ANOVAs with other memory measures, scores on the learning measure were compared between a group of depressed individuals and a group of nondepressed individuals as determined by recorded clinical diagnosis and treatment.

Test	Details	Association with Depression
California Verbal Learning Test (CVLT) Learning	The difference between groups fell just below significance, indicating a trend for worse performance on one of the memory measures. Although post hoc analyses were not performed, inspection of CVLT scores indicated a trend for poorer learning capacity in the depression group.	T

Satz et al (1998)

Approach 1: This approach explored differences. The sample was split into three groups according to recovery/disability status and depression status. In Group 1 were individuals with moderate and severe disability with depression. In Group 2 there were individuals with moderate and severe disability without depression. In Group 3 there were individuals with good recovery and non-TBI individuals, both without depression. MANCOVAs were used, controlling for age and education.
Approach 2: This approach explored relationships. Two correlations were conducted, the first between the learning measure and the SCL90-R measure of depression; and the second between the learning measure and the NRS-13 measure of depression.
Approach 3: Multiple linear regression analyses were then computed with the SCL90-R, controlling for age, education and recovery/disability status to determine the unique effect of depression on learning (and 13 other variables). Criteria for statistical significance was set at $p<0.004$ to account for numerous analyses and reduce the likelihood of type-1 error.
The three approaches were used with two learning measures (RAVLT and Memory Word List).

Test	Details	Association with Depression
Rey Auditory Verbal Learning Test (RAVLT) Delayed Recall	Approach 1 (MANCOVAs): Analyses revealed a difference between the groups on the RAVLT learning measure that fell just below significance and therefore suggested that depression had not impacted on learning ability.	No
	Approach 2 (correlation with SCL90-R): The correlation did not reach significance and therefore suggested that there was no association between depression, as measured by the SCL90-R, and learning performance.	No
	Approach 2 (correlation with NRS-13): There was a significant negative correlation between learning scores and the NRS-13 indicating an association between depression and poorer performance. (However, age, education and recovery/disability status were not controlled for here)	Yes
	Approach 3 (Multiple regression with SCL90-R): Results showed no significant effects of depression on learning ability.	No
Memory Word List Learning	Approach 1 (MANCOVAs): Analyses revealed a significant difference between the groups on the learning measure. However, on closer inspection, Group 1 (depression group) and Group 2 had similar learning scores which were lower than those of Group 3. Therefore the difference was due to recovery/disability status and thus suggested that depression had not impacted on learning ability.	No
	Approach 2 (correlation with SCL90-R): The correlation did not reach significance and therefore suggested that there was no association between depression, as measured by the SCL90-R, and learning performance.	No
	Approach 2 (correlation with NRS-13): There was a significant negative correlation between learning scores and the NRS-13 indicating an association between depression and poorer performance. (However, age, education and recovery/disability status were not controlled for here)	Yes
	Approach 3 (Multiple regression with SCL90-R): Results showed significant effects of recovery/disability status on learning but no significant effects of depression on learning ability.	No

Rapoport et al (2005)

Approach 1: In analyses of variance, scores on two measures of learning were compared between a group of individuals with major depression and a group of individuals with no depression as determined by structured clinical interview. Criterion for statistical significance was set at $p \leq 0.006$ and for statistical trend at $p \leq 0.05$. Bonferroni corrections were used. Age and past history of depression were controlled for.
Approach 2: Percentile cut-offs were used to determine the percentage of the groups that would be considered impaired on each of the measures.

Test	Details	Association with Depression
California Verbal Learning Test (CVLT) Delayed Recall	Approach 1 (group comparisons): There was a significant difference between the groups, with worse performance in the major depression group. This indicated that major depression had affected learning capacity.	Yes
	Approach 2 (percentile cut-offs): There were statistical trends for those in the major depression group to be more likely impaired on the learning task.	T
Brief Visuospatial Memory Test (BVMT) Learning	Approach 1 (group comparisons): A statistical trend was revealed, with worse performance in the major depression group. This indicated that major depression might have affected learning capacity.	T
	Approach 2 (percentile cut-offs): There were statistical trends for those in the major depression group to be more likely impaired on the learning task.	T

Chamelian & Feinstein (2006)

Scores on the delayed recall measure were compared using MANCOVAs between a group of individuals with subjective cognitive complaints (determined by questions on the Rivermead Postconcussion Questionnaire) and a group who did not have subjective complaints. In the no complaints group there were no individuals with depression whereas 18.5% of the complaints group had depression as determined by structured clinical interview.

Test	Details	Association with Depression
Brief Visuospatial Memory Test (BVMT) Delayed Recall	Individuals in the subjective complaints group performed significantly worse on the measure of delayed memory in comparison to the group who did not have subjective complaints. The difference lost significance once depression was accounted for. The authors concluded that for most participants, their difficulties were linked to co-morbid depression, indicating a close association between their mood and performance.	Yes

Keiski et al (2007)

Approach 1: Using t-tests (or Mann Whitney U tests), performance was compared between individuals with high depression and low depression scores.
Approach 2: Using ANCOVAs, performance was compared between individuals with high depression and low depression scores, controlling for motivation (symptom validity test score). *This approach was not applied in the learning condition.*
Approach 3: Using ANCOVAs, performance was compared between individuals with high depression and low depression scores, controlling for degree of impairment (APR score). *This approach was not applied in the learning condition.*
Approach 4: A correlation was conducted between memory performance and depression.
Approach 5: A partial correlation was conducted between memory performance and depression, controlling for impairment and motivation.

Test	Details	Association with Depression
California Verbal Learning Test (CVLT)	Approach 1 (t-test): Individuals in the depressed group performed significantly worse than those in the nondepressed group. This indicated that depression impacted on learning.	Yes
	Approach 4 (correlation): On the first learning trial (immediate memory), there had been no association between CVLT scores and depression, however, a significant correlation showed that as depression increased, learning capacity decreased on the fifth learning trial. This revealed an association between depression and reduced learning capacity.	Yes
	Approach 5 (partial correlation): On the first learning trial (immediate memory), there had been no association between CVLT scores and depression, however, a significant partial correlation showed that as depression increased, learning capacity decreased on the fifth learning trial, even after controlling for impairment and motivation. This revealed an association between depression and reduced learning capacity.	Yes

Preece & Geffen (2007)

ANCOVAs compared learning performance in the first 24 hours after injury between individuals who had pre-existing depression and those without pre-existing depression, as determined by reports of previous diagnosis and short form Depression Anxiety Scales (DASS).

Test	Details	Association with Depression
Hopkins Verbal Learning Test (HVLT) Delayed Recall	Score differences between groups did not reach significance. MTBI and depression did not appear to interact to impair delayed recall in the first 24 hours after injury.	No

Rao et al (2010)

Using t-tests, differences on two measures of learning were explored between groups of individuals with and without depression. Criteria for statistical significance was set at $p \leq 0.05$ and statistical trend at $p \leq 0.10$.

Test	Details	Association with Depression
Brief Visuospatial memory Test (BVMT) Delayed Recall	Individuals with depression showed significantly poorer learning ability than those without depression.	Yes
Hopkins Verbal Learning Test (HVLT) Delayed Recall	Differences between the groups did not reach significance. This indicated that learning ability as measured by the HVLT in individuals with depression was equal to those without depression, suggesting that depression did not impact on learning ability in this (verbal, in contrast with the visual) task.	No

Appendix 8: Impact of depression on working memory

Visual representation of the 10 results

Study	Working Memory Condition
Cicerone & Kalmar (1997)	×
Sherman et al (2000)	× ×
Ruttan & Heinrichs (2003)	×
Rapoport et al (2005)	✓ ✓
Alfano (2006)	✓ ✓ ×
Chamelian & Feinstein (2006)	✓

× = Found no association between depression and memory performance
✓ = Found poorer performance in depression

Details of each of the 10 analyses organised by study

Cicerone & Kalmar (1997)

In multivariate ANOVAs with other memory measures, scores on the working memory measure were compared between a group of depressed individuals and a group of nondepressed individuals as determined by recorded clinical diagnosis and treatment.

Test	Details	Association with Depression
Digit Span Working Memory	The difference between groups fell just below significance. Post hoc analyses were not performed. Inspection of delayed recall scores showed that they were fairly similar, indicating that depression had not affected working memory.	No

Sherman et al (2000)

Approach 1: All neuropsychological data were converted to norm-based z-scores. z-score differences on one measure of working memory between the high-depression and low-depression groups were inspected.
Approach 2: To explore the clinical significance of group differences further, for each participant, a calculation was made of the percentage of neuropsychological tests on which they had impaired performance.

Test	Details	Association with Depression
Digit Span Working Memory	Approach 1 (z-score inspection): This revealed similar scores between the groups in working memory as measured by the Digit span task. From these similar scores, it could be assumed that the difference was not significant but the authors did not conduct analyses on this data to determine whether or not differences were statistically significant. However, they did highlight that from a clinical standpoint differences of less than half a z-score unit are minimal.	No
	Approach 2 (percentage impaired): Differences between the groups in the number of individuals with scores in the impaired range on the working memory task did not reach significance. Meaning that similar numbers of individuals in each of the depression groups had scores in the impaired range on the working memory task which would indicate no relationship between depression and working memory performance.	No

Sherman et al (2000)

This study conducted analyses using two different samples, but working memory was only assessed in sample 1.

Sample 1:

Depression was measured by the *Dysthymia* scale of the *MCMI-2*.
Hierarchical regression procedures were conducted with the working memory measure.

Test	Details	Association with Depression
Brown-Peterson Consonant Trigrams Working Memory	Dysthymia failed to make a significant contribution to the prediction of working memory performance, revealing no association between depression and working memory.	No

Rapoport et al (2005)

Approach 1: In analyses of variance, scores on the working memory measure were compared between a group of individuals with major depression and a group of individuals with no depression as determined by structured clinical interview. Criterion for statistical significance was set at $p \leq 0.006$ and for statistical trend at $p \leq 0.05$. Bonferroni corrections were used. Age and past history of depression were controlled for.
Approach 2: Percentile cut-offs were used to determine the percentage of the groups that would be considered impaired on the measure.

Test	Details	Association with Depression
WAIS Working Memory Task Working Memory	Approach 1 (group comparisons): There was a significant difference between the groups, with worse performance in the major depression group. This indicated that major depression had affected working memory.	Yes
	Approach 2 (percentile cut-offs): Significantly more participants with major depression were impaired on the working memory task.	Yes

Alfano (2006)

Correlations were conducted between memory performance (on two tasks) and depression scores (on three measures).

Test	Details	Association with Depression
Digit Span Working Memory	Depression Measure 1: A significant negative correlation with the CES-D revealed an association between depression and working memory. As depression scores increased, working memory ability decreased.	Yes
	Depression Measure 2: A significant negative correlation with the PAS revealed an association between depression and working memory. As depression scores increased, working memory ability decreased.	Yes
	Depression Measure 3: A non-significant result with the SCL90-R revealed no association between depression and delayed recall.	No

Chamelian & Feinstein (2006)

Scores on the working memory measure were compared using MANCOVAs between a group of individuals with subjective cognitive complaints (determined by questions on the Rivermead Postconcussion Questionnaire) and a group who did not have subjective complaints. In the no complaints group there were no individuals with depression whereas 18.5% of the complaints group had depression as determined by structured clinical interview.

Test	Details	Association with Depression
WAIS Working Memory Task Working Memory	Individuals in the subjective complaints group performed significantly worse on the measure of working memory in comparison to the group who did not have subjective complaints. The difference lost significance once depression was accounted for. The authors concluded that for most participants, their difficulties were therefore linked to co-morbid depression, indicating a close association between their mood and performance.	Yes

Appendix 9: Individual measures used and a visual representation of their results across the studies

Individual measures used and a visual representation of their results across the studies

Test	Immediate	Delayed	Recognition	Learning	Working Memory	Other
RCFT	×	× × × × ×				
Visual Reproduction		× × × × × × ×				
Logical Memory	✓ × ×	× × × × × × × × × × ✓ ✓ T	× × × × ×			
CVLT	× × ×	✓ ✓ ✓ ✓ ✓ ✓ T	✓ ✓ ✓ × × ×	✓ ✓ ✓ ✓ T T		
BVMT		× T		✓ ✓ T T		
Selective Reminding Test				✓ ✓		
HVLT		× × × × T	✓	× ×		
RAVLT	× × × ×	× × × ✓		× × × ✓		
VPA		× × × ✓ ✓	× ×			
Memory Word List				× × × ✓		
Digit Span					✓ ✓ × × × ×	
Brown-Peterson Consonant Trigrams					×	
WAIS WM measure					✓ ✓ ✓	
Babcock Story Recall						× ×

×= found no association between depression and memory performance
✓= found poorer performance in depression
T= found trend towards poorer performance in depression

Appendix 10: Common Cognitive Complaints Checklist (CCCC) (Jones, 2010)

Common Cognitive Complaints Checklist 25/07/2010 V2

Instructions: Below are some common lapses of attention and memory. Please read each item carefully and rate whether they have ever happened to you by ticking "Yes" or "No". If you ticked "No" please move straight on to the next item. If you have ticked "Yes" then please indicate how often this happens to you and the distress it causes when it occurs.

		Yes/No		Frequency					Distress				
		Yes	No	Less than weekly	Once a week	Several times a week	Once or twice a day	Several times a day	Not at all distressing	A Little distressing	Quite distressing	Very distressing	Extremely distressing
1	Find yourself unintentionally wearing mismatched socks or other apparel?												
2	Difficulty remembering the content of conversations and/ or meetings?												
3	I have upset/embarrassed people I care about because I can't stop myself saying what is on my mind												
4	Difficulty remembering what you intended to write?												
5	Lose track of a conversation because you lost concentration?												
6	You suddenly wonder whether you've used a word correctly?												
7	Do you have difficulty remembering directions to a new place?												
8	Find you confuse right and left when giving directions?												
9	Sometimes I only remember about things I have done when people tell me about them												
10	Not remembering simple directions that others give me												
11	Do you have difficulty remembering to arrive at appointments on time?												
12	Forget to pass on messages (e.g., phone messages)?												
13	Problems recognising people on the street who you have known for years?												
14	Forgetting something from the shops that you explicitly went to get												

		Yes/No			Frequency						Distress				
		Yes	No		Less than weekly	Once a week	Several times a week	Once or twice a day	Several times a day		Not at all distressing	A Little distressing	Quite distressing	Very distressing	Extremely distressing
15	Accidently forgetting to eat a meal?														
16	Absent mindedly mixed up the targets of your actions (pouring milk in the wrong container)?														
17	Difficulty remembering your train of thought as you are speaking?														
18	Leaving water taps on?														
19	Forgetting an essential phone number minutes after you have learnt it, e.g., for a taxi?														
20	Performing a routine activity twice by mistake (e.g. putting two lots of coffee into a cup)?														
21	Have difficulty remembering what work you had to do when you finally sit down to do it?														
22	I have trouble remembering large parts of my childhood														
23	Forget people's names even though you have rehearsed them?														
24	Knowing that you know someone but not able to recall any details														
25	Difficulty remembering important details about yourself e.g. date of birth														
26	Problems stopping myself doing something even though I know it will get me into trouble or offend people I care about														
27	Accidently forgetting to get money out of the bank, when that is what you set out to do?														
28	Forgetting where you chequebook is?														
29	My speech coming out jumbled so that other say I make no sense														
30	Can't remember the house I lived in as a child														

		Yes/No			Frequency						Distress				
		Yes	No		Less than weekly	Once a week	Several times a week	Once or twice a day	Several times a day		Not at all distressing	A Little distressing	Quite distressing	Very distressing	Extremely distressing
31	Difficulty doing anything without somebody prompting you														
32	Forget important dates like birthdays and anniversaries?														
33	Difficulty remembering the year or season														
34	Not able to cook a meal such that all of the ingredients are ready at the same time														
35	Go to the fridge to get one thing (e.g., milk) and take something else (e.g., juice).														
36	Forgetting that you need to get petrol for your car?														
37	Forgetting the plot of a television programme you watched recently?														
38	Do you have difficulty remembering how some words are spelt?														
39	You have problems following the plots of a television programme or a film?														
40	Forgetting how to spell something really simple like "and" or "then"?														
41	Forgetting what someone said half an hour ago														
42	Difficulty concentrating long enough to watch a 30 minute TV show from start to finish														
43	People say I'm like a scratched record because I repeat myself so much														
44	Forgetting to add detergent to the washing machine or dishwasher?														
45	Accidentally forgetting a grooming activity (brushing your hair, teeth or shaving)?														
46	Forgetting where I live														
47	Putting clothes on in the wrong order														
48	Find that you bump into things?														

		Yes/No			Frequency						Distress				
		Yes	No		Less than weekly	Once a week	Several times a week	Once or twice a day	Several times a day		Not at all distressing	A Little distressing	Quite distressing	Very distressing	Extremely distressing
49	Forgetting to do things someone has asked you to do?														
50	Minutes or hours pass by and I have know idea what I have not done														
51	Not being able to keep up with a conversation because you can't think quick enough														
52	Problems recognising people who you see of a regular basis														
53	Read through a paragraph and realised you have not taken it in?														
54	Difficulty remembering how use household appliances e.g., washing machine or microwave														
55	Not remembering to pay bills such that you receive final warning letters														
56	You go to phone, text or email someone but then forget what you were going to say?														
57	Forgetting to return credit cards to your wallet?														
58	Forget appointments?														
59	Forgetting appointments if no one reminded me														
60	Forgetting your place if you are interrupted while reading?														
61	You accidentally throw away the thing you wanted, and keep what you meant to throw away?														
62	Getting easily distracted from what you are doing and then forgetting to come back to it														
63	Drive to places on "autopilot" and not know why you went there														
64	Not being able to recall if you have visited a place on holiday?														

		Yes/No			Frequency						Distress				
		Yes	No		Less than weekly	Once a week	Several times a week	Once or twice a day	Several times a day		Not at all distressing	A Little distressing	Quite distressing	Very distressing	Extremely distressing
65	If you go to the shops with a list of items to purchase do you return without purchasing important items of the list														
66	Double book yourself when scheduling appointments?														
67	Do you forget if you have already eaten?														
68	I do thing and have no memory of what I have done														
69	Difficulty correcting mistakes after seeing them														
70	Gone to introduce a friend but forgotten their name?														
71	Forgetting how to spell my name														
72	Forgetting events within a short space of time e.g., the same hour?														
73	No memory of any of my schoolteachers														
74	Do you forget what you ate for breakfast (or another meal)?														
75	Getting lost on familiar routes														
76	Needing others to make decisions for me														
77	Don’t remember having done certain things even when people remind me of what happened														
78	Difficulty concentrating long enough to read a short magazine article in one sitting														
79	Watching a film twice without recognising that you have seen it before														
80	Accidentally forgetting to put an article of clothing on when you get dressed?														
81	Forgetting where you're sat in a cinema (for example, after going to the toilets)?														
82	Forgetting to take your wallet or purse with you when you leave the house?														

		Yes/No			Frequency						Distress				
		Yes	No		Less than weekly	Once a week	Several times a week	Once or twice a day	Several times a day		Not at all distressing	A Little distressing	Quite distressing	Very distressing	Extremely distressing
83	Missing a important part of a well known routine (i.e., forgetting to turn the cooker on when you are cooking)														
84	Not being able to remember phone numbers I should know														
85	Inability to find words for familiar everyday objects														
86	Forgetting to regularly perform chores such as laundry, cleaning, putting bins out?														
87	Unable to think of more than one way to complete a task when things go wrong														
88	Difficulty remembering information you have read (e.g., newspaper, magazine, book)?														
89	Difficulty noticing and correcting mistakes														
90	Finding yourself gazing into the fridge with no idea what you were initially looking for?														
91	Putting on clothing in the wrong order?														
92	Forgetting your pin number/ sort code, etc?														
93	Do you forget to extinguish matches and cigarettes?														
94	Begin one task and get distracted into doing something else?														
95	Mistaking one object for another (e.g., mistaking a toothbrush for a comb)														
96	Do you forget to regularly shop for food?														
97	Doing things in the wrong order (e.g., putting a teabag into the kettle)														
98	Do you forget to add all of the necessary ingredients in a recipe?														
99	I can be in the middle of something and have no idea what I was just doing														

		Yes/No			Frequency						Distress				
		Yes	No		Less than weekly	Once a week	Several times a week	Once or twice a day	Several times a day		Not at all distressing	A Little distressing	Quite distressing	Very distressing	Extremely distressing
100	Go back to check if you have done something or not (e.g., turning out lights, locking doors)?														
101	You forget where you put something like a newspaper or a book?														
102	Difficulty adding up numbers														
103	Forget passwords?														
104	Unable to remember simple everyday routes, e.g. to the post box, back to your house?														
105	Forgetting where your car is parked?														
106	Fail to notice signposts on the road?														
107	Do you have difficulty remembering faces of people you meet?														
108	You walk somewhere without paying attention to what you experience along the way?														
109	Go into a room to one thing (e.g.,brushmy teeth) and end up doing something else?														
110	Forgetting the entrance/ exit you have used in a store or shopping centre?														
111	Make mistakes because you are doing one thing but thinking about another?														
112	Not recalling the names of people to see on a regular basis														
113	Gone into a room to get something, got distracted, and left without it?														
114	Forgetting you've left items to soak in hot water when washing up?														
115	Not noticing I have upset other people until it is pointed out to me														
116	Do you have difficulty remembering to perform daily routines?														
117	Difficulty holding things in mind for a short time (e.g., remembering a														

		Yes/No			Frequency						Distress				
		Yes	No		Less than weekly	Once a week	Several times a week	Once or twice a day	Several times a day		Not at all distressing	A Little distressing	Quite distressing	Very distressing	Extremely distressing
	telephone number)														
118	Put something in a special place but forget where the special place is														
119	Getting confused if you are trying to concentrate when there is background noise														
120	You fail to see what you want on a supermarket stall (although it's there)?														
121	Forget to set your alarm?														
122	I talk to people on the phone and then call them back minutes latter without memory of the first call														
123	Difficulty speaking in complete sentences														
124	Find you can't quite remember something even though it is on the tip of your tongue?														
125	Can't remember important events in my life														
126	Forgetting to count change when paying for an item?														
127	Difficulty reaching for object without missing them or knocking them over														
128	Forget a person's name almost as soon as you've been told it for the first time?														
129	Problems following the plots of a television programme or a film														
130	Forgetting gifts you have given or received?														
131	Fail to see what you're looking for even though you're looking straight at it?														
132	Forgetting the content of telephone conversations?														
133	Do you forget to turn the stove off when you are done with it?														
134	You drop things because you forget you are holding them?														

		Yes/No			Frequency						Distress				
		Yes	No		Less than weekly	Once a week	Several times a week	Once or twice a day	Several times a day		Not at all distressing	A Little distressing	Quite distressing	Very distressing	Extremely distressing
135	Forget what you went to the supermarket to buy?														
136	Absent mindedly placed things in unintended locations (e.g., milk in a cupboard)?														

Appendix 11: Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983)

HADS

Please read each item and underline the reply which comes closest to how you have been feeling ***in the past week.***
Don't take too long over your replies; your immediate reaction to each item will probably be more accurate than a long thought out response.

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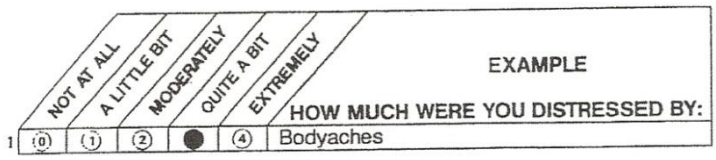
Appendix 12: Symptom Checklist – 90-R (SCL90-R) (Derogatis, 1994)

INSTRUCTIONS:

Below is a list of problems people sometimes have. Please read each one carefully, and blacken the circle that best describes HOW MUCH THAT PROBLEM HAS DISTRESSED OR BOTHERED YOU DURING THE PAST 7 DAYS INCLUDING TODAY. Blacken the circle for only one number for each problem and do not skip any items. If you change your mind, erase your first mark carefully. Read the example before beginning, and if you have any questions please ask about them.



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Copyright Protection

	NOT AT ALL	A LITTLE BIT	MODERATELY	QUITE A BIT	EXTREMELY	HOW MUCH WERE YOU DISTRESSED BY:
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Appendix 13: Mixed-neurological group sheets

a. Introductory Letter 1 (IL1)

b. Information Sheet 1 (IS1)

c. Consent Form 1 (CF1)

a. Introductory Letter 1 (IL1)

Dear **[patient's name]**,

My name is Karen Surridge and I am a Clinical Psychologist in Training on the University of Birmingham Doctoral training course (ClinPsyD). I am working closely with the Neuropsychology team at [redacted], to whom you have been referred.

It is my understanding that you are due to undergo some assessments at [redacted]

As part of the assessment process, patients are generally required to complete a series of tasks and answer questions.

I would like to take this opportunity to invite you to take part in some research. The research involves answering some additional questionnaires and does not affect your treatment in any way. This research is being carried out with the help of patients, like yourself, who have been referred to the neuropsychology service for assessment.

I would be grateful if you could read the information sheet enclosed and complete the consent form and questionnaires in the pack.

When you attend the hospital for your next appointment at the Neuropsychology Service, please take this pack with you and hand it to the clinician carrying out your assessment.

If you need help filling in the questionnaires, ask the clinician to help you when you attend for your appointment.

If you have any questions, please don't hesitate to contact your clinician at the Neuropsychology service. Alternatively, please see the contact details at the bottom of the information sheet enclosed.

Your help is very much appreciated.

Thanking you in anticipation,

Karen Surridge

b. Information Sheet 1 (IS1)

UNIVERSITY OF BIRMINGHAM

Validation of a measure of common cognitive complaints
INFORMATION SHEET

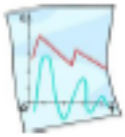
Researcher: Karen Surridge.
I am a Clinical Psychologist in Training and am carrying out research as part of my doctorate course. My research is based on common cognitive complaints.
"Cognitive complaints" means common, everyday mistakes that all people make as we communicate to each other and go about our daily lives. Some of these might be slips of memory or slips of attention like absent-mindedness.

What is the purpose of this research?
The purpose of this research is to find out about the range of these types of complaints in the general population. The purpose of the research is also to find out the range of these errors in the population referred to mental health services, and in the population referred to neuropsychology services.

Why have I been invited to take part?
You have been invited to take part because you are in one of the three populations mentioned above and so the information you can offer about your experience of everyday complaints will be very useful.

What will happen to me if I agree to take part?
If you take part, you will be asked to answer some questions about yourself. You will also be asked to complete 3 questionnaires. These questionnaires will ask you about your experience of common complaints, and about how you feel physically and emotionally. You will also be asked to read a list of words aloud. The process may take up to an hour.

What will happen if I want to stop taking part?
You do not have to carry on with the study. You are free to withdraw at any time during the process, without giving any reasons, and nothing will happen as a result.



What will happen to the results of the research study?
The general results will be written in a report. Only the general information gained from this research will be written up and may be published. Your name or any identifying details will not be attributed to any specific answers you give. You will not be identifiable by your answers.

What happens if I have any further concerns?
You are free to ask any questions at any time. If you are worried about anything, please let the researcher know.

To discuss any aspect of this research or to book an appointment time, please contact me at:

[redacted]

Or contact:
Dr Christopher Jones

[redacted]

Address:
School of Clinical Psychology
University of Birmingham
Edgbaston
Birmingham
B15 2TT

Patient Advice and Liaison Services:

[redacted]

29/05/2010 Version 2

c. Consent Form 1 (CF1)

UNIVERSITY OF BIRMINGHAM

CONSENT FORM

Pg1

Research site: [redacted]

Participant Identification Number:.....

Title of Project: Validation of a measure of common cognitive complaints.

Researcher: Karen Surridge

Please initial box

1. I confirm that I have understood the information sheet dated May 2010 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my care being affected. ☐
3. I understand that the data collected during this study will be looked at by the researcher and relevant others at the University of Birmingham to ensure that the analysis is a fair and reasonable representation of the data. Parts of the data may also be made available to relevant professionals if any previously undisclosed issues of risk to me are highlighted. ☐
4. I understand that the general information I provide may be published in any write-up of the data, but that my name will not be attributed to any specific answers and that I will not be identifiable by my answers. ☐
5. I am not currently participating in other research ☐
6. I agree to take part in the above study. ☐

.....	.....	.....
Name of participant	Date	Signature
.....	.....	.....
Name of researcher	Date	Signature

19/03/2010 Version 1

UNIVERSITY OF BIRMINGHAM

CONSENT FORM

Pg2

Participant Identification Number:.....

I am:

Male ☐ **Female** ☐

- I am aged between:

18-25 ☐ **26-33** ☐ **34-41** ☐ **42-49** ☐ **50-57** ☐ **58-65** ☐

- I am in contact with Mental Health Services

Yes ☐ **No** ☐

- I would like to be contacted and sent information with a summary of the general findings of the study

Yes ☐ **No** ☐

- If you answered yes to the previous question, please provide an address where you would like the information sent.

Address:

Appendix 14: Mental health group sheets – Method 1 (Advertising)

a. Method 1 Information Sheet 2 (IS2)

b. Method 1 Consent Form 2 (CF2)

a. Method 1 Information Sheet 2 (IS2)

UNIVERSITY OF BIRMINGHAM

Validation of a measure of common cognitive complaints
INFORMATION SHEET

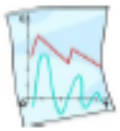
Researcher: Karen Surridge.
I am a Clinical Psychologist in Training and am carrying out research as part of my doctorate course. My research is based on common cognitive complaints.
"Cognitive complaints" means common, everyday mistakes that all people make as we communicate to each other and go about our daily lives. Some of these might be slips of memory or slips of attention like absent-mindedness.

What is the purpose of this research?
The purpose of this research is to find out about the range of these types of complaints in the general population. The purpose of the research is also to find out the range of these errors in the population referred to mental health services, and in the population referred to neuropsychology services.

Why have I been invited to take part?
You have been invited to take part because you are in one of the three populations mentioned above and so the information you can offer about your experience of everyday complaints will be very useful.

What will happen to me if I agree to take part?
If you take part, you will be asked to answer some questions about yourself. You will also be asked to complete 3 questionnaires. These questionnaires will ask you about your experience of common complaints, and about how you feel physically and emotionally. You will also be asked to read a list of words aloud. The process may take up to an hour.

What will happen if I want to stop taking part?
You do not have to carry on with the study. You are free to withdraw at any time during the process, without giving any reasons, and nothing will happen as a result.



What will happen to the results of the research study?
The general results will be written in a report. Only the general information gained from this research will be written up and may be published. Your name or any identifying details will not be attributed to any specific answers you give. You will not be identifiable by your answers.

What happens if I have any further concerns?
You are free to ask any questions at any time. If you are worried about anything, please let the researcher know.

To discuss any aspect of this research or to book an appointment time, please contact me at:

[redacted]

Or contact:
Dr Christopher Jones

[redacted]

Address:
School of Clinical Psychology
University of Birmingham
Edgbaston
Birmingham
B15 2TT

Patient Advice and Liaison Services:

[redacted]

29/05/2010 Version 2

b. Method 1 Consent Form 2 (CF2)

UNIVERSITY OF BIRMINGHAM

CONSENT FORM

Pg1

Research site: ..[redacted]

Participant Identification Number:.....

Title of Project: Validation of a measure of common cognitive complaints.

Researcher: Karen Surridge

Please initial box

1. I confirm that I have understood the information sheet dated May 2010 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my care being affected. ☐
3. I understand that the data collected during this study will be looked at by the researcher and relevant others at the University of Birmingham to ensure that the analysis is a fair and reasonable representation of the data. Parts of the data may also be made available to relevant professionals if any previously undisclosed issues of risk to me are highlighted. ☐
4. I understand that the general information I provide may be published in any write-up of the data, but that my name will not be attributed to any specific answers and that I will not be identifiable by my answers. ☐
5. I am not currently participating in other research ☐
6. I have never suffered a brain injury, experienced neurological symptoms or had a medical condition involving the brain e.g. epilepsy. ☐
7. I agree to take part in the above study. ☐

.....	.....	.....
Name of participant	Date	Signature
.....	.....	.....
Name of researcher	Date	Signature

19/03/2010 Version 1

UNIVERSITY OF BIRMINGHAM

CONSENT FORM

Pg2

Participant Identification Number:.....

- Please confirm diagnosis:

  ICD10: ☐ .....

  or

  DSM IV: ☐ .....

- I am:

Male ☐ **Female** ☐

- I am aged between:

18-25 ☐ **26-33** ☐ **34-41** ☐ **42-49** ☐ **50-57** ☐ **58-65** ☐

- I am in contact with Mental Health Services

Yes ☐ **No** ☐

- I would like to be contacted and sent information with a summary of the general findings of the study

Yes ☐ **No** ☐

- If you answered yes to the previous question, please provide an address where you would like the information sent.

  Address:

Appendix 15: Mental health group sheets – Method 2 (Introduction by mental health team and IAPT staff)

a. Method 2 Information Sheet 3 (IS3)

b. Method 2 Consent Form 2 (CF2)

a. Method 2 Information Sheet 3 (IS3)

UNIVERSITY OF BIRMINGHAM

Validation of a measure of common cognitive complaints INFORMATION SHEET

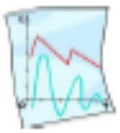
Researcher: Karen Surridge.
I am a Clinical Psychologist in Training and am carrying out research as part of my doctorate course. My research is based on common cognitive complaints.
"Cognitive complaints" means common, everyday mistakes that all people make as we communicate to each other and go about our daily lives. Some of these might be slips of memory or slips of attention like absent-mindedness.

What is the purpose of this research?
The purpose of this research is to find out about the range of these types of complaints in the general population. The purpose of the research is also to find out the range of these errors in the population referred to mental health services, and in the population referred to neuropsychology services.

Why have I been invited to take part?
You have been invited to take part because you are in one of the three populations mentioned above and so the information you can offer about your experience of everyday complaints will be very useful.

What will happen to me if I agree to take part?
If you take part, you will be asked to answer some questions about yourself. You will also be asked to complete 3 questionnaires. These questionnaires will ask you about your experience of common complaints, and about how you feel physically and emotionally. You will also be asked to read a list of words aloud. The process may take up to an hour.

What will happen if I want to stop taking part?
You do not have to carry on with the study. You are free to withdraw at any time during the process, without giving any reasons, and nothing will happen as a result.



What will happen to the results of the research study?
The general results will be written in a report. Only the general information gained from this research will be written up and may be published. Your name or any identifying details will not be attributed to any specific answers you give. You will not be identifiable by your answers.

What happens if I have any further concerns?
You are free to ask any questions at any time. If you are worried about anything, please let the researcher know.

To discuss any aspect of this research or to book an appointment time, please speak to your clinician, or contact me at: [redacted]

Or contact:
Dr Christopher Jones
[redacted]

Address:
School of Clinical Psychology
University of Birmingham
Edgbaston
Birmingham
B15 2TT

Patient Advice and Liaison Services:
[redacted]

29/05/2010 Version 2

b. Method 2 Consent Form 2 (CF2)

UNIVERSITY OF BIRMINGHAM

CONSENT FORM

Pg1

Research site: [redacted]

Participant Identification Number:.....

Title of Project: Validation of a measure of common cognitive complaints.

Researcher: Karen Surridge

Please initial box

1. I confirm that I have understood the information sheet dated May 2010 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my care being affected. ☐
3. I understand that the data collected during this study will be looked at by the researcher and relevant others at the University of Birmingham to ensure that the analysis is a fair and reasonable representation of the data. Parts of the data may also be made available to relevant professionals if any previously undisclosed issues of risk to me are highlighted. ☐
4. I understand that the general information I provide may be published in any write-up of the data, but that my name will not be attributed to any specific answers and that I will not be identifiable by my answers. ☐
5. I am not currently participating in other research ☐
6. I have never suffered a brain injury, experienced neurological symptoms or had a medical condition involving the brain e.g. epilepsy. ☐
7. I agree to take part in the above study. ☐

.....	.....	.....
Name of participant	Date	Signature
.....	.....	.....
Name of researcher	Date	Signature

UNIVERSITY OF BIRMINGHAM

CONSENT FORM

Pg2

Participant Identification Number:.....

- Please confirm diagnosis:

  ICD10: ☐ .....

  or

  DSM IV: ☐ .....

- I am:

Male ☐ **Female** ☐

- I am aged between:

18-25 ☐ **26-33** ☐ **34-41** ☐ **42-49** ☐ **50-57** ☐ **58-65** ☐

- I am in contact with Mental Health Services

Yes ☐ **No** ☐

- I would like to be contacted and sent information with a summary of the general findings of the study

Yes ☐ **No** ☐

- If you answered yes to the previous question, please provide an address where you would like the information sent.

  Address:

Appendix 16: Mental health group sheets – Method 3 (Postal survey)

a. Method 3 Introductory Letter (IL2)

b. Method 3 Information Sheet 4 (IS4)

c. Method 3 Consent Form 3 (CF3)

a. Method 3 Introductory Letter (IL2)

[redacted]

Dear [redacted] Service-User,

Our records show that you attend for appointments at [redacted]

We would like to take this opportunity to invite you to take part in some research.

The research involves filling in some questionnaires.
It does not affect your treatment in any way.
This research is being carried out with the help of clients, like yourself, who attend [redacted]

We would be grateful if you could read the information sheet enclosed and consider taking part.

Karen Surridge is carrying out the research. She is an employee of [redacted] and she works closely with [redacted] She is also a Clinical Psychologist in Training on the University of Birmingham Doctoral training course (ClinPsyD).

If you have any questions about this research, please see the contact details at the bottom of the information sheet enclosed or speak to your clinician.

Karen understands that the questionnaires can look a little daunting, but she is willing to go and fill them in with you if you would like her help. If you would like Karen's help, please contact her to make an appointment.

Your help is very much appreciated.

Thanking you in anticipation,

[redacted]

[redacted]

b. Method 3 Information Sheet 4 (IS4)

UNIVERSITY OF BIRMINGHAM

Validation of a measure of common cognitive complaints INFORMATION SHEET

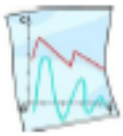
Researcher: Karen Surridge.
I am a Clinical Psychologist in Training and am carrying out research as part of my doctorate course. My research is based on common cognitive complaints.
"Cognitive complaints" means common, everyday mistakes that all people make as we communicate to each other and go about our daily lives. Some of these might be slips of memory or slips of attention like absent-mindedness.

What is the purpose of this research?
The purpose of this research is to find out about the range of these types of complaints in the general population. The purpose of the research is also to find out the range of these errors in the population referred to mental health services, and in the population referred to neuropsychology services.

Why have I been invited to take part?
You have been invited to take part because you are in one of the three populations mentioned above and so the information you can offer about your experience of everyday complaints will be very useful.

What will happen to me if I agree to take part?
If you take part, you will be asked to answer some questions about yourself. You will also be asked to complete 3 questionnaires. These questionnaires will ask you about your experience of common complaints, and about how you feel physically and emotionally. The process may take up to an hour. When you have finished, please post your consent form and questionnaires back to us in the envelope provided.

What will happen if I want to stop taking part?
You do not have to carry on with the study. You are free to withdraw at any time during the process, without giving any reasons, and nothing will happen as a result.



What will happen to the results of the research study?
The general results will be written in a report. Only the general information gained from this research will be written up and may be published. Your name or any identifying details will not be attributed to any specific answers you give. You will not be identifiable by your answers.

What happens if I have any further concerns?
You are free to ask any questions at any time. If you are worried about anything, please let the researcher or your clinician know.

To discuss any aspect of this research please contact me at:
[redacted]

Or contact:
Dr Christopher Jones
[redacted]

Address:
School of Clinical Psychology
University of Birmingham
Edgbaston
Birmingham
B15 2TT

Patient Advice and Liaison Services:
[redacted]

02/12/2011 Version 3

c. Method 3 Consent Form 3 (CF3)

UNIVERSITY OF BIRMINGHAM

CONSENT FORM

Pg1

Research site: ..[redacted].....

Title of Project: Validation of a measure of common cognitive complaints.

Researcher: Karen Surridge

Please initial box

1. I confirm that I have understood the information sheet dated December 2011 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my care being affected. ☐
3. I understand that the data collected during this study will be looked at by the researcher and relevant others at the University of Birmingham to ensure that the analysis is a fair and reasonable representation of the data. Parts of the data may also be made available to relevant professionals if any previously undisclosed issues of risk to me are highlighted. ☐
4. I understand that the general information I provide may be published in any write-up of the data, but that my name will not be attributed to any specific answers and that I will not be identifiable by my answers. ☐
5. I am not currently participating in other research ☐
6. I have never suffered a brain injury, experienced neurological symptoms or had a medical condition involving the brain e.g. epilepsy. ☐
7. I agree to take part in the above study. ☐

.....	.....	.....
Full Name of participant	Date	Signature

02/12/2011 Version 2

UNIVERSITY OF BIRMINGHAM

CONSENT FORM

Pg2

I am:
Male ☐ Female ☐

My date of Birth is:.....

I am currently employed as:.....
(If you are currently unemployed, please state your previous employment)
(Please state if you are currently a student and your level of study)

Please state the number of years of education you received:
(For example: ages 5 to 16 = 11years) ☐ Years

Any additional information:.....

Please state your highest level of education:
(For example: GCSE) .....

Any additional information:.....

- I would like to be contacted and sent information with a summary of the general findings of the study

  Yes ☐ No ☐

- If you answered yes to the previous question, please provide an address where you would like the information sent. (email is also acceptable)

  Address:

Appendix 17: Ethical approval

a. Initial approval

b. Approval following substantial amendments (application for postal survey method)

Appendix 18: Base-rate data (Endorsement of each of the CCCC items within the non-clinical group)

Cumulative Frequency of Item Endorsement for the Non-Clinical Group

	No	**Yes, Less than weekly (or more)**	**Yes, Once a week (or more)**	**Yes, Several times a week (or more)**	**Yes, Once or twice a day (or more)**	**Yes, Several times a day (or more)**
	% calculated on total number of participants (n=74)					
CCCC Frequency Question 53: Read through a paragraph and realised you have not taken it in	10 (13.51%)	64 (86.49%)	39 (52.70%)	24 (32.43%)	8 (10.81%)	2 (2.70%)
CCCC Frequency Question 94: Begin one task and get distracted into doing something else	12 (16.22%)	62 (83.78%)	28 (37.84%)	8 (10.81%)	2 (2.70%)	1 (1.35%)
CCCC Frequency Question 100: Go back to check if you have done something or not (e.g., turning out lights, locking doors)	19 (25.68%)	55 (74.32%)	32 (43.24%)	17 (22.97%)	7 (9.46%)	0 (0.00%)
CCCC Frequency Question 124: Find you can't quite remember something even though it is on the tip of your tongue	20 (27.03%)	54 (72.97%)	16 (21.62%)	7 (9.46%)	4 (5.41%)	1 (1.35%)
CCCC Frequency Question 113: Gone into a room to get something, got distracted, and left without it	22 (29.73%)	52 (70.27%)	18 (24.32%)	8 (10.81%)	3 (4.05%)	1 (1.35%)
CCCC Frequency Question 108: You walk somewhere without paying attention to what you experience along the way	26 (35.14%)	48 (64.86%)	30 (40.54%)	21 (28.38%)	4 (5.41%)	0 (0.00%)
CCCC Frequency Question 118: Put something in a special place but forget where the special place is	26 (35.14%)	48 (64.86%)	12 (16.22%)	6 (8.11%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 49: Forgetting to do things someone has asked you to do	28 (37.84%)	46 (62.16%)	19 (25.68%)	8 (10.81%)	3 (4.05%)	0 (0.00%)
CCCC Frequency Question 5: Lose track of a conversation because you lost concentration	29 (39.19%)	45 (60.81%)	26 (35.14%)	13 (17.57%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 103: Forget passwords	30 (40.54%)	44 (59.46%)	17 (22.97%)	9 (12.16%)	2 (2.70%)	1 (1.35%)
CCCC Frequency Question 111: Make mistakes because you are doing one thing but thinking about	30 (40.54%)	44 (59.46%)	19 (25.68%)	9 (12.16%)	4 (5.41%)	1 (1.35%)

	No	Yes, Less than weekly (or more)	Yes, Once a week (or more)	Yes, Several times a week (or more)	Yes, Once or twice a day (or more)	Yes, Several times a day (or more)
	% calculated on total number of participants (n=74)					
another						
CCCC Frequency Question 12: Forget to pass on messages (e.g., phone messages)	31 (41.89%)	43 (58.11%)	11 (14.86%)	6 (8.11%)	3 (4.05%)	1 (1.35%)
CCCC Frequency Question 101: You forget where you have put something like a newspaper or a book	32 (43.24%)	42 (56.76%)	15 (20.27%)	7 (9.46%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 109: Go into a room to do one thing (e.g., brush my teeth) and end up doing something else	32 (43.24%)	42 (56.76%)	22 (29.73%)	8 (10.81%)	4 (5.41%)	1 (1.35%)
CCCC Frequency Question 119: Getting confused if you are trying to concentrate when there is background noise	32 (43.24%)	42 (56.76%)	27 (36.49%)	12 (16.22%)	3 (4.05%)	2 (2.70%)
CCCC Frequency Question 7: Do you have difficulty remembering directions to a new place	33 (44.59%)	41 (55.41%)	16 (21.62%)	5 (6.76%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 4: Difficulty remembering what you intended to write	35 (47.30%)	39 (52.70%)	17 (22.97%)	6 (8.11%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 17: Difficulty remembering your train of thought as you are speaking	35 (47.30%)	39 (52.70%)	17 (22.97%)	9 (12.16%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 90: Finding yourself gazing into the fridge with no idea what you were initially looking for	37 (50.00%)	37 (50.00%)	20 (27.03%)	9 (12.16%)	3 (4.05%)	1 (1.35%)
CCCC Frequency Question 82: Forgetting to take your wallet or purse with you when you leave the house	38 (51.35%)	36 (48.65%)	5 (6.76%)	2 (2.70%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 2:Difficulty remembering the content of conversations and/ or meetings	40 (54.05%)	34 (45.95%)	18 (24.32%)	7 (9.46%)	1 (1.35%)	0 (0.00%)

	No	Yes, Less than weekly (or more)	Yes, Once a week (or more)	Yes, Several times a week (or more)	Yes, Once or twice a day (or more)	Yes, Several times a day (or more)
	% calculated on total number of participants (n=74)					
CCCC Frequency Question 38: Do you have difficulty remembering how some words are spelt	40 (54.05%)	34 (45.95%)	15 (20.27%)	6 (8.11%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 6: You suddenly wonder whether you've used a word correctly	43 (58.11%)	31 (41.89%)	11 (14.86%)	6 (8.11%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 8: Find you confuse right and left when giving directions	43 (58.11%)	31 (41.89%)	11 (14.86%)	6 (8.11%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 14: Forgetting something from the shops that you explicitly went to get	44 (59.46%)	30 (40.54%)	10 (13.51%)	3 (4.05%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 60: Forgetting your place if you are interrupted while reading	46 (62.16%)	28 (37.84%)	13 (17.57%)	8 (10.81%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 62: Getting easily distracted from what you are doing and then forgetting to come back to it	46 (62.16%)	28 (37.84%)	11 (14.86%)	5 (6.76%)	3 (4.05%)	0 (0.00%)
CCCC Frequency Question 24: Knowing that you know someone but not able to recall any details	47 (63.51%)	27 (36.49%)	7 (9.46%)	4 (5.41%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 35: Go to the fridge to get one thing (e.g., milk) and take something else (e.g., juice)	48 (64.86%)	26 (35.14%)	15 (20.27%)	10 (13.51%)	2 (2.70%)	1 (1.35%)
CCCC Frequency Question 41: Forgetting what someone said half an hour ago	48 (64.86%)	26 (35.14%)	11 (14.86%)	6 (8.11%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 128: Forget a person's name almost as soon as you've been told it for the first time	48 (64.86%)	26 (35.14%)	10 (13.51%)	6 (8.11%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 131: Fail to see what you're looking for even though you're looking straight at it	48 (64.86%)	26 (35.14%)	8 (10.81%)	6 (8.11%)	1 (1.35%)	1 (1.35%)

	No	Yes, Less than weekly (or more)	Yes, Once a week (or more)	Yes, Several times a week (or more)	Yes, Once or twice a day (or more)	Yes, Several times a day (or more)
	% calculated on total number of participants (n=74)					
CCCC Frequency Question 19: Forgetting an essential phone number minutes after you have learnt it, e.g., for a taxi	49 (66.22%)	25 (33.78%)	10 (13.51%)	5 (6.76%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 56: You go to phone, text or email someone but then forget what you were going to say	49 (66.22%)	25 (33.78%)	14 (18.92%)	8 (10.81%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 88: Difficulty remembering information you have read (e.g., newspaper, magazine, book)	49 (66.22%)	25 (33.78%)	18 (24.32%)	12 (16.22%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 9: Sometimes I only remember about things I have done when people tell me about them	50 (67.57%)	24 (32.43%)	10 (13.51%)	3 (4.05%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 10: Not remembering simple directions that others give me	50 (67.57%)	24 (32.43%)	8 (10.81%)	4 (5.41%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 32: Forget important dates like birthdays and anniversaries	50 (67.57%)	24 (32.43%)	5 (6.76%)	3 (4.05%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 48: Find that you bump into things	50 (67.57%)	24 (32.43%)	12 (16.22%)	8 (10.81%)	3 (4.05%)	0 (0.00%)
CCCC Frequency Question 70: Gone to introduce a friend but forgotten their name	50 (67.57%)	24 (32.43%)	5 (6.76%)	3 (4.05%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 105: Forgetting where your car is parked	50 (67.57%)	24 (32.43%)	7 (9.46%)	3 (4.05%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 120: You fail to see what you want on a supermarket stall (although it's there)	51 (68.92%)	23 (31.08%)	8 (10.81%)	4 (5.41%)	1 (1.35%)	1 (1.35%)
CCCC Frequency Question 16: Absent mindedly mixed up the targets of your actions (pouring milk in the wrong container)	52 (70.27%)	22 (29.73%)	6 (8.11%)	4 (5.41%)	0 (0.00%)	0 (0.00%)

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CCCC Frequency Question 61: You accidentally throw away the thing you wanted, and keep what you meant to throw away	52 (70.27%)	22 (29.73%)	5 (6.76%)	3 (4.05%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 3: I have upset/embarrassed people I care about because I can't stop myself saying what is on my mind	53 (71.62%)	21 (28.38%)	6 (8.11%)	1 (1.35%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 22: I have trouble remembering large parts of my childhood	53 (71.62%)	21 (28.38%)	7 (9.46%)	4 (5.41%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 28: Forgetting where you chequebook is	53 (71.62%)	21 (28.38%)	5 (6.76%)	2 (2.70%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 37: Forgetting the plot of a television programme you watched recently	53 (71.62%)	21 (28.38%)	11 (14.86%)	4 (5.41%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 81: Forgetting where you're sat in a cinema (for example, after going to the toilets)	53 (71.62%)	21 (28.38%)	4 (5.41%)	3 (4.05%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 84: Not being able to remember phone numbers I should know	53 (71.62%)	21 (28.38%)	14 (18.92%)	6 (8.11%)	2 (2.70%)	2 (2.70%)
CCCC Frequency Question 92: Forgetting your pin number/ sort code, etc	53 (71.62%)	21 (28.38%)	8 (10.81%)	4 (5.41%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 135: Forget what you went to the supermarket to buy?	53 (71.62%)	21 (28.38%)	7 (9.46%)	3 (4.05%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 136: Absent mindedly placed things in unintended locations (e.g., milk in a cupboard)	53 (71.62%)	21 (28.38%)	6 (8.11%)	5 (6.76%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 29: My speech coming out jumbled so that other say I make no sense	54 (72.97%)	20 (27.03%)	13 (17.57%)	3 (4.05%)	1 (1.35%)	1 (1.35%)

	No	Yes, Less than weekly (or more)	Yes, Once a week (or more)	Yes, Several times a week (or more)	Yes, Once or twice a day (or more)	Yes, Several times a day (or more)
	% calculated on total number of participants (n=74)					
CCCC Frequency Question 65: If you go to the shops with a list of item to purchase do you return without purchasing important items of the list	54 (72.97%)	20 (27.03%)	6 (8.11%)	2 (2.70%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 76: Needing others to make decisions for me	54 (72.97%)	20 (27.03%)	15 (20.27%)	10 (13.51%)	3 (4.05%)	2 (2.70%)
CCCC Frequency Question 34: Not able to cook a meal such that all of the ingredients are ready at the same time	55 (74.32%)	19 (25.68%)	12 (16.22%)	6 (8.11%)	1 (1.35%)	1 (1.35%)
CCCC Frequency Question 63: Drive to places on "autopilot" and not know why you went there	55 (74.32%)	19 (25.68%)	10 (13.51%)	5 (6.76%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 106: Fail to notice signposts on the road	55 (74.32%)	19 (25.68%)	7 (9.46%)	5 (6.76%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 133:Do you forget to turn the stove off when you are done with it	55 (74.32%)	19 (25.68%)	6 (8.11%)	3 (4.05%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 21: Have difficulty remembering what work you had to do when you finally sit down to do it	56 (75.68%)	18 (24.32%)	8 (10.81%)	4 (5.41%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 102: Difficulty adding up numbers	56 (75.68%)	18 (24.32%)	13 (17.57%)	6 (8.11%)	3 (4.05%)	0 (0.00%)
CCCC Frequency Question 130: Forgetting gifts you have given or received	56 (75.68%)	18 (24.32%)	4 (5.41%)	2 (2.70%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 1:Find yourself unintentionally wearing mismatched socks or other apparel	57 (77.03%)	17 (22.97%)	8 (10.81%)	5 (6.76%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 89: Difficulty noticing and correcting mistakes	57 (77.03%)	17 (22.97%)	10 (13.51%)	6 (8.11%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 36: Forgetting that you need to get petrol for your car	58 (78.38%)	16 (21.62%)	5 (6.76%)	2 (2.70%)	0 (0.00%)	0 (0.00%)

	No	Yes, Less than weekly (or more)	Yes, Once a week (or more)	Yes, Several times a week (or more)	Yes, Once or twice a day (or more)	Yes, Several times a day (or more)
	% calculated on total number of participants (n=74)					
CCCC Frequency Question 77: Don't remember having done certain things even when people remind me of what happened	58 (78.38%)	16 (21.62%)	4 (5.41%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 99: I can be in the middle of something and have no idea what I was just doing	58 (78.38%)	16 (21.62%)	11 (14.86%)	4 (5.41%)	2 (2.70%)	1 (1.35%)
CCCC Frequency Question 126: Forgetting to count change when paying for an item	58 (78.38%)	16 (21.62%)	10 (13.51%)	5 (6.76%)	3 (4.05%)	0 (0.00%)
CCCC Frequency Question 23: Forget people's names even though you have rehearsed them	59 (79.73%)	15 (20.27%)	6 (8.11%)	2 (2.70%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 27: Acidently forgetting to get money out of the bank, when that is what you set out to do	59 (79.73%)	15 (20.27%)	5 (6.76%)	2 (2.70%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 57: Forgetting to return credit cards to your wallet	59 (79.73%)	15 (20.27%)	7 (9.46%)	2 (2.70%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 59: Forgetting appointments if no one reminded me	59 (79.73%)	15 (20.27%)	8 (10.81%)	4 (5.41%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 78:Difficulty concentrating long enough to read a short magazine article in one sitting	59 (79.73%)	15 (20.27%)	11 (14.86%)	3 (4.05%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 117: Difficulty holding thing in mind for a short time (e.g., remembering a telephone	59 (79.73%)	15 (20.27%)	11 (14.86%)	6 (8.11%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 121: Forget to set your alarm	59 (79.73%)	15 (20.27%)	4 (5.41%)	2 (2.70%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 26: Problems stopping myself doing something even though I know it will get me into trouble or offend people I care about	60 (81.08%)	14 (18.92%)	4 (5.41%)	3 (4.05%)	1 (1.35%)	0 (0.00%)

	No	Yes, Less than weekly (or more)	Yes, Once a week (or more)	Yes, Several times a week (or more)	Yes, Once or twice a day (or more)	Yes, Several times a day (or more)
	% calculated on total number of participants (n=74)					
CCCC Frequency Question 110: Forgetting the entrance/ exit you have used in a store or shopping centre	60 (81.08%)	14 (18.92%)	6 (8.11%)	2 (2.70%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 129: Problems following the plots of a television programme or a film	60 (81.08%)	14 (18.92%)	7 (9.46%)	5 (6.76%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 20: Performing a routine activity twice by mistake (e.g. putting two lots of coffee into a cup)	61 (82.43%)	13 (17.57%)	6 (8.11%)	2 (2.70%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 39: You have problems following the plots of a television programme or a film	61 (82.43%)	13 (17.57%)	6 (8.11%)	4 (5.41%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 50: Minutes or hours pass by and I have know idea what I have not done	61 (82.43%)	13 (17.57%)	9 (12.16%)	4 (5.41%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 58: Forget appointments	61 (82.43%)	13 (17.57%)	8 (10.81%)	5 (6.76%)	3 (4.05%)	0 (0.00%)
CCCC Frequency Question 66: Double book yourself when scheduling appointments	61 (82.43%)	13 (17.57%)	7 (9.46%)	5 (6.76%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 75: Getting lost on familiar routes	61 (82.43%)	13 (17.57%)	5 (6.76%)	4 (5.41%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 51: Not being able to keep up with a conversation because you can't think quick enough	62 (83.78%)	12 (16.22%)	10 (13.51%)	8 (10.81%)	4 (5.41%)	0 (0.00%)
CCCC Frequency Question 114: Forgetting that you've left items to soak in hot water when washing up	62 (83.78%)	12 (16.22%)	7 (9.46%)	2 (2.70%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 11: Do you have difficulty remembering to arrive at appointments on time	63 (85.14%)	11 (14.86%)	7 (9.46%)	3 (4.05%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 43: People say I'm like a scratched record because I repeat myself so much	63 (85.14%)	11 (14.86%)	8 (10.81%)	5 (6.76%)	3 (4.05%)	0 (0.00%)

	No	Yes, Less than weekly (or more)	Yes, Once a week (or more)	Yes, Several times a week (or more)	Yes, Once or twice a day (or more)	Yes, Several times a day (or more)
	% calculated on total number of participants (n=74)					
CCCC Frequency Question 72: Forgetting events within a short space of time e.g., the same hour	63 (85.14%)	11 (14.86%)	6 (8.11%)	5 (6.76%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 86: Forgetting to regularly perform chores such as laundry, cleaning, putting bins out	63 (85.14%)	11 (14.86%)	5 (6.76%)	2 (2.70%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 98: Do you forget to add all of the necessary ingredients in a recipe	63 (85.14%)	11 (14.86%)	9 (12.16%)	4 (5.41%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 87: Unable to think of more than one way to complete a task when things go wrong	64 (86.49%)	10 (13.51%)	7 (9.46%)	2 (2.70%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 97: Doing things in the wrong order (e.g., putting a teabag into the kettle)	64 (86.49%)	10 (13.51%)	6 (8.11%)	2 (2.70%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 55: Not remembering to pay bills such that you receive final warning letters	65 (87.84%)	9 (12.16%)	4 (5.41%)	3 (4.05%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 69: Difficulty correcting mistakes after seeing them	65 (87.84%)	9 (12.16%)	6 (8.11%)	2 (2.70%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 83: Missing a important part of a well known routine (i.e., forgetting to turn the cooker on when you are cooking)	65 (87.84%)	9 (12.16%)	6 (8.11%)	2 (2.70%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 85: Inability to find words for familiar everyday objects	65 (87.84%)	9 (12.16%)	3 (4.05%)	2 (2.70%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 107: Do you have difficulty remembering faces of people you meet	65 (87.84%)	9 (12.16%)	5 (6.76%)	2 (2.70%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 132: Forgetting the content of telephone conversations	65 (87.84%)	9 (12.16%)	6 (8.11%)	2 (2.70%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 134: You drop things because you forget you are holding them	65 (87.84%)	9 (12.16%)	3 (4.05%)	3 (4.05%)	1 (1.35%)	0 (0.00%)

	No	Yes, Less than weekly (or more)	Yes, Once a week (or more)	Yes, Several times a week (or more)	Yes, Once or twice a day (or more)	Yes, Several times a day (or more)
	% calculated on total number of participants (n=74)					
CCCC Frequency Question 13: Problems recognising people on the street who you have known for years	66 (89.19%)	8 (10.81%)	2 (2.70%)	1 (1.35%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 31: Difficulty doing anything without somebody prompting you	66 (89.19%)	8 (10.81%)	6 (8.11%)	5 (6.76%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 40: Forgetting how to spell something really simple like and or then	66 (89.19%)	8 (10.81%)	5 (6.76%)	4 (5.41%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 45: Accidentally forgetting a grooming activity (brushing your hair, teeth or shaving)	66 (89.19%)	8 (10.81%)	5 (6.76%)	3 (4.05%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 68: I do thing and have no memory of what I have done	66 (89.19%)	8 (10.81%)	5 (6.76%)	3 (4.05%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 74: Do you forget what you ate for breakfast (or another meal)	66 (89.19%)	8 (10.81%)	4 (5.41%)	3 (4.05%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 115: Not noticing I have upset other people until it is pointed out to me	66 (89.19%)	8 (10.81%)	4 (5.41%)	2 (2.70%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 18: Leaving water taps on	67 (90.54%)	7 (9.46%)	4 (5.41%)	3 (4.05%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 44: Forgetting to add detergent to the washing machine or dishwasher	67 (90.54%)	7 (9.46%)	5 (6.76%)	2 (2.70%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 80: Accidentally forgetting to put an article of clothing on when you get dressed	67 (90.54%)	7 (9.46%)	4 (5.41%)	1 (1.35%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 15: Accidently forgetting to eat a meal	68 (91.89%)	6 (8.11%)	5 (6.76%)	3 (4.05%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 42: Difficulty concentrating long enough to watch a 30 minute TV show from start to finish	68 (91.89%)	6 (8.11%)	5 (6.76%)	4 (5.41%)	0 (0.00%)	0 (0.00%)

	No	Yes, Less than weekly (or more)	Yes, Once a week (or more)	Yes, Several times a week (or more)	Yes, Once or twice a day (or more)	Yes, Several times a day (or more)
	% calculated on total number of participants (n=74)					
CCCC Frequency Question 47: Putting clothes on in the wrong order	68 (91.89%)	6 (8.11%)	3 (4.05%)	3 (4.05%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 64: Not being able to recall if you have visited a place on holiday	68 (91.89%)	6 (8.11%)	2 (2.70%)	2 (2.70%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 79: Watching a film twice without recognising that you have seen it before	68 (91.89%)	6 (8.11%)	4 (5.41%)	1 (1.35%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 30: Can't remember the house I lived in as a child	69 (93.24%)	5 (6.76%)	3 (4.05%)	2 (2.70%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 54: Difficulty remembering how use household appliances e.g., washing machine or microwave	69 (93.24%)	5 (6.76%)	3 (4.05%)	2 (2.70%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 73: No memory of any of my schoolteachers	69 (93.24%)	5 (6.76%)	3 (4.05%)	1 (1.35%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 91: Putting on clothing in the wrong order	69 (93.24%)	5 (6.76%)	4 (5.41%)	2 (2.70%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 96: Do you forget to regularly shop for food	69 (93.24%)	5 (6.76%)	3 (4.05%)	3 (4.05%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 104: Unable to remember simple everyday routes, e.g. to the post box, back to your house	69 (93.24%)	5 (6.76%)	2 (2.70%)	1 (1.35%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 123: Difficulty speaking in complete sentences	69 (93.24%)	5 (6.76%)	3 (4.05%)	1 (1.35%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 33: Difficulty remembering the year or season	70 (94.59%)	4 (5.41%)	2 (2.70%)	2 (2.70%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 71: Forgetting how to spell my name	70 (94.59%)	4 (5.41%)	3 (4.05%)	3 (4.05%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 112: Not recalling the names of people to see on a regular basis	70 (94.59%)	4 (5.41%)	2 (2.70%)	1 (1.35%)	0 (0.00%)	0 (0.00%)

	No	Yes, Less than weekly (or more)	Yes, Once a week (or more)	Yes, Several times a week (or more)	Yes, Once or twice a day (or more)	Yes, Several times a day (or more)
	% calculated on total number of participants (n=74)					
CCCC Frequency Question 116: Do you have difficulty remembering to perform daily routines	70 (94.59%)	4 (5.41%)	3 (4.05%)	1 (1.35%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 125: Can't remember important events in my life	70 (94.59%)	4 (5.41%)	2 (2.70%)	1 (1.35%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 127: Difficulty reaching for object without missing them or knocking them over	70 (94.59%)	4 (5.41%)	2 (2.70%)	1 (1.35%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 25:Difficulty remembering important details about yourself e.g. date of birth	71 (95.95%)	3 (4.05%)	3 (4.05%)	1 (1.35%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 52: Problems recognising people who you see of a regular basis	71 (95.95%)	3 (4.05%)	3 (4.05%)	2 (2.70%)	1 (1.35%)	0 (0.00%)
CCCC Frequency Question 67: Do you forget if you have already eaten	71 (95.95%)	3 (4.05%)	2 (2.70%)	2 (2.70%)	2 (2.70%)	0 (0.00%)
CCCC Frequency Question 93: Do you forget to extinguish matches and cigarettes	71 (95.95%)	3 (4.05%)	3 (4.05%)	1 (1.35%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 95: Mistaking one object for another (e.g., mistaking a toothbrush for a comb)	71 (95.95%)	3 (4.05%)	2 (2.70%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
CCCC Frequency Question 46: Forgetting where I live	72 (97.30%)	2 (2.70%)	2 (2.70%)	1 (1.35%)	1 (1.35%)	1 (1.35%)
CCCC Frequency Question 122: I talk to people on the phone and then call them back minutes latter without memory of the first call	72 (97.30%)	2 (2.70%)	2 (2.70%)	1 (1.35%)	0 (0.00%)	0 (0.00%)