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**MEASURING MEMORY IN OLDER ADULTS: THE RELEVANCE OF EVERYDAY  
MEMORY AND THE RIVERMEAD BEHAVIOURAL MEMORY TEST**

**A thesis presented in partial  
fulfilment of the requirements for the degree  
of Doctor of Philosophy  
in Psychology at  
Massey University**

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## ABSTRACT

Assessment of memory in older adults is complicated by the varying health and disability status of older individuals, by normal age-related changes and by inadequacies in the theory underpinning memory aging. Additionally, there are limitations in conventional measures of memory when used with older adults particularly in the lack of ecological validity in measuring everyday memory processes. This limitation may risk overestimating the degree of impairment relative to the typical daily demands on memory experienced by older people.

The current studies present an evaluation of the Rivermead Behavioural Memory Test (RBMT), a measure of everyday memory performance, which appeared to address some of these concerns. The RBMT was produced as a screening tool, but an exploratory study suggested that some of its subtests may discriminate between dementias of vascular and nonvascular origin. A series of studies were subsequently undertaken to evaluate the properties of the test when used in clinical memory assessment of older adults. Results supported the use of the RBMT as both a screening and diagnostic tool. This expanded use requires clinical norms based on the subtest raw scores. Results also supported the view that everyday memory remains relatively stable into the ninth decade in the absence of a dementing condition.

The RBMT was not designed against a theoretical concept or model. Findings from these studies are interpreted within a working memory and systems theory framework. It is concluded that short composite measures relevant to everyday memory experiences might ultimately prove more reliable and valid than conventional tests, in assessing memory in older adults.

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## OVERVIEW

This study arose in 1992 out of dissatisfaction with measures available for clinical memory assessment with older adults. Conventional tests did not reflect the day-to-day demands on memory which most older people experienced and often appeared to overestimate the degree of deficit. It seemed that measures which used content drawn from tasks relevant to everyday memory might be more reliable and clinically valid for use with older adults.

The Rivermead Behavioural Memory Test (RBMT), which was designed to have high ecological validity, was subsequently used over a two year trial period in our practice with a wide range of older adults. Observation and retrospective analyses suggested that the test was useful as a screening test (which was its initial objective) and also had potential as a diagnostic aid for distinguishing between early vascular and Alzheimer's-type dementias. A series of studies were undertaken to examine these observations more thoroughly. The initial studies were designed to clarify issues concerning reliability while the final study was aimed at evaluating the discriminative validity of the test.

This thesis commences with a discussion of the difficulties faced when testing memory function in older adults and reasons are outlined why more attention is needed to this growing field of neuropsychology. Chapter 1 also outlines the main considerations when testing memory in older clients and suggests that these considerations are not well met when examined alongside conventional memory tests. The traditional emphasis on laboratory-derived memory tests is a major reason for this and in Chapter 2, the conventional approach to conceptualising memory processes is outlined. Although expansively researched, there is still no integrated theory of memory function and aging. This chapter also introduces concepts related to everyday memory, working memory

and systems theory each of which are relevant to the theoretical rationale underpinning the current studies.

The results of research on normal and abnormal memory aging are discussed and summarised in Chapter 3. The concept of age-associated memory impairment is outlined and terms and distinguishing characteristics related to the main forms of dementia are defined.

In Chapter 4, the RBMT is described and evaluated with reference to research reporting its reliability and validity when used with older adults. A recapitulation is presented in Chapter 5 and the research design for the studies which follow is outlined.

An initial exploratory study (Chapter 6) is followed by three further studies each of which report on properties of the RBMT in measuring everyday memory in older adults. Chapters 7 and 8 each clarify reliability issues based on the results obtained from a well independent sample and two clinical samples. Chapter 9 reports on the discriminative properties of the RBMT when used to distinguish between two types of dementing condition.

Theoretical explanations are considered in Chapter 10 and following a summary of the project, the final chapter suggests a number of modifications to the RBMT and outlines areas for future research.

## CHAPTER 1

### INTRODUCTION

*“In evaluating the older person, the neuropsychologist is challenged more than by any other age group. The complex interaction of age and disease makes diagnosis especially difficult.”*  
(Albert 1981, p.847).

#### **1.1 Complexity of memory assessment in older adults**

Assessment of older adults remains as challenging today as it was 17 years ago when Albert made this observation. Neuropsychological evaluation is still largely reliant on measures developed for younger age groups and is further complicated by developmental changes as well as frequent and often multiple medical problems. The relevance of conventional measures of memory, and the theoretical concepts underpinning them, is questionable when applied in an elderly setting (Cunningham, 1986; Woodruff-Pak, 1997). It is likely that the day-to-day demands on memory processes which most older adults experience is significantly less than the results on formal tests would indicate.

Compounding problems associated with the inadequacy of memory measures are three factors specific to older people. Firstly, there is evidence that cortical aging occurs in most older people although the coexistence of cognitive problems may not be obvious. Such changes are rarely seen in younger people (Arriagada, Marzloff, & Hyman, 1992; Boone et al., 1992; Breteler, Claus, Grobbee, & Hofman, 1994).

Secondly, differential diagnosis between people in the very early stages of a dementing process and those who are aged but functioning at a suboptimal level, is complicated (Heun, Papassotiropoulos, & Jennssen, 1998; Storandt, Botwinick, & Danziger, 1986). Thus research, as well as observation

and self-reports, indicate that memory lapses are a common complaint amongst older adults (Deptula, Singh, & Pomara, 1993; Roberts, 1983; Yesavage, 1984; Zarit, Gallagher, & Kramer, 1981).

Thirdly, there are numerous physical conditions and some psychological conditions which are known to affect day-to-day memory function and performance on psychometric assessment (Albert, 1981; Breteler et al., 1994; Hart & Semple, 1990). For example, one source has listed 42 separate conditions that may give rise to features of a dementia, most of which are reversible with early identification (Hart & Semple, 1990).

That more attention has not been given to memory evaluation in older adults is something of a paradox since disorders of memory are primarily a phenomenon of aging. There is a growing awareness of the need to address this challenge (Cunningham, 1986; Barr, Benedict, Tune, & Brandt, 1992). In the meantime, distinguishing between benign and pathological decline in memory function in older adults remains an often complex process made more so by the lack of suitable measures (Huppert & Wilcock, 1997).

## **1.2 Need for improved memory measures**

The main cause of serious memory difficulties in older age groups is a dementing process of some kind. The incidence of dementia increases in each decade from 60 years onwards (Gurland & Cross, 1986; Hart & Semple, 1990; Rosenstein, 1998) and, with the growth in the aged population, increasing numbers of cases are being identified (Flicker, Logiudice, Carlin, & Ames, 1997). There has been only one prevalence study reported in this country to date which estimated that between 1992 and 2016, the prevalence of dementia will almost double, compared with a rise in the general population of 18-26% (National Advisory Committee on Health & Disability [NACHD], 1997).

Australian projections are equally dramatic with prevalence predicted to triple between 1987 and 2031 (Ames, Flicker, & Helme, 1992).

A major concern in psychogeriatric assessment is to rule out early onset dementia as a likely cause of memory loss (Storandt & Hill, 1989). It has been reported that in approximately one patient in five, treatment of underlying problems can reverse or substantially alleviate cognitive symptoms (Pachana, Cummings, Hinkin, & Van Gorp, 1996). In cases where a dementia seems probable, accurate differentiation between dementia type is essential since in some cases, it may be possible to arrest the progression of the disease (Bowler et al., 1997; Hart & Semple, 1990). Early detection then, has sound economic and social benefits.

Even in cases where symptoms cannot be halted, the early detection of cognitive impairment may be vital in case management (Flicker et al., 1997). Dementing conditions do not necessarily follow a fixed course of progression. Patients are likely to present with problems affecting different domains that reflect varying stages and levels of decline (Nixon, 1996). Many patients and carers will benefit therefore, from timely information, advice and therapy designed to assist both sufferer and carer to maintain an optimum quality of life through each stage. Early psychological interventions have been shown to improve the relationship between the person with dementia and the carer and to delay entry to institutional care (British Psychological Society, 1994; NACHD, 1997).

Dementia already presents a considerable financial cost to society and an emotional burden to carers and relatives. With the projected growth in the proportions of elderly affected, its early detection and appropriate management becomes more pressing (Gurland & Cross, 1986; NACHD, 1997; Kaye, 1997; Wimo, Ljunggren, & Winblad, 1997). Accurate measurement and monitoring of memory function has a major role in this process (Cohen, 1986). It is unfortunate that the

development of measures for the evaluation of memory has not progressed in line with the increasing proportions of older adults reporting memory problems.

### **1.3 Issues to consider in testing memory function in older adults**

Considerations in clinical memory assessment of older adults are likely to be different to those of younger clients. Decisions that may need to be made, at least partially on the basis of memory test results, are often more far reaching. For example, issues may need to be resolved related to living independently, the need for home supports, giving up driving, downsizing the house, moving towns, or moving into permanent care. Such major life-stage issues place special significance on the assessment process, and on clinical and theoretical considerations relating to the selection of measures including which memory processes are assessed.

#### **The assessment process.**

There are a number of practical issues that may complicate the test process when working with older adults. For example, older people are unused to viewing their difficulties in a psychological light and may be especially prone to anxiety in the test environment (Woodruff-Pak, 1997).

Furthermore, older adults often have decreased stamina, making it advisable to conduct test sessions over two or three well-spaced intervals. There is the related problem that some tests are quite difficult for older adults to master quickly which may affect concentration and confidence very early in the test process and increase anxiety. This problem may be compounded when test content is based on unfamiliar experimental material. Declining sensory capabilities, especially those of vision and hearing, may pose further limitations on both test choice and interpretation.

Procedures may need to be adjusted for older adults or made more appropriate to the diagnostic group in question. While the skilled practitioner is generally able to anticipate and deal with these

more practical issues, clinical considerations related to the selection of measures and the processes to be assessed pose continuing problems.

### **Selection of measures.**

The measures selected for assessment of memory should compare favourably against the following criteria (Cunningham, 1986; Erickson & Howieson, 1986):

1. Have established reliability and validity including sufficient face validity to be viewed as relevant by the older adult.
2. Enable functional predictions to be made that are found to be reasonably accurate over time.
3. Provide a range of appropriate norms.
4. Have multiple forms for test-retest purposes.
5. Be sensitive to changes in memory functioning over time while remaining free of floor and ceiling effects.
6. Have proven discriminative validity.

### **What is assessed.**

Ensuring that the assessment is relevant and comprehensive while remaining relatively brief poses a dilemma in considering what to assess (Erickson & Howieson, 1986; Groth-Marnat, 1990; Woodruff-Pak, 1997). In general, tests should:

1. Assess both immediate and delayed recall of newly learned material.
2. Make use of a range of stimulus materials to enable bilateral hemisphere assessment.
3. Enable an assessment of a variety of memory processes including encoding, storage, retrieval, rehearsal and organising strategies.
4. Enable the collection of both quantitative and qualitative data.
5. Include tests that reflect everyday memory behaviour.

Most conventional memory measures reveal limitations when evaluated against the above considerations especially when used with elderly populations (Albert, 1981; Crook, Larrabee, & Youngjohn, 1990; Cunningham, 1986; Erickson & Howieson, 1986; Huppert & Wilcock, 1997; Leng & Parkin, 1990; Loewenstein, Arguelles, Arguelles, & Linn-Fuentes, 1994; Loring & Papanicolaou, 1987; Woodruff-Pak, 1997).

#### **1.4 Limitations in conventional tests of memory when used with older adults**

##### **Face validity.**

A major limitation in conventional memory measures is that the issue of face validity has been largely ignored (Crook et al., 1990; Groth-Marnat, 1990). Consequently, there is a shortage of measures containing content which could be considered appropriate to the day-to-day experiences of older adults and to the cognitive demands they might typically face. This is emphasised in a review of memory measures for use in dementia assessment, where only two tests are described which have content with high face validity (Pachana et al., 1996). This situation may be improving since five such tests are listed in a more recent review of developments in everyday memory (Garcia, Garcia, Guerrero, Triguero, & Puente, 1998). However, one of these requires computerised administration which may not be so suitable for many older adults.

Lack of attention to face validity may affect the reliability of results. For example, a client may be unwilling to cooperate to complete the measures or be unable to sustain motivation at an adequate level during the session if face validity is low. This is less likely if the client is able to see some relevance in the content and process and the session is relatively short (Cunningham, 1986).

### **Predictive validity.**

A further major limitation is that conventional measures of memory do not reliably predict the functional capacities of older adults over time (Kaszniak & Davis, 1986; Goldstein, McCue, Rogers, & Nussbaum, 1992). One reason for this weakness is that conventional memory tests adapted for use in elderly clinical settings, may tend to overestimate the degree of impairment relative to the cognitive demands older adults face in managing their day-to-day lives (Hunt, 1986; Mook, 1989). This presents a dilemma for the clinician asked to comment on the capacity of an older client to continue independent living.

### **Normative data.**

Inconsistency in predictive validity may be partly due to weaknesses in normative data in tests currently used for measuring memory function in older populations (Mayes, 1995; van Balen, Westzaan, & Mulder, 1996; Woodruff-Pak, 1997). It is common to find that norms are based on the performances of young and middle-aged adults. When norms for older adults are available, they tend to be based on small samples that are not always representative of the wider population. However, there are signs of increased awareness of the special needs of older adults as evidenced by the appearance of age-appropriate normative data for some conventional memory tests (e.g., Ivnik et al., 1992; Schmidt, Tombaugh, & Faulkner, 1992; Tombaugh & Hubley, 1997; Tombaugh & Schmidt, 1992; Tombaugh, Schmidt, & Faulkner, 1992). The question of face validity remains an issue, however.

The health status of those used in normative samples is also a particular issue in clinical work with older adults. It might be argued that since chronic illness is more prevalent amongst older people, a normal aging population should include individuals with a representative scattering of chronic illness. Conversely, it has been argued that differentiation should be made between cognitive changes relating to disease and those relating to age (Albert, 1981). Stratified norms are preferable

in clinical practice especially as growing numbers of people remain physically and socially active into older age. Ideally, such norms should cover both well and unwell older groups in addition to those with a diagnosed cerebral pathology.

### **Parallel forms.**

A further limitation with traditional memory measures is the lack of parallel forms of a test (Erickson & Howieson, 1986). Serial administrations are frequently desirable for tracking change when working with older clients just as they are with younger clients. Most conventional measures, if used serially, introduce the possible bias of practice effect.

### **Ceiling effects.**

Ceiling effects also impose limitations on the use of some tests with older adults (Lezak, 1995; Woodruff-Pak, 1997). Ideally, tests should be capable of measuring impairment ranging from very mild to very severe. In some studies, it has been found that the measures could be completed by only the more mildly impaired proportion of the sample (Fuld, 1986). Similarly, it is often difficult to measure variation within the demented range because tests do not have “floors” low enough to measure differences (Woodruff-Pak, 1997).

### **Discriminative validity.**

Finally, current memory measures are not reliable in the diagnostic task of discriminating between underlying dementing pathologies in the test patterns of older adults found to be memory impaired (Almkvist, 1994; Bowler et al., 1997; Cohen, 1986; Fuld, 1986; Rosenstein, 1998). The availability of such discriminative measures would be particularly valuable in the earlier stages of a dementia. Differential diagnosis of Dementia of the Alzheimer's-Type (DAT) is known to be especially difficult in the early stages of the disease (Kurita, Black, Blass, Deck, & Nolan, 1993; Mendez, Mastri, Zander, & Frey, 1992; Mitrushina et al., 1994). Even the newer neuroimaging techniques

are not always helpful (Albert, Naeser, Duffy, & McAnulty, 1986; Nixon, 1996) and diagnosis is essentially made by exclusion.

## **1.5 Chapter summary**

In summary, there are a number of weaknesses inherent in conventional measures of memory when used with older adults. Very few measures are portable and easily administered, short but sufficiently comprehensive, have sufficiently inclusive norms, can be used at different levels of impairment, include content relevant to the day-to-day demands on memory which older people face and have acceptable predictive validity. In addition, existing measures do not reliably discriminate between the different types of pathology underlying memory loss. These limitations, complicated by the developmental and physical changes in older age, present a very real challenge to the clinician. The process of selecting a suitable package of measures which will reliably distinguish between normal and abnormal memory aging remains complex. Reasons for this are linked to the lack of coherence in theories and concepts of memory aging and to the lack of effective cooperation between laboratory research and the clinician. In the next two chapters, concepts and theory as related to the present studies will be defined.

## CHAPTER 2

### THEORETICAL CONSIDERATIONS

*“A major problem for practicing clinical psychologists who must evaluate memory functioning in the elderly on a day-to-day basis is that the dominant instrument was based on a rather vague and unsystematic concept 40 years ago.”(Cunningham, 1986, p.27).*

#### 2.1 Structure and process concepts

Although memory function is probably the most researched aspect of cognition, there remains no coherent and integrated theory of memory aging available to guide the clinician (Light, 1991). Knowledge in this area has been described by one source as “...a vast and foggy jungle...” (Cunningham, 1986, p.28) and by another as “...a scrapbook-type collection of findings showing losses in a variety of cognitive functions [which] are not representative of real life cognitive performances” (Rybash, Hoyer, & Roodin, 1986, p.15). Light systematically reviewed some 340 papers which had examined four leading hypotheses regarding memory aging- -metamemory, processing resource theory, deliberate recollection and semantic deficit hypothesis- -and concluded that “these hypotheses, taken individually or collectively, do not provide an adequate account for the observed patterns of spared and impaired function found in old age” (pp.365-366).

However, these same theoretical concepts underpin most conventional memory measures. In particular, the information processing models which emphasise various structures, processes, stages and types of storage system, have been influential in memory test development (Albert & Moss, 1988; Kausler, 1982; Levin, 1986; Poon, 1985; Shum, 1998). These models assume that memory aging is caused by some failure or damage to one or other of the components of memory processing. The more common concepts comprising the structure and process models are listed and defined in Table 2:1.

Table 2:1

**Structure and process models of memory: An outline of concepts and definitions**

<u>Concept</u>	<u>Description</u>
Retrospective memory	Global term for ability to recall past information.
Prospective memory	Global term for ability to remember to carry out intended actions and requests in the future.
Registration	New information is initially registered through one of the senses; sometimes referred to as sensory memory. Information received is seen as highly unstable and subject to rapid decay unless actively processed.
Primary memory	Short-term storage. Inferred by ability to recall or recognise information immediately after it is presented. Duration approximately 30 seconds but may remain for up to one hour if actively rehearsed. Capacity seen as limited to 7 items (+/-2).
Secondary memory	Long-term storage. Inferred by ability to recall information after a delayed interval. Information is thought to pass through encoding and storage processes to be consolidated for later retrieval (recall). If recall is available, the information is inferred to have been learned. Different types of storage systems have been proposed to account for different forms of memory behaviour, e.g., semantic memory, (facts, language, concepts, rules), episodic memory, (past specific events), recognition memory, (pictures, faces and spatial information) and prospective memory (events occurring at some future time).
Tertiary (Remote) <sup>a</sup>	Very long-term memory storage. Information built up through childhood and young adulthood.

<sup>a</sup>Not all accounts talk about remote memory. In an elderly clinical setting it is a useful concept since it separates primary and secondary memory (the capacity for day-to-day remembering which may be impaired) from often very detailed accounts that old people can provide about their early years.

Most tests of memory in regular use have been designed to measure one or more of the concepts derived from the models. Research has been predominantly laboratory-based and has mainly used participants under the age of 65 years. Student volunteers have comprised the largest participant population.

While the structure and process models may well represent a valid conceptualisation of memory function, the traditional emphasis on controlled, laboratory-based research has hindered the development of reliable and valid measures of memory for use with older adults. It is arguable whether this remains the most theoretically productive and clinically relevant line to follow in explaining memory aging (Banaji & Crowder, 1989; de Wall, Wilson, & Baddeley, 1994; Kaszniak, Poon, & Riege, 1986; Poon et al., 1992), but it is clear that the traditional method has been generally disappointing to the clinician. In a paper commenting on memory aging and its everyday operations, Kausler (1992) notes:

A major issue facing laboratory research on aging's effects on memory is the generalisability of the processes studied in the laboratory to the processes involved in everyday memory performances. In some cases, age sensitive processes may be involved in laboratory simulations that are absent from the everyday-world counterparts, leading to an overestimation of aging deficits in everyday memory. In other cases, the reverse may be true, resulting in an underestimation of aging deficits in the real world .... Clearly, more attention needs to be given to the external validity of the results... (pp. 490-491).

Kausler is clearly not dismissing the laboratory approach but is chiding researchers for their preoccupation with resolving relatively minor theoretical issues. This preoccupation has impeded the development of measures and the understanding of memory in the "real" world.

## **2.2 The concept of metamemory**

Metamemory refers to the self-reported expectations and beliefs that people hold about their memory and strategies they might use to improve remembering under different memory loads ( Craik, Anderson, Kerr, & Li, 1995). It is a relatively recent concept which has been implicated as a factor in memory aging. According to Light (1991), four hypotheses accounting for reports of lowered memory efficiency in older adults have received the most attention in metamemory research- -incorrect beliefs about the nature of memory, incorrect beliefs about strategies appropriate for different tasks, less spontaneous use of suitable memory strategies, and less effective self-monitoring of encoding and retrieval processes. While mixed results have been obtained in research, metamemory concepts have not been shown to cause age differences in actual memory performance (Craik et al., 1996; Light, 1991). However, the concept remains relevant in clinical work with older adults since self-reported concerns about memory are frequent but often not reflected in poor performance on memory tests (Bolla, Lingren, Bonaccorsy, & Bleecker, 1991; Ponds & Jolles, 1996). Furthermore, numerous self-report questionnaires have been produced to measure beliefs about memory and memory abilities. These are often unreliable and wrongly substituted for measures of memory performance (Craik et al., 1996).

## **2.3 The concept of working memory**

The concept of working memory (Baddeley, 1986), has received growing interest as a complementary information processing approach to understanding memory. Working memory focuses on the initial stages of memory processing and is seen as a limited storage facility able to temporarily hold and process information immediately after it is presented (Baddeley, 1986; Baddeley, 1995). Working memory concepts were initially developed to account for the increasingly complex pattern of data from experiments on short-term memory. It was proposed that

the concept of a unitary short-term memory store could be replaced by assuming a working memory system made up of sensory and primary memory combined.

Baddeley (1986) described working memory as “a system for the temporary holding and manipulation of information during the performance of a range of cognitive tasks such as comprehension, learning, and reasoning” (p.34). In other words, to keep something in mind while concentrating momentarily on something else (Lezak, 1998).

The main components of working memory are described as a central executive and two subsidiary systems- -the visuo-spatial scratchpad and the phonological loop. The central executive is seen as the control system for attention processes and is essentially the core of the working memory model. It is assumed to be responsible for the selection and operation of strategies for dealing with incoming information, and for maintaining and switching attention as required while also maintaining access to long-term memory. The visuo-spatial scratchpad is assumed to set up and maintain visuo-spatial information while verbal information is held using the phonological loop (Baddeley, 1995). It is thought that three subtypes of attention, namely selective, sustained and divided attention (defined in Table 2:2) are mediated via the central executive.

There is now growing evidence that selective attention and aspects of divided attention underlie the difficulties that people with early Alzheimer’s disease experience in performing everyday tasks (Perry & Hodges, 1999). Various studies have linked working memory concepts to tasks that involve simultaneously storing and manipulating digits (Dobbs & Rule, 1989) and words (Belleville, Peretz, & Malenfant, 1996), to spatial operations (Courtney, Petit, Maisog, Ungerleider, & Haxby, 1998), to reading and comprehending prose and to coordinating information from a range of sources (Baddeley, 1995). These capacities have been found to be impaired in patients with Alzheimer’s disease when measured using

simultaneous tasks (Baddeley, Bressi, Della Sala, Logie, & Spinnler, 1991; Haut et al., 1998; Salmon et al., 1996). Working memory has also been linked with deficits in such executive functions as capacity for planning, initiating, and regulating behaviours (Alderman, 1996; Baddeley & Della Sala, 1996; Perry & Hodges, 1999). Such deficits are known to occur early in the course of Alzheimer's-type dementia and, along with attention processes, have been linked to compromise in the central executive component of working memory (Baddeley, 1995; Perry & Hodges, 1999).

**Table 2:2**

**Subtypes of attention and defining characteristics**

<u>Attention subtype</u>	<u>Defining characteristic</u>
Sustained attention	Maintenance of ability to focus attention over extended periods of time.
Selective attention	Focus is on single relevant stimulus at one time while ignoring irrelevant or distracting stimuli.
Divided attention	Sharing of attention by focussing on more than one relevant stimulus or process at one time.

Note. Adapted from Perry & Hodges, (1999)

To date, research on the working memory model proposed by Baddeley appears to have been exclusively laboratory-based. The research methods adopted have made use of conventional tests or especially contrived dual attention paradigms. As noted, exclusive reliance on these methods has traditionally proved disappointing in producing valid tests of memory for use with older adults.

An alternative but largely complementary model of working memory has been proposed by Hunt (1986). This model differs most fundamentally from that of Baddeley in that Hunt's model places greater emphasis on the constituent behaviours that help to determine whether an older person's memory is adequate for independent living. Hunt is therefore a strong advocate for the use of

ecologically valid tests and measures of memory with elderly people. Hunt argues that from both a theoretical and pragmatic point of view, working memory capacity should be tested in contexts that are important in a person's life. He writes:

Many tests, for good reasons, are based on experimental material and psychometricians have deliberately avoided test situations and material where performance depends on a person's idiosyncratic experiences. As a result, most test procedures place the patient in a relatively unfamiliar situation. Most of the context is removed and the results are used for examining brain structures involved in memory because such structures are assumed to exert a context-free influence on memory. What context-free tests do not provide is an assessment of whether or not a person's memory is adequate for daily life... (Hunt, p. 51).

#### **2.4 The relevance of general systems theory**

General systems theory may also be relevant in understanding the anecdotal and observational evidence seen in real-life memory aging. Systems theory would argue that memory must be studied in the context in which it is embedded and cannot be understood without reference to the natural environment of the memory system. For example, one study reported that younger and older adults remembered contextually meaningful information equally well whereas the young out-performed the old for less meaningful and incidental information (Sinnott, 1989). In explaining these findings, it was suggested that the older adult may invest more time and effort in remembering information that has obvious social links (visits, telephone calls) as an adaptive mechanism. This explanation is consistent with Hunt's argument for ecologically valid memory assessment in older adults. The incorporation of systems theory may assist in the development of more suitable memory measures for older adults as it would ensure recognition of the broader environmental variables which are likely to influence memory performance in real-life settings.

## 2.5 Everyday memory

The argument for ecological validity in memory assessment with older adults has gained support over the past ten years (Bahrlick, 1989; Baddeley, 1995; Garcia et al., 1998; Wilson, Cockburn, Baddeley, & Hiorns, 1989). From the need to improve predictive validity of day-to-day memory function following brain damage (in mainly younger people), the concept of everyday memory has emerged (Baddeley, 1995). While there does not appear to be a standard definition, the term generally refers to the memory capacities needed to manage one's day-to-day living environment. Everyday memory has been described as a relatively stable skill during adulthood (Youngjohn & Crook, 1993) and van Balen et al. (1996) likened it to a "species-wide capacity" (p.205) similar to those discussed by Lezak (1995). Everyday memory presumably calls on a combination of working memory and long-term memory capacity and, particularly when applied to older people, is concerned with the maintenance rather than the extension of memory function.

Some progress has been made in developing measures with high ecological validity using content which reflects routine day-to-day demands on memory processes (Baddeley, 1995; Garcia et al., 1998; West, Crook, & Barron, 1992). However, Light (1991) in the introduction to her review, notes a number of earlier studies in which the scores of older adults were lower than younger adults on different memory tasks designed to have greater ecological validity. On the other hand, studies have reported no age-related cognitive decline in cognitive activities which are dependent on everyday experiences (Poon et al., 1992; Rubin et al., 1998; Youngjohn & Crook, 1993) although such studies have not always been based on formal measures of everyday memory. While initial research findings may be inconsistent, the everyday memory approach seems to address many of the concerns about the use of conventional measures with older adults. Improved measures and a greater readiness amongst psychometricians for more eclectic research strategies may see progress in this area (Bahrlick, 1989).

## 2.6 Summary and direction

The laboratory-based information processing model of memory aging has been generally disappointing at producing valid measures of memory for use with older adults. The measures available have been accused of possibly over-estimating the relevance of internally driven memory systems and the significance of deficit in older clients. While the working memory concept remains somewhat speculative, over-generalised and inconsistent in accounting for all possible patterns of memory deficit seen in aging, Light (1991) concluded that such concepts may account for at least some of the discrepancies found in memory assessment between younger and older people. To the neuropsychologist, it appears a useful practical model to account for some of what is observed in clinical practice.

Baddeley's model of working memory has received the most attention in the literature. This is primarily a revision of the information processing model and research to date appears to have been largely laboratory-based, making use of experimental materials. Its concepts have not been adapted specifically to real-life ecologically valid memory measures although Baddeley clearly supports the complementary role between laboratory and real-life research. The views of Hunt and the broader systems perspective call for measures of memory performance in real-life settings that recognise contextual variables. As well as memory performance, the environment and behaviours which help to determine whether an older person's memory is adequate for independent living are of focal concern. Together with Baddeley's model of working memory, these emphases may further the development of ecologically valid tests of memory for use with older adults. Before examining one such measure, there is a need to clarify what is known about normal and abnormal memory aging. Given the duality in definition and the complexities when assessing memory processes in older adults, how does normal memory aging differ from that seen in dementing conditions?

## CHAPTER 3

### NORMAL MEMORY AGING AND DEMENTIA

*“The experimental evidence confirms the general view that memory performance does decline as a function of normal aging but that it declines more in some situations than in others.”*  
(*Craik et al., p.232*).

#### **3.1 Dementia defined**

While there are numerous variations in the definition of dementia, all contain the notion of global cognitive impairment atypical of normal intellectual functioning which occurs with no clouding of consciousness (Hart & Semple, 1990). However, it is noted that the literature on dementia presents certain problems in terminology. For example, the term may be used as a diagnostic classification referring to a specific disease or group of diseases characterised by progressive and usually irreversible deterioration of higher intellectual function. But the term can also be used to refer to a general clinical syndrome characterised by chronic global impairment of mental status resulting from a variety of conditions including metabolic and nutritional disorders, drug toxicity, infection and depression. Some prefer the latter usage since it more likely ensures thorough medical investigation leading to treatment where indicated and a possible reversal of symptoms (Hart & Semple, 1990). Either terminology may be reflected in cases presenting for memory assessment.

The main irreversible dementias are listed in Table 3:1. The most common form of dementia is primary degenerative dementia of the Alzheimer’s type (DAT) followed by vascular dementia (VAD). Together, these account for approximately 80% of all dementias of old age (Hart & Semple, 1990; NACHD, 1997). It is estimated that approximately 50% to 70% of these are of the Alzheimer type while 10% to 20% are of vascular origin (NACHD, 1997; de Leon, George, &

Ferris, 1986; Hart & Semple, 1990). Within the primary degenerative diseases listed in Table 3:1, a distinction is sometimes made between cortical and subcortical dementia (Cummings, 1986; Dunne, 1993). The distinction reflects the predominant cerebral structures involved in the condition. Accurate differentiation may have implications for treatment (Dunne, 1993). DAT is held to be the classic example of cortical dementia along with the less common Pick's Disease. The remainder of those listed in the table are categorised as subcortical dementias.

**Table 3:1**

**Classification of main forms of irreversible dementia**

<u>Primary degenerative diseases</u>	<u>Vascular conditions</u>	<u>Other conditions</u>
Alzheimer's disease	Multiple infarction	Creutzfeldt-Jacob disease
Pick's disease	Lacunar state	Alcoholic dementia
Parkinson's disease	Binswanger's disease <sup>a</sup>	
Progressive supranuclear palsy		
Huntington's disease		
Aids dementia complex		

<sup>a</sup>There is disagreement on whether Binswanger's disease listed in this table as a separate condition, is in fact a valid diagnostic classification. There is a view that it is the same condition as Lacunar state (Hart & Semple, 1990).

VAD is produced by a generalised deterioration (atherosclerosis) in the blood vessels of the brain leading to a series of small blockages or haemorrhages. These are sometimes referred to as transient ischaemic attacks or minor strokes. Their effect is to cause focal areas of dead tissue resulting in specific, but later more generalised, areas of cognitive impairment (Brinkman, Lergen, Cushman, Braun, & Block, 1986).

On the other hand, DAT is associated with widespread degeneration of brain tissue. This results in progressive cell loss over and above that seen in normal aging and produces a gradual but

generalised decline in cognitive function with memory loss the key early feature (American Psychiatric Association. (1994). *Diagnostic & Statistical Manual of Mental Disorders* (4<sup>th</sup> ed.); Brinkman et al., 1986). Unlike VAD, the cause of DAT is unknown although numerous theories have been advanced (Nixon, 1996; Hart & Semple, 1990). The only sure way of diagnosing DAT is through autopsy examination where typically, the hippocampal formation and association cortices of sufferers show the presence of neuritic plaques and neurofibrillary tangles. Significant cell loss and enlargement of the ventricles are also found (Brandt & Rich, 1995; Hart & Semple, 1990). There are both common and differentiating clinical characteristics between DAT and VAD which are summarised in Table 3:2.

### **3.2 Age-associated memory impairment (AAMI)**

The popular stereotype views memory decline and growing old as going hand-in-hand. A major justification for this belief is found in the frequency with which older adults complain of poor day-to-day memory. Among the more common complaints are decreased ability to recall recent and past events, lapses in remembering a name, phone number, appointment, what was read, where something has been put, what one had gone to the shop to buy and losing the thread of thought in a conversation (Deptula et al., 1993; Roberts, 1983; Scogin & Prohaska, 1993; Yesavage, 1984; Zarit et al., 1981). Community surveys have suggested that as many as 46% to 50% of people over the age of 60 years report memory problems (Zarit et al., 1981). And it is known that many older adults present for memory assessment due to anxiety about the possibility of having an Alzheimer's-type condition but their memory complaints are not found indicative of any pathological process (Scogin & Prohaska, 1993). Depression has sometimes been implicated as a factor in memory impairment in older people (Bola et al., 1991; Levy-Cushman & Abeles, 1998; Nixon, 1996)

**Table 3:2**

**Common and differentiating characteristics in diagnostic criteria for dementia of  
Alzheimer's-type and Vascular Dementia**

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Common characteristics

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The development of multiple cognitive deficits manifested by

- (a) memory impairment (an inability both to learn new information and to recall old information)

and

- (b) at least one of the following  
 aphasia  
 apraxia  
 agnosia  
 disturbances in executive functioning.

The cognitive deficits must

- (a) cause significant impairment in social or occupational functioning and  
 (b) represent a significant decline from previous levels.

Deficits do not occur exclusively during the course of delirium.

Differentiating characteristics

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Dementia of the Alzheimer's-type (DAT)

Vascular dementia (VAD)

Gradual onset (mild forgetfulness)

Step-like progression

Progressive decline

Periods of maintained or improved memory

Often normal neuroimaging data

Evidence of cerebro-vascular disease on neuroimaging examination

Focal signs absent

Focal signs or symptoms

Normal laboratory tests

Laboratory evidence of cerebro-vascular disease

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(Adapted from Nixon, 1996)

although studies have also indicated that once the seventh decade is passed, cognition in depressed and nondepressed 70 to 85 year olds is comparable (Boone et al., 1994).

To recognise greater than average memory loss beyond the age of 50 in otherwise healthy individuals, a diagnostic criteria for Age Associated Memory Impairment (AAMI) was published in 1986 (Crook et al., 1990). Brandt and Rich (1995) noted that a prevalence rate of 35% for AAMI amongst older adults had been reported which led them to conclude that the diagnostic criteria was probably “too liberal”(p.244). AAMI has received some attention in the literature (Craik et al., 1996; Huppert & Wilcock, 1997; Crook, Larrabee & Youngjohn, 1990; Rubin et al., 1998; Starr, Deary, Inch, Cross, & MacLennan, 1997; Trahan & Larrabee, 1992; Youngjohn & Crook, 1993). Central to research has been the question of whether all memory decline that occurs is disease-related or whether it can occur as part of normal aging. Longitudinal studies such as those of Rubin et al. and Starr et al., have provided strong support for concluding that cognitive processes in older age remain relatively stable and that some disease entity is generally involved when greater than average memory decline occurs.

Youngjohn and Crook (1993) noted that AAMI is essentially equivalent to normal aging and that it is the subjective complaint of worsening memory that earns the diagnostic label. Of special note in this study was their finding that people meeting the criteria for AAMI, do not decline over time on tasks of everyday memory. Overall, the current consensus is that global decline in memory does not occur with normal aging and that any specific age-related memory losses are quite variable and mild (Craik et al., 1995; Rubin et al., 1997; Scogin & Prohaska, 1995).

Also of relevance is a condition labeled Mild Cognitive Impairment (MCI), thought to be a transitional state between normal aging and DAT (Petersen et al., 1999). Interest has focussed on memory impairment beyond that expected for age and education but not meeting the criteria for

dementia. It is thought that this may signal increased risk of developing DAT. Regular neuropsychological evaluations over an 11 year period have indicated that rate of change in test scores is a key differentiating characteristic between MCI cases, normal control participants and patients with DAT (Petersen et al., 1999).

### **3.3 Memory changes in normal aging and dementia compared**

On the other hand, a range of specific memory failures associated with the onset of a dementia have been identified (Brandt & Rich, 1995; Hart & Semple, 1990; Nixon, 1996). These are contrasted with those reported in normal aging in Table 3:3. Since memory problems are a characteristic early feature of DAT and are more pervasive, the changes listed in Table 3:3 are derived mainly from research findings related to DAT rather than to VAD.

From Table 3:3 it can be concluded that older age is associated with difficulty on memory tasks that require elaborate processing, organisation of information and visual elaboration of stimuli but wide individual variation can be expected (Poon, 1985). In tasks that ensure proper encoding of material, the rates of forgetting information are virtually identical for younger and older adults ( Craik et al., 1995; Kaszniak et al., 1986). As noted earlier, everyday memory remains a relatively stable skill during adulthood (van Balen et al., 1996; Rubin et al., 1998; Youngjohn & Crook, 1993). The variable but mild age-related memory changes which can occur with normal aging, are in sharp contrast to the memory changes in dementia which begin in the early stages of the disease and are progressive and widespread.

Table 3:3

**A comparison of memory changes associated with normal aging with those associated with dementia**

**Memory changes in normal aging**

**Memory changes in dementia**

**Primary Memory**

Digit and word span memory tasks hold up into later old age and may then decline slightly. The decline is not thought to be crucial in the causes of longer-term memory failures in older adults (Craik et al., 1995).

Recall of digits may be normal or near normal in the early stages but later deteriorates with dementia severity (Brandt & Rich, 1995).

**Working Memory**

Sustained attention remains stable into old age (Lezak, 1995). Divided and selective attention declines gradually with age but major individual differences. Decline possibly due to a combination of cognitive slowing, reduced processing resources and difficulty inhibiting information not relevant to the memory task (Craik et al., 1995).

Sustained attention remains intact in the milder stages; evidence points to an early defect in both divided and selective attention in DAT (Perry & Hodges, 1999). Impairment possibly due to a defect in the central executive system (Baddeley, Della Sala, Papagno & Spinnler, 1997).

**Long Term Memory**

Performance decrements appear to depend on the task and the learning conditions. Thought probable that encoding and retrieval rather than storage operations are affected. If initial performance levels are equated across age groups, later forgetting rates are essentially equivalent across the adult age range (Craik et al., 1995).

Marked and progressive decline occurs in long-term memory. A breakdown in encoding and acquisition processes are thought to be partly responsible. Decline seen most clearly on measures of episodic and semantic memory (Brandt & Rich, 1995).

**Memory changes in normal aging****Memory changes in dementia****Episodic memory**

Memory for specific events which were experienced directly (episodic memory) declines with age over the adult years ( Craik et al., 1995).

Episodic memory impairment has been labeled “the hallmark of dementia” (Brandt & Rich, 1995, p.247). Memory failures are likely to be seen in remembering new information such as a news item, a family event or details of a trip.

**Semantic memory**

Ability to remember facts, general knowledge and names appears relatively stable over the adult life span (Light,1991) although some studies have reported subtle age related differences. Craik et al.,(1995) concluded that well learned material may show little change with age except when retrieval conditions are unfavourable. Memory for newly learned factual material may be less efficient unless aided by prior knowledge or expertise in that area. Cues can improve recall.

Recalling names and places, general word finding, the learning and recall of word lists, confrontational naming and verbal fluency are likely to display striking deficits. Cues in the form of visual or word prompts, are less likely to be effective in aiding recall which is characterized by a rapid rate of forgetting (Nixon, 1996; Brandt & Rich, 1995; Hart & Semple, 1990).

**Recognition memory**

While differences between the young and old for recognition of nonverbal information such as pictures and faces appears to be slight, spatial material shows greater deficits with increased age (Craik et al., 1995). The latter includes geographical information, routes, maps and building locations.

Recognition memory for nonverbal material such as pictures or faces, shows a progressive decline. There is a tendency for false positive responses to increase on recognition tests. Recognition of spatial material also declines (Brandt & Rich, 1995).

**Prospective memory**

Self-initiation of tasks at a future time are not remembered as well by older people compared to younger groups (Huppert & Wilcock, 1997). When older people can use their typical cues for remembering a future task, (e.g., writing a note), there is no difference between old and young (Craik et al., 1995).

Prospective memory has been less well researched (Huppert & Beardsall, 1993). Current evidence suggests a more rapid decline in the presence of dementia than in normal memory aging since multiple cognitive operations are involved. Cues are less useful since the context for the task may be forgotten.

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### 3.4 Sensitivity of memory measures

Variations in cognitive symptoms in normal and abnormal memory aging adds complexity to memory measurement amongst older adults (Huppert & Wilcock, 1997). Over the years, a variety of instruments have been used in the attempt to distinguish between normal and abnormal cognitive decline and to track progression when a dementia is considered the most probable diagnosis (Heun et al., 1998; Nixon, 1996). As illustrated in Table 3:4, there now appears to be a measure of agreement on a number of characteristics which discriminate between normal and abnormal memory aging. However, it remains unclear which correlates are more sensitive in discriminating between dementias of vascular and nonvascular origin (Bowler et al., 1997; Cohen, 1986; Rosenstein, 1998).

**Table 3:4**

#### **Characteristics reported to discriminate between normal memory aging and dementia**

<u>Discriminating characteristics</u>	<u>Researchers</u>
Delayed recall of prose	Chapman, White, & Storandt, (1997); Rubin et al., (1998).
Delayed recall of geometric figures	Locascio, Growdon, & Corkin, (1995).
Recognition memory	Welsh, Butters, Hughes, Mohs, & Heyman, (1991).
Intrusion errors in delayed recall	Welsh et al., (1991).
Flat learning curve/recency effects	Bigler, Rosa, Schultz, Hall & Harris, (1989).
Immediate & delayed recall of word lists	Heun et al., (1998); Linn et al., (1995); Mitrushina et al., (1994).
False positive errors in recognition recall tasks	Gianotti & Marra, (1994).
Prospective memory	Huppert & Beardsall, (1993).
No or limited response to cues	Cummings & Benson, (1986); Petersen, Smith, Kokmen, Ivnik, & Tangalos, (1992).

One recent review (Almkvist, 1994), examined some thirty studies which sought to find differences in the neuropsychological test profiles of participants diagnosed as either VAD or DAT. Only slight differences were reported leading to the conclusion that there was more evidence for functional similarity than divergence. While tests have been found to lack sensitivity for both screening and diagnosis of dementia (Huen et al., 1998; Huppert & Wilcock, 1997) some studies have reported more encouraging results. These will be outlined in Chapter 9.

### **3.5 Comments on research**

Reviews of data on memory and aging reveal three important factors. Firstly, many studies have been designed to test a theoretical assumption about the structure or process of memory and have made use of a wide variety of experimental test materials. Further, participants may be required to take multiple tests but the possible occurrence of test fatigue is seldom considered as an issue. These factors might help to explain why findings are often inconsistent. The significance of findings from such research might not be particularly relevant to the measurement of everyday memory capacity in older adults.

Secondly, there are obviously very large individual differences in the memory capabilities of older adults such that generalisations are likely to be questionable- -especially in view of the material on which they are based (Huen et al., 1998; Rosenstein, 1998; Woodruff-Pak, 1997). This is highlighted in a recent study that compared the decline in memory across the life span from age 20 to 89 as measured by 19 conventional measures and a measure of everyday memory (Ostrosky-Solis, Jaime, & Ardila, 1998). The standard deviations when computed for each measure as a percentage of the obtained score, varied widely with aging but showed significantly greater variation on most of the conventional tests compared to the measure of everyday memory.

Thirdly, the make-up of the sample studied may be a third reason for variability in findings related to memory loss with dementia (Nixon, 1996). For example, many studies have used mixed DAT and VAD samples or mixed cortical and subcortical cases in DAT samples because of the difficulty of accurately diagnosing and staging the different forms of dementia. Since the nature and seriousness of memory impairment in each condition is known to differ, especially in the earlier stages (Bowler et al., 1997; Cummings, 1986; Dunne, 1993), different patterns and levels of memory impairment are likely to be reported. Variability may also be associated with evidence that cortical aging occurs in most older adults even in the absence of reports of cognitive problems. This has led to the suggestion of a continuum based on speed of cortical aging underlying the pathology differentiating normal older adults and demented persons (Arriagada et al., 1992; Huppert, Brayne, Gill, Paykel, & Beardsall, 1995). In their review, Brandt and Rich (1995) noted:

Recent research in the neuropsychology of dementia has revealed dissociable patterns of preserved and impaired memory abilities among different disease states. These findings clearly indicate that dementia is not a homogenous disorder. Attempts to delineate specific impairments associated with specific diseases suggest that the disparate memory profiles observed are a function of the particular brain regions affected by each disease. (pp. 261-262)

### **3.6 Summary**

In summary, the age-related changes in memory function that occur with normal aging occur to a much greater extent in dementia. The heterogeneity in symptoms presented by individual cases continues to present problems to the clinician and adds to the complexity in memory measurement amongst older adults. Reliable and valid memory assessment of older clients remains a major challenge although the need for more suitable measures has increased. Thus Huppert and Wilcock (1997) conclude:

It is clear... that there are definite age-related changes in many aspects of cognitive function, and that these present a fairly consistent pattern within an aging population. This would

appear to be a sound foundation upon which to base attempts to separate abnormal i.e., dementia-related, changes from the norm. In practice, however, this has proved disappointing and we have not yet been able to develop a tool that clearly distinguishes between normal aging and the cognitive deficits that are a feature of one or other of the dementias... (p.21).

In the previous chapter, the potential of more ecologically valid tests of memory to overcome limitations in conventional tests was discussed. At least one such measure of memory function, the Rivermead Behavioural Memory Test (RBMT), has been published (Wilson, Cockburn et al., 1989). This test uses everyday memory tasks to assess the adequacy of memory. The RBMT, which will be examined in the next chapter, appears consistent with the view that memory be assessed using materials and contexts which are relevant to the everyday memory experiences of older adults.

## CHAPTER 4

### THE RIVERMEAD BEHAVIOURAL MEMORY TEST (RBMT)

*“...there is never going to be a single measure that will tell us how well a patient’s memory works. The sort of picture that one needs depends upon the purpose of testing.” (Hunt 1986, p.52).*

#### DEVELOPMENT OF THE RBMT

##### 4.1 Introduction

The RBMT represents a move away from memory assessment based on measuring acquisition and retention of basically experimental material (Wilson, Cockburn et al., 1989; Wilson, Baddeley, Cockburn, & Hiorns, 1989). It represents a “bridge” between laboratory-based measures and measures developed through observation and questionnaire. The RBMT is essentially an atheoretic test designed to detect impairment in everyday memory function and to monitor treatment (Lezak, 1995). The subtest items involve remembering to carry out everyday tasks and retaining the type of information needed for everyday function.

Although initially designed for use in cases of traumatic brain injury, the RBMT had been reported to be a sensitive measure for detecting memory impairment in older people and for monitoring change (Cockburn & Collin, 1988). A review of the test by the present author suggested that it more closely met the considerations outlined in Chapter 1 for memory assessment with older adults, than other available tests. Furthermore, it seemed to fit with the broad direction of Baddeley’s model of working memory and with calls for content and context relevancy.

## 4.2 Development

The original standardisation of the RBMT was based on 176 brain-damaged patients attending the Rivermead Centre and 188 controls (Wilson, Cockburn et al., 1989). Most of these two groups were within the age range 14 to 69 (average age 44.4 years, patients, and 41.17 years, controls). However, approximately 20 were over the age of 70 years. In analysing the data and establishing the limits of normal performance, the oldest group was excluded but it was noted that there appeared to be a fall-off in scores and greater variability with advancing age. The researchers hypothesised that the RBMT might be sensitive to changes in everyday memory skills that occur with normal and abnormal aging (Cockburn & Collin, 1988; Cockburn & Smith, 1989).

Subsequently, a further standardisation was carried out with a sample of 119 people aged 70 to 94 years (Cockburn & Smith, 1989). This sample was drawn by selecting every 4<sup>th</sup> name born in or before 1917 from the register of a five-doctor general practice that covered both urban and rural areas. This was drawn separately for the males and females. A pool of 276 names was created (subsequently reduced to 233). With time constraints, refusals and inability to contact, this was eventually reduced to a total of 85 people. A further 34 were recruited from a local geriatric day hospital and from occupants of “floating” beds in a community hospital. The final sample comprised 119 people (44 males and 75 females) aged 70 to 94 years of age. Fifty-four were living in their own homes, 31 were in sheltered housing, 28 were attending a day hospital and six were occupants of floating beds in a community hospital. On average, the sample was receiving regular help to live independently from an average of 2.60 sources (range 0-7). Of the 119 participants, 15 had been unable to complete all of the tests used for the study including four that could not complete all of the RBMT items. Results, therefore, are presented for numbers varying between 94 and 114 participants and the normative tables are based on data from the 106 who were living in

their own homes or sheltered housing. Full sample details can be found in test manuals and elsewhere. (See Cockburn & Smith, 1989; Wilson, Baddeley et al., 1989; Wilson, Cockburn et al., 1989).

### **4.3 Description of the test**

The test consists of 12 subtests covering a range of everyday memory skills. The raw scores for each subtest are summarised in the form of a Profile (or standardised) score and a Screening (or pass/fail) score. The subtests are detailed in Table 4:1 together with the maximum raw score obtainable on each subtest. A copy of the test form is contained in Appendix A.

Since the scores on individual subtests may vary between 0 and 21, the standardised Profile Score was introduced to equate the importance of each subtest by giving it a maximum weighting of 2. Accordingly, the total Profile Score ranges from 0 to 24. The Screening Score is basically a pass/fail score derived from the score pattern of the standardisation sample. This can be summed into a total Screening score ranging from 0 to 12. In practice, the Profile score is preferred in analysing the performance of older clients because it uses more of the available information (Cockburn & Smith, 1989).

The test comes in four parallel forms, Versions A to D. Correlations between the Profile scores on Versions B, C and D and Version A were reported in the validation study as 0.86, 0.83 and 0.88 respectively (Wilson et al., 1989). A Behavioural Checklist comprising 19 examples of everyday memory lapses is included in the test materials. This is intended for completion by a spouse or carer and may serve to validate results from the test.

**Table 4:1****List of subtests comprising the RBMT with brief definitions and maximum scores**

Subtest	Brief description	Maximum score
1. Names	Remembering a first name and surname after a delay of approximately 25 minutes (cueing is available if the client is unable to recall the names spontaneously).	4
2. Belonging	Remembering to ask for return of a hidden belonging on being given a pre-arranged cue.	4
3. Appointment	Remembering to ask for an appointment (in response to a cue).	2
4. Picture Recognition	Recognising 10 pictures of familiar objects presented for 5 seconds and later presented with 20 distracter items after a delay of three to five minutes.	10
5. Story recall (Immediate)	Recalling a short prose passage in the form of a news story immediately after presentation.	21
6. Story recall (Delayed)	Recalling the same passage after a delay of approximately 15 minutes.	21
7. Face Recognition	Recognising five photographs of unfamiliar faces presented for 5 seconds and later presented with ten distracter photographs after delay of three to five minutes.	5
7. Route (Immediate)	Repeating (walking) a five-step route around a room immediately after demonstration.	5
8. Route (Delayed)	Repeating the route after a 10 to 15 minute delay.	5
10. Message	Remembering to pick up and deliver a message on the two route recall tasks.	6
11. Orientation	Awareness of time and place.	9
12. Date	Knowing the date.	2

Although the elderly standardisation sample comprised 119 participants, not all data could be used in the provision of norms for the test. It is noted in the test manual (Cockburn & Smith, 1989) that four participants were unable to complete all RBMT items due to vision or speech limitations, while a further 11 were unable or unwilling to complete the corollary tests used in the validation study. A later study is reported which used 94 data sets from the normative sample (Cockburn & Smith, 1991). In this study it is noted that data from a total of 25 participants were discarded because of difficulties they had experienced in completing one or more of the measures used in the development protocol. This later study seems to explain why the test manual presents summary data for numbers varying from 94 to 114 participants. Formal norms for 106 participants aged 70 to 94 years living in their own homes or sheltered housing have been published.

#### **4.4 Validation**

Validation studies arising from the initial development of the RBMT were reported by the Rivermead researchers in their supplement to the Test Manual (Wilson, Baddeley et al., 1989). The finding of substantially lower scores for their brain-damaged patients compared to normal controls provided a “crude indication” (p.5) of validity. This finding was later validated by therapists’ ratings taken over a two-week period in which memory lapses were recorded daily on the Behavioural Checklist. The correlation between memory lapses recorded and the patients’ RBMT Profile score was  $-.75$  ( $p < .001$ ). Subjective ratings of memory problems provided by relatives and the patients themselves also provided some support for the validity of the RBMT as a measure of day-to-day memory performance.

As a further method of validation, Profile and Screening scores for patients aged 14 to 69 were correlated with scores on a number of standard memory measures. Since the RBMT was designed as a measure of day-to-day memory, high correlations with more traditional memory measures were

not expected. Results in the range .20 to .43 on five tests and .60 to .63 on two tests were reported. All correlations exceeded  $p < .05$  level.

As noted, the above findings did not relate specifically to older adults. A preliminary study of the relevance of the RBMT for use with older people was based on a sample of 20 independent-living and 20 partially dependent elderly (Cockburn & Collin, 1988). As well as the RBMT, the sample completed the Mini Mental Status Examination (MMSE), (Folstein, Folstein, & McHugh, 1975). The authors noted a considerable difference in test scores favouring the independent-living sample. They also reported that two of the subtests, Date and Route (Immediate) were less sensitive discriminators between the two groups. This study concluded that the RBMT was a reliable and valid test for discriminating memory ability before memory loss had become severe enough to be detected on the MMSE.

Several independent validation studies have been reported which have generally supported the findings reported by the Rivermead researchers. Lincoln and Tinson, (1989) reported higher correlations between the Behavioural Checklist and a pre-publication version of the RBMT, than with a number of more conventional tests. The results were considered predictable since the content of the RBMT is more context-relevant than the more abstract and experimental material used in conventional tests of memory. A further study compared RBMT performance of a group of 36 brain-damaged patients aged 18 to 63 with results on laboratory cognitive measures and ratings of everyday functioning obtained from staff and relatives (Malec, Zweber, & DePompolo, 1990). Results led the authors to conclude that the RBMT was a valid measure of memory function. A similar conclusion was reached from a study of 41 stroke patients who completed a Dutch version of the RBMT and two conventional memory tests (Van der Feen, Van Balen, & Eling, 1988). This study aimed to compare test performances against three sources of behavioural ratings to determine which related better to everyday memory function. Only the Screening score was examined and

was found to correlate significantly with the behavioural ratings ( $r = .75$ ). A recent review indicates that at least four other European studies have validated the RBMT as a reliable measure of everyday memory in both younger and older participants (Garcia et al., 1998).

In addition to the above, there have been a number of reports published in which the RBMT has been used as a dependent variable for measuring cognitive changes in older participants following the manipulation of an independent variable (e.g., Dalrymple-Alford, Jamieson, & Donaldson, 1995; Grubb, O'Carroll, Cobbe, Sirel, & Fox, 1996; Kotler-Cope & Camp, 1995; Mockler, Riordan, & Sharma, 1997; Ponds & Jolles, 1996; Sunderland, Stewart, & Sluman, 1996). While these reports are mainly only of general relevance to the present studies, they support the use of the RBMT as a valid measure of cognitive change.

#### **4.5 Variables influencing performance on the RBMT**

In their 1989 study, Cockburn and Smith reported that “the greatest influence on RBMT scores appear to be chronological age, level of social, domestic and leisure activity (as measured by the Frenchay Activities Index), and current level of cognitive ability as measured by Raven’s Matrices raw score” (p.11). Of these variables, age was consistently found to have the greatest influence on RBMT scores.

Significant correlations were reported between age and raw scores for Story Recall (Immediate and Delayed) ( $p < .001$ ), Name (surname only), Belonging, Appointment and Message (each at  $p < .05$ ) but not for the remaining subtests. The correlation between age and total profile score was  $-.44$  ( $p < .01$ ). Years of education was reported as correlating with both of the Story Recall subtests ( $p < .05$ ) but not with any of the other subtests nor with the Profile score. Significant correlations

with activity level were reported for the Profile score and for all subtests except Belonging, Appointment, Picture, Story (Immediate and Delayed) and Message.

In a later reanalysis of the same data, the relative influence of intelligence and age on RBMT scores was examined more closely (Cockburn & Smith, 1991). Using a multiple regression analysis, it was found that fluid intelligence (scores obtained on the Raven's Progressive Matrices) was a significant predictor of performance on most of the memory items. However, the residual effects of chronological age was also found to be a significant predictor over and above the effects of intelligence on prospective and verbal memory items. On the other hand, number of years education and crystallised intelligence (scores on the National Adult Reading Test [NART], Nelson, 1982), made little independent predictive contribution except on the Story Recall subtests ( $p < .05$ ). Further analysis, conducted after deleting low scorers who might be seen as likely dementias (15% of the sample) continued to support pure age effects over and above the effects of intelligence.

These findings were further corroborated when data generated in the development of an extended version of the RBMT was analysed (de Wall et al., 1994). Once again, correlation analysis indicated that the various subtests were tapping separate aspects of memory, virtually all of which were found to be clearly separable from differences in verbal intelligence. The exception in this study was the Message subtest which correlated at  $-.42$  with the NART.

#### **4.6 Summary of RBMT development**

In summary, the RBMT was developed as a test of everyday memory with content drawn from observations of the type of memory failures experienced by patients with traumatic brain injuries. It differs from conventional memory tests in that it arose from clinical observations rather than from laboratory research. The test was not initially developed for older adults but subsequent research

indicated that the RBMT had potential as a measure of abnormal memory aging. The test was found to have reasonable validity as a measure of memory when used with older clinical cases. Furthermore, performance on the RBMT was not closely tied to either education or general intellectual ability although level of general activity may have had an effect on some subtests. Age was found to be the predominant demographic variable to influence test performance in the elderly normative sample. In Chapter 1 (1:3) a number of limitations inherent in conventional memory tests used to assess older adults were outlined. In the next section, the degree to which the RBMT reflects the same limitations will be evaluated.

## **EVALUATION OF THE RBMT**

### **4.7 Face validity**

Since the RBMT uses content relevant to everyday memory experiences, it could be viewed as having high face validity. Amongst the memory failures most frequently reported by older adults are forgetting names, routines, objects, faces, appointments, locations, addresses and phone numbers, what has been read and where something has been put (Cavanaugh, 1983; Scoggin & Prohaska, 1993; Yesavage, 1984). Each of these areas is reflected in RBMT content. Furthermore, the test is relatively short (25 minutes approximately) and seems more likely to reflect the day-to-day cognitive demands common to older adults.

### **4.8 Predictive validity**

Support for the predictive validity of the RBMT has been reported from at least two studies. Wilson (1991) followed up the dependency status of 43 surviving members of the patient group who had taken part in the original development of the RBMT. All survivors, who ranged in age

from 15 to 65, had experienced severe memory disorders arising from traumatic brain injury. Independence was defined as “living alone and/or in full time education and/or in paid employment” (p.126). It was found that the original Screening scores predicted subsequent independence ( $p < .01$ ). Profile scores, which were not used in the development studies, predicted independence at the higher statistical level of  $p < .001$ . This study also found that the Wechsler Memory Scale-Revised was less efficient in discriminating between dependent and independent subjects.

Goldstein et al. (1992) compared the predictive validity of the RBMT with that of two less “ecologically valid” (p.309) memory tests, the Wechsler Memory Scale and the Memory Scale from the Luria Nebraska Neuropsychological Battery. A hospitalised population ranging in age from 60 to 87 years were assigned to either a depressed group, a dementia group or a normal control group. Memory was assessed early in the course of hospitalisation, after two weeks, and again at six months post-discharge. The criterion measure was an instrument for measuring activities of daily living. While there was an attrition rate of almost 44% in this study, results indicated that each of the tests was able to predict functional abilities at six months when the data was examined for the group as a whole. However, only the RBMT showed a correlation approaching statistical significance and in the expected direction for the dementia group (but not for the depressed and normal groups).

#### **4.9 Normative data**

Normative data for the RBMT has been developed specifically for elderly people aged 70 to 94 years, reducing one of the principal weaknesses in conventional tests of memory. However, data is presented only for Profile scores that must be interpreted in percentile points given in five-year age bands. The norms can at best be used as indicators if using the test to detect memory impairment.

This is primarily because only four percentile points are given starting at (or above) the 50th and scaling down through at or above the 20th, 10th and 5th percentiles. There can obviously be a very large functional variation between a 70 year old scoring, for example, at or above the 20th compared to the 50th percentile rank.

A more fundamental reservation about the published norms, however, is that they may underestimate normal day-to-day memory performance in well, independent-living older adults (Fraser & Glass, 1996). As noted earlier, everyday memory is generally accepted as being a relatively stable skill during adulthood. It has been likened by van Balen et al. (1996) to a species-wide capacity. According to Lezak's (1995) definition of such capacities, this implies that it is not closely tied to demographic variables and does not vary greatly in cognitively intact people although aging may "dull" it (Lezak, p. 100). As such, it follows that test scores obtained on valid measures of everyday memory would not be expected to follow a normal distribution. This was confirmed in the initial adult standardisation across the age range 16 to 70 years where the distribution of RBMT scores were reported as J-shaped (Wilson et al., 1989). In contrast, the elderly standardisation of the RBMT reported a normal-shaped distribution of test scores which suggested that older-age performance may be influenced by cognitive aging in addition to certain demographic variables. However, it is possible that due to the sampling procedures followed, the greater variability in the distribution of scores is reflecting a bias towards indifferent health or higher than average dependency rather than a reliable pattern of RBMT performance in older populations.

As previously noted, the published norms for elderly are presented for 106 participants as not all of the 119 could complete all of the test protocol. There were indications that the sample may have had a lower level of social, domestic and leisure activity and a higher average level of dependency than might be found in the wider adult population. This seems even more likely when, in a later

reexamination of the original data from which 25 data sets had been removed, it was noted that a further 15% of cases (approximately 14) were removed from the 94 remaining, because of the likelihood of an incipient dementia (Cockburn & Smith, 1991). It is possible these factors account for the moderate correlations between several of the subtest scores and the Frenchay Activities Index although it was noted that the amount of home help had no significant effect on RBMT performance “independent of the contribution of the other variables” (Cockburn & Smith, 1989, p.9).

To examine the reliability of the Oxford norms, Fraser, Glass, and Leathem, (in press, see Appendix B) collected data on the RBMT for well, independent-living older adults aged 60 to 89 and compared this against the Oxford data. The distribution of scores was predominantly J-shaped. The Profile scores for the 70 to 89 year old participants were significantly higher for the NZ data ( $p < .001$ ) as were six of the standardised subtest scores. Fraser et al. concluded that normal older adults in the 70 year plus age range were capable of more robust performance on the RBMT than the Rivermead researchers had found. The Fraser et al. data supported that of others (see Chapter 2, 2:5) who have reported that everyday memory remains a stable skill well into older age. The study suggested that the Oxford norms were more representative of unwell and semi-dependent older adults.

A further finding from the Fraser et al. study was that Profile scores for participants aged 60 to 69 years were almost two points lower than the wider 16 to 69 year age group reported by the Oxford researchers. The latter had concluded that separate norms for age 60 to 69 were unnecessary since their RBMT performance was essentially the same as that for younger groups. As it is often in this age range that an early dementia will first present, normative data is preferable from the seventh to the ninth decades.

Assuming that everyday memory is a species-wide capability, there arises the issue of whether population or clinical norms are likely to be of greater value in work with older adults. Lezak (1995), notes that population-based norms are most useful for measurement of deficit for functions that develop in the course of childhood and are not closely tied to either education or general intellectual ability. This would seem to fit with what is known about everyday memory capacity. However, much of the clinical application of memory tests in older adults is aimed at differentiating between changes due to disease and those due to aging. For this task, stratified norms derived from diagnosed clinical samples and from groups representative of different populations of older adults such as well-independent, unwell, and dependent, are more useful. This issue has been addressed recently with the publication of normative Profile and Screening scores for older adults based on aetiology-specific characteristics (van Balen et al., 1996). The norms are derived from 892 cases including data for stroke, dementia, traumatic brain injured, unwell and psychiatric cases as well as norms for a control group of healthy adults. Unfortunately, the stratified norms are based only on Profile and Screening scores and no subtest data is included. The authors noted that subtest data would be desirable.

#### **4.10 Parallel forms**

Lack of parallel forms has been addressed with the publication of four separate versions of the RBMT. The likelihood of practice effects with serial administrations is therefore minimised although such effects may occur with the route recall subtests (Garcia et al., 1998).

#### **4.11 Ceiling effects**

A criticism made of the RBMT is that it lacks sensitivity at both high and low ends of memory function and Lezak (1995) writes that the test “is useless for identifying subtle or small memory

deficits in most of the outpatients [she sees]” (p. 512). However, there are grounds to question this when the target population is older people, particularly if increased emphasis were to be placed on subtest scoring patterns.

To address the criticism of ceiling effects, an extended version of the RBMT has been developed for clinical trials (de Wall et al., 1994). In undertaking this work, it was aimed to develop a measure which would be able to detect the relatively small differences in memory performance typically found when healthy older adults are compared to middle-aged adults. It was also aimed to produce a range of scores relatively free of floor or ceiling effects. The normative sample in the initial study of the extended version comprised only 26 middle-aged (mean age 46.7 years) and 22 older participants (mean age 70.0 years) and the need for a larger sample was acknowledged. According to recent advance publicity, the RBMT (Extended version) is about to become commercially available in two parallel forms (Wilson et al., 1999).

While the test in its present form may be less suitable for use with many of the highest functioning individuals, clinical experience indicates that it can almost invariably yield useful information when used with very low functioning people. Although occasionally the test can not be given in its entirety, individual subtests can be administered separately. Furthermore, research on attempts to modify or refine aspects of the RBMT for use with special groups has been reported. One such study looked at the effect of replacing the need to walk around a room in completing the Route subtests for people whose physical mobility was restricted (Towle & Wilsher, 1989). In this study, 20 immobile stroke cases were asked to move a small figure around a line drawing of a room rather than actually walk the route. It was concluded that this is a reliable substitution to make in such cases. A refinement for use with dysphasic patients has also been reported (Cockburn, Wilson, Baddeley, & Hiorns, 1990).

#### 4.12 Discriminative validity

The sensitivity of the RBMT in detecting dementia generally has been reported. Three studies have focussed on particular subtest scoring patterns rather than summary Profile or Screening scores. One such study reported that the Route and Story subtests (Immediate and Delayed recall) and the Name subtest were especially sensitive to gradations in dementia (Beardsall & Huppert, 1991). The researchers were able to distinguish a group with “minimal dementia” from a “low-scoring normal” group and a group diagnosed as having “mild/moderate” dementia. Using the same three groups, the researchers later tested the hypothesis that prospective memory would be more vulnerable than retrospective memory to the effects of cognitive impairment in dementia (Huppert & Beardsall, 1993). The three prospective memory subtests used were Appointment, Belonging and Message. Five retrospective memory tasks were used three of which were RBMT subtests, Route recall (Immediate and Delayed) and Name. Findings were in line with the hypothesis that prospective memory is susceptible “even to the mildest form of cognitive impairment in dementia, a level of severity so mild that the diagnosis of dementia does not meet the operational criteria of DSM-III-R...but may represent a very early stage of the disorder” (p.818). In this study, the data on retrospective memory (in relation to the RBMT subtests) was not as carefully examined except for Route recall (Delayed). Results indicated that the minimal dementia group displayed greater impairment on the prospective task (remembering to deliver the message) than they did for the retrospective task (remembering the details of the route).

One potential weakness in the Huppert and Beardsall data is that of the 70 participants, only twelve were in their minimally demented group and five (later increased to nine) in their mildly/moderately demented group. (There were 27 “normals” and 26 “low-scoring normals”). Nevertheless, these studies are significant in terms of the present research in that they support an emphasis on subtest

analysis as a possible aid to diagnosis. The Huppert and Beardsall data point to the possibility that some of the subtests may be more sensitive both in detecting dementia and in distinguishing between grades of dementia. It is, in fact, surprising that the developers of the RBMT did not undertake more work on subtest analysis since the observation that not all subtests were equally sensitive in detecting cognitive impairment was reported in one of their earlier studies (Cockburn & Collin, 1988).

It is possible that analysis of subtest scores may have led to a different conclusion by Jhaveri (1989) who failed to find any significant differential memory effects in three groups of older adults who received different types of anaesthetic for cataract surgery. In this study, the total raw score for all 12 subtests was used as one of two criterion measures. While little change in the total scores was found over three administrations, it is possible that differences in individual subtest scores would have been identified had they been analysed separately. However, Grubb et al. (1996) reported that severity of memory impairment on RBMT Profile scores correlated significantly with measures of duration of cardiac arrest, when survivors were tested at least two months following the event. Also of interest in this study was the finding that the level of memory deficit was not significantly associated with age, occupation, social situation, or estimated premorbid intelligence which further supports the relative neutrality of the RBMT as a measure of everyday memory.

A study reported from a Chinese medical journal examined differential subtest patterns on the RBMT in 142 patients with cerebral arteriosclerosis and a control group (Yuan et al., 1993). The study reported a correlation between the degree of damage shown on neuroimaging data and decline in screening scores on the RBMT. The highest rate of "anomalies" in subtest screening scores was found for patients with cerebral arteriosclerosis compared to the control group. This report also noted that, except for the Picture and Face Recognition subtests, all of the subtests were significantly different between the two groups. The authors noted that many of the people in their

control group “got low scores with (the) behavioural memory test” which was seen as support for the sensitivity of the RBMT in detecting early cognitive change. Further support for discriminative validity between different clinical groups is reported in a recent Spanish study of mainly older adults (Perez & Godoy, 1998).

#### **4.13 Demand characteristics**

Two studies have examined demand characteristics in relation to the RBMT. Cockburn and Smith (1994) studied the effects of anxiety on scores obtained for the Appointment subtest using the elderly standardisation data. Anxiety level had been measured using a visual analogue scale. They reported more correct responses for low and high anxiety than for intermediate levels and tentatively explained their findings in terms of the effects of anxiety on working memory capacity. Koenders et al. (1993) differentiated between two types of anxiety in their study. They examined the effects of state (situational) and trait (achievement motivation) anxiety on test performance in older adults (average age 73.6 years) on the RBMT and a conventional memory test. Twenty-six of the sample of 35 were diagnosed with a dementia of which 22 had a diagnosis of DAT. It was concluded that state anxiety had no measurable effect on RBMT performance while trait anxiety had a positive effect (more so on the conventional test). Koenders and colleagues did not report on subtest differences therefore their results can not be compared with those of Cockburn and Smith. While they concluded that differentiating between the two forms of anxiety should be an essential preliminary to testing, their correlations were low and no raw score data was provided. It is difficult to judge therefore, how much emphasis should be placed on their suggestion since clinical experience has not suggested anxiety to be a common occurrence. In support, it is noted that Grubb et al. (1996) in their study of survivors of cardiac arrest, reported that severity of memory impairment was not significantly associated with either measures of anxiety or depression.

#### 4.14 Summary

The RBMT is a measure of everyday memory. Evidence suggests that it is less affected by the limitations found in more conventional measures of memory when used with older adults.

Development studies indicate that the test appears relatively uninfluenced by demographic variables apart from age, it has high face validity, and there is some support for its validity in predicting functional independence. Furthermore, there are encouraging preliminary reports that the RBMT may be more successful than many conventional tests in discriminating between pathologies underlying evidence of dementia.

The most obvious weakness in the RBMT relates to the normative data for older adults. There are indications that this needs to be reviewed as it appears to underestimate the performance of healthy independent older adults and reflects more the performance of semi-dependent 70 to 90 year olds. In effect, the published norms may represent a set of stratified norms for semi-dependent and unwell older people. The availability of recently published norms based on stratified clinical groups is a useful development but subtest data has not been reported for either population-based or stratified samples. The evidence to date suggests that investigation of discriminative validity will depend on increased emphasis on interpretation of differential subtest scores. Thus a particular subtest score pattern may signal a high probability of an early dementing condition irrespective of the Profile score. Before this can be investigated more thoroughly, improved normative data covering the three decades from age 60 and including subtest data is required. Further, such data is needed both for different clinical groups and for normal, well, independent older adults.

While the RBMT would usually be supplemented with other measures in a comprehensive assessment of memory processes, it appears to be a useful measure of the day-to-day demands on

memory experienced by most older adults. As a measure of everyday memory, it has been described by the Rivermead researchers as having higher ecological validity than any other available test (de Wall et al., 1994) and there has been recent independent support for this view (Garcia et al., 1998). It seems possible then, that the RBMT is relatively consistent with the views of Hunt (1986) and others who advocate the use of measures of memory performance in real-life settings using content which recognises contextual variables.

## CHAPTER 5

### RECAPITULATION AND EVOLUTION OF RESEARCH DESIGN

*One of the most striking features of human memory research over the past decade has been the increasing concern with measuring the function of memory under realistic everyday conditions.” (de Wall et al., 1994, p.149).*

#### 5.1 Recapitulation

One of the major reasons to conduct a psychogeriatric assessment is to rule out early onset dementia as a likely cause of memory loss. Measures of memory have an important role in this process. Assessment of memory in older adults, however, presents special difficulties. It is complicated by normal age-related changes, by varying levels of health and disability and by a shortage of suitable measures. Conventional memory tests were not developed with the needs of older adults in mind and do not measure up well against most of the key considerations when testing an older person. It is likely their use with older adults overestimates the level of impairment relative to the day-to-day demands on memory that most older people experience. This, in turn, might help to explain why memory tests have not been successful in discriminating between the different pathologies underlying evidence of impairment. The process is further complicated by inadequacies in the theory underpinning memory aging.

The Rivermead Behavioural Memory Test (RBMT) is a relatively new memory assessment measure. Although designed for use with younger head injured victims, it has subsequently proven useful for detecting and monitoring memory changes in older adults. The test is not theoretically based, moving away from conventional memory assessment by using instead, everyday memory situations through a series of short subtests. Test results are converted to summary scores designed

to screen for abnormal memory loss. The RBMT appears to be high in ecological validity and therefore more consistent with calls for context-relevancy in measuring everyday memory in older adults.

Although studies generally support the reliability and validity of the RBMT, it is doubtful that the norms reliably represent the performance of well, independent older adults. As noted, the sampling procedures probably resulted in a broad-based sample weighted with unwell and semi-dependent older adults. Furthermore, normative data was based on a sample aged 70 to 90 years with 60 to 69 year olds included in the wider 16 to 69 year norms. There are indications that these norms overestimated the normal performance of people aged 60 to 69 years. A further weakness is the absence of normative data based on raw scores for individual subtests. The conversion of raw scores to standard scores disguises the possible significance of subtest analysis when working with different clinical groups.

## **5.2 The current studies**

The current studies evolved from an interest in functionally-based memory assessment of older adults and from early clinical observations of RBMT scoring profiles.

Study 1 involved an exploratory analysis of early RBMT clinical data to determine whether further research was warranted. Preliminary analyses were encouraging as summary Profile and Screening scores appeared to discriminate different degrees of memory aging without being confounded by chronological age. There was also a suggestion of gender differences on at least two subtests, based on raw score analysis. Of special interest was the different pattern of subtest failures observed in cases with a likely diagnosis of dementia compared to other clinical cases. This pattern was more noticeable in cases diagnosed as probable DAT and lead to speculation that certain subtests could

serve as markers to dementia. The Huppert and Beardsall (1993) study, which appeared about this time, provided some support for this view. However, the RBMT was not designed as a diagnostic tool and extending its use in this way highlighted the inadequacies in the normative data described earlier.

An initial concern was the absence of reliable norms for performance on subtests in a normal healthy population. Although observations suggested it unlikely that a similar pattern of subtest scores would occur in both a healthy older sample and a sample known to have a dementia, it was nevertheless necessary to obtain confirmation of such a pattern. This required collection of data from a well, independent older sample. It was also important to clarify the subtest pattern in a sample of generally unwell older adults not suspected of having a dementia. Such a sample could be expected to perform somewhere between the well and demented samples but presumably obtain a different subtest profile to those with a dementia. Study 2, therefore, involved a comparison of RBMT Summary and Subtest scores between an unwell sample, a demented sample and a well, independent sample. The study aimed to establish reliable data for both clinical and nonclinical samples with a special emphasis on raw score subtest scoring patterns.

Study 3 clarified the effects of age, education and gender on scoring patterns with the aim of increasing reliability of subtest interpretation. This study involved a reanalysis of the raw score data obtained in Study 2.

With subtest scoring patterns established for the three samples, Study 4 involved a regrouping of the dementia sample into a vascular and a nonvascular diagnostic group. The study sought to verify whether consistent differences existed in raw score subtest patterns between the two groups. Such patterns would provide support for the discriminative validity of the RBMT and encourage greater emphasis on ecological validity in memory measures used in assessment of older adults.

### 5.3 Research design

The overall research design is summarised in Table 5:1

**Table 5:1**

#### Summary of research design and progression

<u>Study</u>	<u>Investigation</u>	<u>Sample details</u>		
1.	Exploratory analysis of subtest scoring patterns	Consecutive clinical cases tested on RBMT over a two year period ( <u>N</u> = 78)		
2.	Compared RBMT summary and subtest scores	Diagnosed Dementia ( <u>n</u> = 74)	Unwell ( <u>n</u> = 51)	Well-Independent ( <u>n</u> = 80)
3.	Clarified effects of age, education and gender on score patterns	74	51	80
4.	Compared subtest scores by dementia type	35 (Vascular Dementia)	39 (Nonvascular Dementia)	

## CHAPTER 6

### STUDY 1: EXPLORATORY ANALYSIS OF RBMT DATA IN A CLINICAL PSYCHOGERIATRIC SETTING

*“Memory research must include the everyday, the naturalistic, to generate meaningful questions about an ability that is really a survival function for an organism living in a multi-system world.”  
(Sinnott, 1992, p.67).*

#### 6.1 Introduction

The RBMT had been used as part of the assessment processes in a regional psychogeriatric setting over a period of 12 months, at the time of this analysis. Referrals represented a cross-section of mainly older adults and included probable DAT cases, other likely central nervous system (CNS) degenerative cases, people with a history of cortico-vascular disease and stroke as well as others for whom memory problems had been reported.

Clinical observations had generally indicated the RBMT to be a reliable, relevant and pragmatic measure of the memory performance of older adults. A review of early clinical data collected during the first several months of using the test suggested that closer attention to the subtest scoring pattern obtained by individual cases could enhance the interpretation of results in a clinical psychogeriatric setting. Although Profile and Screening scores tended to suggest similar levels of memory impairment between cases, the contribution of subtests to the summary scores appeared to be quite variable. This review, together with relevant research, suggested that three aspects of the test could be targeted for exploratory analysis:

1. Subtest sensitivity: The Huppert and Beardsall (1991) and Cockburn and Collin (1988) studies (cited in Chapter 4) suggested that some subtests were more sensitive than others in detecting cognitive impairment.
2. Gender effects: Although it is reported that “neither patients nor the control group showed any significant differences in performance as a function of sex either for overall score or on any of the subtests” (Wilson, Baddeley et al., 1989, p.13) other research has suggested differential rates of cognitive impairment amongst older men and women with women tending to show greater impairment on semantic-type tasks (Bentham, Jones, & Hodges, 1997; Buckwalter, et al., 1996; Jagger, Clarke, & Cook, 1988).
3. False positive responses: Research findings have suggested that reduced performance on recognition-type tasks and the occurrence of false positive responses may be associated with dementia (Gianotti & Marra, 1994; Hart & Semple, 1990).

## 6.2 Method

### Participants.

Consecutive data sets were available for 78 clinical cases (37 female and 41 male ). Average age was 72.6 years (males) and 74.1 years (females) ranging from 48 to 90 years. No exclusion criteria were applied and all participants with complete data sets were included regardless of type of CNS disease. Based on the MMSE score (Folstein et al., 1975), data was divided into a high MMSE group  $\geq 24$  (high) and a low MMSE group  $\leq 23$  (low). This division, which was similar to that used by Cockburn and Collin (1988) in their preliminary study, resulted in 41 cases in the high group and 37 in the low group. The mean MMSE score for the total sample was 23.23 (26.45 for the high group and 20.31 for the low group), with a range of 14 to 30 in scores. Almost similar MMSE

scores for gender were obtained by the high group (26.58 and 26.60, males and females respectively) with minor differences in the low group favouring males (21.05 and 19.31). Based on behavioural reports and other psychometric data, the majority of low cases would be defined as having mild cognitive impairment.

### **Procedure.**

All clinical cases had completed both the MMSE and the RBMT in addition to other measures as part of neuropsychological assessment. The procedure followed was comparable to the Cockburn and Collin (1988) study except that both summary and subtest scores were examined in the current study.

### **6.3 Results**

Means and standard deviations for Profile and Screening scores and for subtest scores were computed for the high and low groups. Since the study was designed as exploratory and no exclusion criteria had been applied to the sample, statistical analysis was restricted to Student's t-tests and a correlational analysis. There were three main findings to emerge from this preliminary study.

Firstly, as shown in Table 6:1, some subtests appeared to be more sensitive to level of cognitive impairment based on the MMSE score. While there was a trend towards negative correlations between age and scores on both the MMSE and the RBMT, the only significant correlation was found on Delayed Story recall on the RBMT ( $r = -.319, p < .05$ ). Age, therefore, did not appear to be a confounding variable and the overall pattern of scoring was consistent with decreasing scores with increasing cognitive impairment.

Belonging and Date and the addition of Route (Delayed), this data is similar to that of Cockburn and Collin (1988). It was noted that only three Profile scores (Name, and Immediate and Delayed Story recall) met the failure criteria each of which occurred in the low MMSE group.

Secondly, there was tentative support for gender differences on Story recall subtests. Both the mean Profile and Screening scores were higher for males than females on the Story recall subtests irrespective of MMSE groupings. The mean raw scores for males and females on the Immediate recall subtest were 4.15 and 2.4,  $t(76) = 3.37$ ,  $p < .01$  and on Delayed recall 2.33 and 1.24,  $t(76) = 2.31$ ,  $p < .05$ . These differences are illustrated in Table 6:2 which presents the percentage of each gender reaching raw score criteria for the Profile and Screening score on Immediate and Delayed Story recall.

**Table 6.2**

**Percent of males (n = 41) and females (n = 37) reaching raw score criteria for Screening and Profile score on Story Recall subtests grouped by high and low MMSE score**

	Screening Score		Profile Score	
	Female	Male	Female	Male
<b><u>Immediate Recall</u></b>				
High MMSE	12.1	52.4	25.0	66.7
Low MMSE	0.0	9.5	15.0	52.4
<b><u>Delayed Recall</u></b>				
High MMSE	12.5	47.6	43.8	81.1
Low MMSE	5.0	9.5	15.0	33.3

**Table 6.1****Proportion (%) of sample failing each RBMT subtest grouped by high (n=37) and low (n=41) MMSE Score**

Subtest	Screening score		Profile score	
	High	Low	High	Low
Names	48.65	80.47	56.76	80.49
Appointment	62.16	87.80	16.22	46.34
Date	37.84	70.73	27.03	36.59
Face	51.35	65.85	18.92	21.95
Message	59.46	70.73	40.54	60.98
Orientation	37.84	73.17	8.11	50.00
Picture	32.43	58.54	16.22	24.39
Route (I) <sup>a</sup>	32.43	58.54	18.92	36.59
Route (D) <sup>b</sup>	37.84	60.98	29.73	41.46
Story (I) <sup>a</sup>	75.68	85.37	51.35	75.61
Story (D) <sup>b</sup>	75.68	92.68	35.14	78.05
Belonging	56.76	65.85	8.11	26.83

<sup>a</sup> Immediate recall; <sup>b</sup> Delayed recall

The pattern of scoring resembled that of the Cockburn and Collin (1988) semi-dependent (Day Hospital) group. In that study, the most sensitive subtests were defined as those on which two thirds or more of the sample failed on the Screening Scores. Applying the same criteria in the current study, the most sensitive subtests for the low MMSE group were Name, Belonging, Appointment, Orientation, Message, Immediate and Delayed Story recall, Face Recognition and Date. In contrast, the most sensitive subtests for the high MMSE group, were Immediate and Delayed Story recall with Appointment almost reaching the two thirds criteria. Aside from

Finally, false positive errors were found to be more prevalent amongst the low than the high group. On the Picture Recognition subtest, 2% of the high MMSE group compared to 26% of the low group made false positive errors. On the Face Recognition subtest, 24% of the high and 34% of the low MMSE group made false positive errors. To further explore these trends, a subset of 24 cases was isolated for additional analysis. Each case had a provisional medical diagnosis of a probable DAT pathology. Sixty-four percent was found to have made false positive errors on the Picture Recognition subtest while 50% made false positive errors on the Face Recognition subtest. Because of the unselected nature of this subsample, the findings were not subjected to statistical analysis. However, they were interpreted as tentative support for a more thorough analysis of false positive responses at a later date.

#### **6.4 Discussion**

Exploratory analysis of unselected clinical data from older clients with a wide range of diagnoses, revealed fairly similar patterns to those previously reported in the early study of Cockburn and Collin, (1988). Thus, higher scores on the RBMT were generally recorded by those with higher than lower MMSE scores. However, two discrepancies were found in this exploratory study. Firstly, males in both high and low MMSE groups scored at higher levels than females on the Story Recall subtests and secondly, a pattern of false positive responding emerged which appeared worthy of further examination.

Based on these patterns, it was hypothesised that the interpretation and practical application of results on the RBMT might be enhanced by more careful scrutiny of differential responding on subtests especially in cases suspected of an early dementia. Although not examined in this initial analysis, the wider question arose as to whether some RBMT subtests might prove more sensitive

than others in discriminating between normal and abnormal cognitive aging. It was further speculated that a subtest or combination of subtests might prove to have diagnostic potential (Glass, 1996). However, before these questions could be examined, it was apparent that improved normative data that encompassed subtest performance was an overriding prerequisite. Furthermore, such data was needed for well, independent-living older adults as well as for clinical samples.

## CHAPTER 7

### STUDY 2: COMPARISON OF RBMT PROFILE, SCREENING AND SUBTEST SCORES BETWEEN WELL, UNWELL AND DEMENTING OLDER ADULTS

*“It is important to recognise that reliability of psychological tests is not an absolute quantity but varies across samples and situations. When assessing the memory of the elderly, clinicians need to know the reliability of a test for both community dwelling elderly and impaired groups.”*  
(Cunningham, 1986, p.31).

#### 7.1 Introduction

It is likely that the published norms for the RBMT underestimate normal day-to-day memory performance in adults aged 70-89 and overestimate normal performance in people aged 60-69 (Fraser et al., in press). Furthermore, the published norms relate only to summary Profile scores and do not include raw score performance standards for the 12 subtests.

As noted, uncertainty about the reliability of the published norms and the lack of subtest mean raw score data, limits the clinical application of the RBMT and restricts interpretation of results. Thus a well-normal client, an unwell client and a client with an early dementia will often be found to have similar or near similar summary Profile scores made up of different patterns of subtest scores. Examination of these differences may be helpful in discriminating between the pathology underlying evidence of cognitive impairment (Glass, 1996; Glass, 1998, Appendix C).

In clinical practice it is useful to have standards of performance not only for representative demographic samples of older adults but also for clinical groups such as unwell older adults and for those with a diagnosis of dementia. Although van Balen et al. (1996) produced a set of stratified

mean Screening and Profile scores for healthy elderly controls as well as for cases with stroke, dementia, traumatic brain injury and alcohol related impairment, they did not produce subtest data.

The current study was designed to establish reliable RBMT Profile and subtest data for stratified samples of older adults in a provincial New Zealand setting. Such data was necessary to clarify scoring similarities and differences between older people who were well, unwell or diagnosed with a dementing condition. Until such standards were established, further work on evaluating the possible diagnostic significance of RBMT score patterns could not proceed. Additionally, it was considered that the subtest data generated would be valuable in clinical practice when interpreting individual result profiles and as an adjunct to the published norms.

In this study, the performance of a well, independent-living older sample was compared with that of two clinical samples, one diagnosed as having a dementia and the other representing a cross-section of unwell older adults. Special emphasis was placed on subtest analysis. Arising from the exploratory study described in Chapter 6, the patterns of false positive responses on the two Recognition subtests were identified for separate analysis for each of the samples.

## 7.2 Hypotheses

1. There will be significant differences between RBMT Profile, Screening and Subtest scores obtained by a well, independent-living older sample (well), an unwell older sample (unwell), and an older sample diagnosed with a dementia (dementia).
2. The dementia sample will record a higher frequency of false positive responses on the Picture Recognition and Face Recognition subtests than either the well or unwell samples.

### 7.3 Method

#### Participants

##### Well sample.

This group comprised 80 participants drawn from a larger group of 131 volunteers aged between 60 and 89 who had taken part in a New Zealand-based normative investigation of the RBMT (Fraser et al., in press, Appendix B). Participants were predominantly Caucasian. All participants had been required to meet a set of inclusion criteria including reaching a defined standard on the Short Form of the MMSE (Braekhus et al., 1992). For the present study, sample size and characteristics were sought which were relatively similar to the two clinical groups. Thus age, gender and years of formal education (i.e., total of primary and secondary schooling combined) were broadly matched. In addition, normal or near normal performance on the RBMT was sought based on the summary Profile score obtained. To this end, data sets with a Profile score over one standard deviation below the mean Profile score for the appropriate age decade reported in the Fraser et al study were excluded. On this basis, 15 data sets were removed.<sup>1</sup> To arrive at a sample size relatively similar

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<sup>1</sup>There are a number of justifications for eliminating data in this way. It has been noted that everyday memory is a relatively stable skill during adulthood (Youngjohn & Crook, 1993). It has also been noted that most people (at least up to the age of 69 years) should obtain normal or near normal scores on the RBMT i.e., Profile score 22 – 24; Screening score 10 – 12 (Wilson et al., 1989; Lezak, 1995). It is likely that at least some volunteers came forward because of concern about their day-to-day memory although this was one of the exclusion criteria. It is equally likely that some of those eliminated were unwell but not receiving medical treatment; some may have been in the early stages of a dementing process. In clinical practice, a score at or below one standard deviation from the mean of a test would be grounds for further assessment once other relevant factors had been taken into account. The current study sought a sample stratified on the basis of normal or near normal summary Profile scores as the ultimate aim was to clarify differential subtest patterns. The original Fraser et al. sample comprised 138 volunteers. Seven data sets were removed as outliers when the data was being prepared for publication since each was 2.5 or more standard deviations below the mean for the relevant age decade. Follow-up medical and neuropsychological investigation of five of the participants achieving these scores revealed that four were suffering from a dementing condition. In total, 22 data sets (7 + 15) were removed from the original volunteer group of 138. These cases had an average age of 72.43 years and an average of 10.47 years of formal education. This compared with 72.92 years and 10.59 years for the remaining 116. Based on these comparisons, it seemed unlikely that either education or age were contributing factors to the lower scores. Full details of the Fraser et al. sample is contained in Appendix B.

to the two clinical samples, a further 36 cases were eliminated via a random elimination process applied proportionately to each decade to maintain roughly similar age and gender characteristics. The remaining 80 cases had an average age of 73.03 years. Thirty-four percent had received nine or less years of formal education, 35% had received 10 or 11 years and 31% had completed 12 or more years. Overall, the average number of years of education was 10.64 years (range 6-18 years).

### **Unwell sample.**

This group comprised 51 data sets drawn retrospectively from a larger pool of 272 cases that had been referred over a five-year period for assessment of cognitive function. Participants with known cerebro-vascular and neurological pathologies likely to explain reported cognitive difficulties at the time of referral were excluded as were those who were referred back to the service due to further cognitive complaints. Apart from these exclusions, two aims were paramount. The first was that the sample be representative of unwell older people typically seen in a comprehensive service for older adults. The second aim was to match data sets as closely as possible to the age and gender distributions of the well and dementia samples. A range of nonacute medical and surgical conditions was represented in the final sample. This included seven participants (14%) who were rehabilitating following hip replacement surgery or repair of fractured hip or femur and 13 (25%) with a known single or comorbid diagnosis of clinical depression.

Participants were being treated as inpatients (22%), outpatients (46%) or community day patients (32%) when referred. At the time they had become unwell, all but four were living in their own homes. The average MMSE score (Folstein et al., 1975) was 26.5 (range 18 to 30). No participant included in this analysis had satisfied the criteria for a diagnosis of dementia based on DSM criteria (DSM-III-R 1987 third edition, revised; DSM-IV 1994 fourth edition). The average age of the sample was 75.45 years which was almost 2½ years older than the well sample. This was unavoidable due to the stringent exclusion criteria. However, subsequent analysis (see Chapter 8)

indicated that age was not a biasing factor. Forty-one percent had completed nine years or less formal education, 33% 10 or 11 years and 22% 12 or more years. (Education level could not be confirmed for two cases.) Based on data for the 49 for whom formal education could be estimated, the average was 9.89 years (9.37 and 10.41 males and females respectively).

### **Dementia sample.**

This group comprised 74 data sets, extracted from case records of 165 older adults referred for cognitive assessment over a period of 33 months up until October 1994. Case records were extracted if both neuroimaging data and a RBMT profile were available. Those cases which appeared to satisfy a DSM-III-R diagnostic criteria (DSM-III-R 1987 third edition, revised) for vascular or nonvascular dementia were retained. A total of 91 cases met the criteria.

The clinical record of each of the 91 cases was reviewed by a consultant geriatrician which resulted in 17 cases being removed. Thirteen were discarded either because the pathology was complicated by such factors as known alcoholism, Parkinson's Disease, Huntington's Chorea (one case) and severe depression or because a dementing condition was not reasonably confirmed. A further four younger cases (age < 60) were removed to preserve the homogeneity of the sample. This selection process left 74 cases for which a clear diagnosis of dementia was established. No attempt was made to separate cases according to lesion location and spread or to the type or stage of dementia at the time of testing. The majority of cases were in the early to mildly demented stage based on the MMSE score (Mean 23.03, range 12 to 30) and on behavioural reports.

The sample of 74 had a mean age of 74.79 years (range 60 to 89). Forty-three percent had completed nine or less years of formal education, 23%, 10 or 11 years and 32% 12 or more years. Approximate average years of formal education was 10.19 years. Reasons for referral included baseline documentation of cognitive impairment, assistance with diagnosis and discharge planning,

and evaluation for possible cognitive remediation training. Participants came from the same variety of sources as those detailed for the unwell sample; inpatients (20%), outpatients (34%) and day hospital cases (28%). A further 18% had been referred via primary healthcare providers.

The main demographic features of the three samples are summarised in Table 7:1.

**Table 7.1**

**Summary of demographic characteristics of participants**

Characteristic	Well ( <u>n</u> = 80)	Unwell ( <u>n</u> = 51)	Dementia ( <u>n</u> = 74)
Age (Mean years)	73.03	75.45	74.79
Education (Mean years)	10.64	9.89	10.19
Age groupings (%)			
60-69	27	29	22
70-79	48	47	53
80-89	25	24	24
Gender (%)			
Male	43	51	45
Female	57	49	55

**Measures.**

The RBMT was administered to all participants. Eighty-three percent of cases (104) comprising the two clinical groups completed Version A of the test. Twenty percent (16) from the well sample completed Version A while the remainder completed Version B. Although Wilson et al. (1989) reported high intercorrelations for all four versions when the test was initially developed, for the

purposes of the current study it was considered prudent to cross-check performance on the two sets. Accordingly, Profile and Screening scores were compared for the 16 participants who completed Version A with a randomly selected group of 16 who had completed Version B. The mean Profile and Screening scores for the groups were very similar (Profile, 19.68 and 19.25; Screening, 8.93 and 8.87 for Versions A and B respectively). An independent samples t-test indicated no significant differences and the correlation between the two versions was .94.

The stories used in the RBMT Story recall subtests reflected minor terminology relevant to the United Kingdom setting. In keeping with the ecological validity of the test, the stories for Versions A and B were amended to make them relevant in the New Zealand context (in a similar way to North American amendments which were published with the test). As the modifications did not alter the gist of the stories, equivalency was maintained.<sup>2</sup> The original and the amended versions of the two stories are set out in Appendix D.

As noted, participants completed the MMSE (Folstein et al., 1975) or the Shortened Version of the MMSE (Braekhus et al., 1992). In most cases, the clinical groups completed additional neuropsychological measures as part of a more comprehensive assessment. These measures formed no part of the present study.

### **Procedure.**

The standard procedures for administering the RBMT as set out in the test manual, were followed for all participants. The average time taken to complete the test was 25 minutes. The well sample had chosen to complete the test session either at an outpatient facility or in their own homes.

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<sup>2</sup>This was checked by comparing the means obtained on Immediate Story recall of 20 consecutive earlier cases who had completed the original version with 20 cases who had completed the amended version. The mean scores were 3.3 and 3.1 respectively.

Mobility and means of transport were important considerations in their choice of location. To ensure that results from the two locations were comparable, the Profile and Screening scores from the home-tested group ( $n = 26$ ) were compared with those from three successive sets of 26 from the outpatient group. Although the means were marginally higher for the latter group (between 0.20 and 0.40 points) the differences were not significant.

All but 16% (8) of the unwell sample, were assessed in an outpatient facility attached to the Services for Elderly. (This was the same facility as that used for the well sample). The remaining eight were seen in their homes. Approximately half of the dementia sample completed at least part of the neuropsychological assessment in their own homes while the remainder were seen at the same outpatient facility as used for testing the above groups. Twenty-eight percent (21) of the dementia sample had completed repeat neuropsychological measures as part of case monitoring. It was decided in each of these cases to use only the most recent data set for the present study. Since different forms of the RBMT were used, practice effects were considered unlikely.

### **Data analysis.**

For all three groups, individual RBMT subtest raw scores as well as Screening and Profile scores were extracted for analysis. The raw score for the Picture Recognition and Face Recognition subtests was the number correct (rather than number correct minus number of false positives which were examined separately).

All analyses were run using the SPSS software package, version 6 (later upgraded to version 8). Data was subjected to the usual analyses for assessing normality. Inspection of Stem and Leaf and Normal and Detrended Normal probability plots indicated the data did not follow a normal distribution for either the well or the demented samples. However, an assumption of normality could be sustained for the unwell sample. Distribution of scores tended to follow a J-shaped pattern

for the well sample while the dementia sample tended to have many lower scores extending to the tail of the J and relatively few in the stem. A similar pattern has been observed by others (e.g., van Balen et al., 1996; Wilson et al., 1989). These factors were taken into account by running both parametric and nonparametric analyses for each data set making appropriate corrections for unequal variances and by using multiple comparison tests (Coakes & Steed, 1996; Everitt, 1996). Similar probability estimates were obtained in testing both hypotheses irrespective of the type of statistical analysis used. Therefore, following the suggestion of Allison, Gorman and Primavera (1993), only parametric data is reported in Study 2 and Study 3. In all cases, only the most conservative probability estimates have been accepted with the alpha level set at .05; comparisons were 2-tailed unless otherwise specified.

One-way Analysis of Variance (ANOVA) was employed to examine mean differences. For each analysis, the Levene Test was applied to determine whether equal or unequal variance estimates should be consulted. To establish which of the means contributed to findings of significant F Ratios, Tamhane's pairwise post hoc multiple comparisons were computed. This test does not assume equal variances (Coakes & Steed, 1996). Multiple comparisons compute the difference and standard error for each subtest for each sample, and compare the result with each of the other samples for each subtest. A probability is calculated for each comparison separately. Multiple comparison tests are particularly useful with the current data since they are known to be conservative in assessing significance level (Everitt, 1996). Independent-Samples t-test was used to determine probabilities when two sets of means were being compared.

Chi-Square Kruskal-Wallis Test was used as the nonparametric measure. An exploratory Simultaneous Regression Analysis was also computed. The variables age, education, gender and health status (i.e., well, unwell, dementia) with Profile Score as the Dependent Variable were entered. The analysis indicated that neither education nor gender contributed in any significant way

to the Profile Score. Predictably, health status contributed most of the variance ( $p < .001$ ) but age was also found to make a significant contribution ( $p < .01$ ). Each of the variable effects is analysed separately in Study 3.

## 7.4 Results

### Profile and screening scores

Means, standard deviations and F ratios for the Profile and Screening scores and confidence intervals for each of the three samples are shown in Table 7:2. The F ratios obtained were large and post hoc multiple comparisons confirmed that all three samples differed significantly in both mean Profile and Screening scores. Inspection of the standard deviations for the three samples suggested greater variability in the raw scores of the dementia sample than in either of the other two samples.

**Table 7:2**

**RBMT Profile and Screening scores: Means, standard deviations, confidence intervals and F ratios for three samples of older adults**

Sample	<u>M</u>	<u>SD</u>	<u>n</u>	95% Confidence Interval		<u>F</u>
				Lower	Upper	
<b>Profile Score</b>						
Well	20.57	2.45	80	20.03	21.12	136.61***
Unwell	18.08	2.68	51	17.32	18.83	
Dementia	10.35	5.62	74	9.05	11.65	
<b>Screening Score</b>						
Well	9.46	1.77	80	9.07	9.86	100.43***
Unwell	7.82	1.84	51	7.31	8.34	
Dementia	4.30	2.96	74	3.61	4.98	

\*\*\*p < .001.

**Subtest scores.**

Raw score subtest ANOVA data is summarised in Table 7:3. Inspection of the raw score means for each subtest indicated that the well sample means were higher on eight subtests, approximately equal on three and marginally lower on one subtest (Immediate Route recall) when compared with the unwell sample. The dementia sample means were lowest on all subtests and standard deviations again reflected greater variability in raw scores for this sample.

**Table 7:3**

**RBMT subtest raw scores: Means, standard deviations and F ratios**

Subtests	Subtest scores						F
	Well (n = 80)		Unwell (n = 51)		Dementia (n = 74)		
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	
Names	3.10	1.21	2.66	1.45	1.63	1.49	22.34***
Appointment	1.58	0.67	1.43	0.54	0.84	0.74	26.05***
Date	1.91	0.40	1.67	0.68	1.12	0.93	25.08***
Face	4.79	0.52	4.74	0.59	4.27	0.89	12.32***
Message	5.54	0.79	5.27	0.91	4.28	1.78	20.27***
Orientation	8.94	0.24	8.76	0.47	7.32	1.49	64.62***
Picture	9.91	0.28	9.72	0.60	8.77	2.12	15.76***
Route (I) <sup>a</sup>	4.77	0.45	4.90	0.36	4.09	1.17	21.13***
Route (D) <sup>b</sup>	4.78	0.44	4.76	0.76	3.86	1.25	25.06***
Story (I) <sup>a</sup>	7.01	2.56	5.21	2.09	2.67	2.55	60.50***
Story (D) <sup>b</sup>	5.80	2.36	3.70	2.00	1.35	2.12	79.32***
Belonging	3.42	0.95	3.41	0.72	2.79	1.18	09.26***

<sup>a</sup> Immediate recall; <sup>b</sup> Delayed recall.

\*\*\*p <.001.

Table 7:4 summarises the results from post hoc multiple comparison tests. Overall, subtest scores were relatively similar between the well and the unwell samples apart from significantly lower raw scores on Immediate and Delayed Story recall for the unwell sample. On one subtest (Immediate Route) the unwell scored more highly than the well but this did not reach significance ( $p < .21$ ). In contrast, the dementia sample obtained significantly lower results on all comparisons between the well and unwell samples.

**Table 7:4**

**RBMT subtest analysis: Mean differences and significance levels obtained from post hoc multiple comparisons for three samples of older adults**

Subtests	Direction of difference					
	Well > Unwell		Well > Dementia		Unwell > Dementia	
	<u>M</u>	<u>p</u>	<u>M</u>	<u>p</u>	<u>M</u>	<u>p</u>
Names	0.43		1.46	***	1.03	***
Appoint	0.16		0.75	***	0.59	***
Date	0.25		0.79	***	0.59	**
Face	0.04		0.51	***	0.48	**
Message	0.26		1.25	***	0.99	***
Orient	0.17		1.61	***	1.44	***
Picture	0.19		1.14	***	0.96	***
Route I	0.13		0.68	***	0.81	***
Route D	0.02		0.92	***	0.90	***
Story I	1.80	***	4.34	***	2.54	***
Story D	2.10	***	4.44	***	2.34	***
Belonging	0.01		0.63	***	0.61	***

\*\* $p < .01$ ; \*\*\* $p < .001$ .

### Recognition subtests and false positive errors

In the present study, number correct and false positive errors were scored separately. Table 7:5 presents the results of an ANOVA to determine the significance of mean differences in false positive responses amongst the three samples. As shown, significant F-ratios were indicated for both of the Recognition subtests. Post hoc multiple comparisons confirmed that these were accounted for by the higher frequency of false positive responses made by the dementia group. The means for the well and unwell samples were similar on the Picture subtest and almost similar on the Face subtest. As in earlier analyses, it is noted that the variances amongst the dementia sample are considerably greater than for the two comparison samples. The highest alpha level ( $p < .01$ ) was obtained for the comparison between the well and dementia samples on the Face Recognition subtest. All other alpha levels fell between  $p < .02$  and  $p < .04$ .

**Table 7:5**

#### Face Recognition and Picture Recognition subtests: Comparison of mean false positive responses between three samples of older adults

Subtests	Mean false positive responses						F
	Well ( $n = 80$ )		Unwell ( $n = 51$ )		Dementia ( $n = 74$ )		
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	
Face Recognition	0.19	0.45	0.24	0.55	0.62	0.98	8.254***
Picture Recognition	0.02	0.11	0.02	0.28	0.43	1.29	6.267**

\*\* $p < .01$ ; \*\*\* $p < .001$ .

## 7.5 Discussion

### Profile and screening scores

This study confirmed significant differences between RBMT Profile and Screening scores obtained by the well sample compared to the unwell and dementia samples. Furthermore, the two summary scores of the unwell sample were significantly higher than those of the dementia sample. In Table 7:6, Profile and Screening scores obtained from three other studies are contrasted with data from the current study. It can be seen that the mean Profile and Screening scores obtained in the Cockburn and Smith sample were lower than those obtained for the present unwell sample and considerably lower than those for the 70 to 89 year-olds in the Fraser et al. and van Balen et al. studies.

Fraser et al. (in press) claimed that the Oxford data is more representative of a mixed well and unwell older population of varying dependency status. If this is true, then the current unwell sample could have been predicted to more closely resemble the Oxford score patterns and the van Balen et al. rehabilitation sample ( $n = 431$ ). That this pattern did not occur could suggest that the current unwell sample has overestimated the everyday memory performance of generally unwell older adults. On the other hand, the present unwell sample was deliberately selected so as to exclude participants with possible cerebral pathology, in contrast to the more inclusive Oxford sample. Furthermore, the van Balen et al. rehabilitation sample was made up of a very broad grouping of participants including stroke and traumatic brain injury. The summary Profile scores and standard deviations for some of these clinical groupings are listed in Table 7:6. It is notable that the Profile score for the van Balen et al. general hospital cases was 16.4, for outpatient rehabilitation cases 17.3, and for traumatic brain injury cases 16.0. Each of these is higher than the 15.5 obtained by the Oxford sample which is only marginally higher than the 15.1 obtained by the van Balen et al. stroke cases. These comparisons support the conclusion that the current unwell sample is representative of

unwell older adults with no known cerebral pathology while the Oxford data appears more representative of a very broad-based rehabilitation sample of older adults.

**Table 7:6**

**RBMT Profile and Screening scores from other reported studies contrasted with the current study**

Author(s)	N	Participant Group		Profile Score		Screening Score	
		Age	Sample	M	SD	M	SD
Cockburn & Smith (1984;1989)	117	16-69	Normal	22.19	1.74	10.60	1.41
	20	70+	Normal	Not reported		8.80	2.53
	114	70+	Normal/ Dependant	15.54	5.54	6.57	2.93
van Balen et al., (1996)	99	60-69	Healthy	20.50	3.60	9.50	2.20
	89	69+	Healthy	19.00	4.30	8.50	2.40
	431	45-95	In rehab	15.60	5.80	6.70	3.20
	258	45-95	Stroke	15.10	6.02	6.40	3.40
	164	45-95	TBI	16.00	5.50	6.80	3.00
	123	45-95	Rehab OP	17.30	5.20	7.60	3.00
	87	45-95	Gen Hosp	16.40	7.20	7.60	3.80
Fraser et al., (in press)	32	45-95	Dementia	11.10	6.60	4.50	3.30
	41	60-69	Well volunteers	20.61	2.62	9.46	1.88
	64	70-79	Well volunteers	19.55	3.18	8.92	2.09
	26	80-89	Well volunteers	19.62	2.47	8.81	1.65
Current study	80	60-89	Well volunteers	20.57	2.45	9.46	1.77
	51	60-89	Unwell	18.08	2.68	7.82	1.84
	74	60-89	Dementia	10.35	5.62	4.30	2.96

The well sample described in the current study is also more representative of a stratified than a demographic population therefore differences would be expected in comparisons with other data. Nevertheless, it is noted that the mean score for the healthy van Balen et al. oldest sample and that for the current well 60 to 89 year olds, vary by only 1.57 points although the standard deviations show greater variation. This will be discussed in Chapter 8.

Table 7:6 also highlights the similarities in Profile and Screening scores between the van Balen et al. dementia group and that in the current study even though the Dutch study included cases with an age range of 45 to 95 years. These similarities support the view that demographic variables are less relevant in clinical interpretation, since the underlying pathology cancels out their effects. Thus, comparisons against norms obtained from a group with similar pathology may be potentially more useful than comparisons against a demographically representative normative group.

### **Subtest scores.**

As predicted, the subtest scores of the dementia sample were significantly different to those of both the well and unwell samples, while only two subtest scores discriminated between the well and unwell samples. These were the raw scores on the Immediate and Delayed Story recall subtests.<sup>3</sup> Both of these subtests require reasonable levels of sustained attention which might have been more difficult for the unwell sample thus explaining their lower scores.

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<sup>3</sup>In the subtest analysis, a slight advantage was observed in Immediate Recall of a Route for the unwell compared to the well sample. The route for Version A begins and ends at the tester's chair whereas the route for B begins and ends from a door in the room. In effect, it could be seen that there is an extra step in the Version B route which could make Immediate Recall marginally more difficult. The possibility of a bias in Version A was examined. An analysis was made of the results on the two Route subtests for the 26 volunteers who had completed Version A compared to a matched set of 26 from the larger group (Version B). The analysis indicated identical means for the two groups on Immediate Route recall (4.69) and a slight advantage on Version B on Delayed recall (4.81 compared to 4.56). This difference was not significant and the assumption of bias could not be sustained. Nevertheless, further investigation to determine the equivalency of the Route recall subtests is warranted as bias seems the most likely reason for the difference between the well and unwell samples. This difference is not critical to the current studies.

Based on the exploratory analysis described in Chapter 6, some differences had been anticipated. It was also expected that at least some subtest scores would be similarly compromised for the unwell and dementia samples. Finding large differences that clearly discriminated between the dementia and the unwell samples on all subtests, is clinically useful. In effect, the scoring pattern in the present study provides a basis for reliably separating the differential effects on everyday memory from ill health and early dementia. In addition, the subtest analysis confirmed that all of the subtest scores of well older adults differed quantitatively from those of 60 to 89 year olds diagnosed with an early dementia. Collectively, these findings facilitate the investigation of markers in RBMT profiles which may signal an early dementing condition.

Subtest data has not been published to date which would allow a similar comparison to that displayed in Table 7:6 for Profile and Screening scores. The first standardisation study which reported the subtest raw scores for both control ( $n = 118$ ) and patient ( $n = 176$ ) groups (Wilson et al., 1989) used the age range 14 to 69 years. It is therefore less useful as a comparison with the present study.

As noted in the exploratory study, false positive errors on the Face and Picture Recognition subtests were more frequent amongst the low MMSE group than the high MMSE group. This difference was accentuated on the Picture Recognition subtest. It was thought that false positive errors could be a marker to early dementia. The data in Table 7:5 confirms the earlier findings with significant differences occurring in rates of false positive responses on the Recognition subtests in the dementia sample, compared to both the well and unwell samples. This corresponds to other reports which have suggested that dementia sufferers in general record lower identification rates and/or more false positive errors on recognition-type tasks (Cockburn & Smith 1991; Hart & Semple, 1990; Gianotti & Marra, 1994). On the other hand, it has been suggested that this may simply reflect a

characteristic of normal aging (Crook & Larrabee, 1992; Diesfeldt, 1990; Diesfeldt & Vink, 1989; Flicker, Ferris, Crook, & Bartus, 1990). If so, higher rates of false positive responses could have been expected in the response patterns of the other samples in the present study, especially in the older groups. Such a pattern was not found.

To be of most use as a marker to early dementia in a test such as the RBMT, false positive responses should be observed across the whole range of scores including normal or near normal scores. This pattern was present in scatterplots of the distribution of false positive errors on the Face Recognition subtest. These indicated a relatively even spread of errors over the whole range of Profile scores. Thus for the total sample, the range of Profile scores for cases with one false positive was 0 to 23 (median 12); the range of Profile scores for cases making two false positive errors was 3 to 21 (median 10). A similar pattern was found when each sample was viewed separately. The same trend was observed on the Picture Recognition subtest although the frequency of false positive errors was less. There have been no previous reports of false positive scoring patterns on the RBMT.

This analysis supports an association between false positive errors on the two Recognition subtests and early dementia. Although the significance level was stronger on the Face subtest, clinical experience suggests that one false positive error on the Picture subtest in older cases (assuming adequate vision) has higher sensitivity and specificity than one error on the Face subtest. It could be speculated that the latter is more likely to be affected by attitudes, social experiences and failing vision and therefore may be more vulnerable to misinterpretation than simple line drawings. The system of scoring the Recognition subtests separately for number identified from number of false positive responses is recommended as it identifies the type of error making up the raw score result. It is suggested that the RBMT score summary make provision for recording false positive errors since the present form can result in this potentially useful information being overlooked.

## 7.6 Summary and conclusions

This study was designed to establish reliable Profile, Screening and subtest data on the RBMT for two clinical samples and a well, independent sample of older adults. It was undertaken because of uncertainty about the reliability of the published norms and to provide a clear definition of subtest scoring differences between normal and clinical samples. Such data was necessary prior to a detailed analysis being undertaken of the discriminative potential of RBMT subtests. Furthermore, subtest norms were seen as being of more value in clinical work than Profile and Screening score norms. Examination of subtest scoring patterns in this way has not previously been reported.

The scoring patterns of three groups of older adults between the ages of 60 and 89 were compared. The three groups were carefully selected so as to closely represent well, independent-living older adults with no signs of memory aging, unwell older adults with no known cerebral pathology, and older adults known to have an early dementia. The results from this study allow the following conclusions:

1. RBMT Profile and subtest scores clearly discriminated between older adults diagnosed with a dementia and unwell and well samples. Although there were significant differences between their Profile and Screening scores, the unwell sample obtained subtest score patterns which were not significantly different to the well sample on ten of the twelve subtests. This was not the case with the dementia sample which differed significantly on all subtests as well as on the Profile and Screening scores. Furthermore, the differences were large and clearly defined the dementia sample from each of the other two groups.

2. Older adults who were well and living independently obtained summary Profile scores almost five points higher than those reported in the Oxford normative study and those who were unwell but not suffering from a dementia, almost three points higher. The Oxford norms appear to represent a more heterogenous grouping of well, unwell and dependent older people
  
3. It is likely that the presence of false positive responses in a score profile may serve as a marker to an early dementing condition. The method of scoring the number correct separately from the number of false positive errors, is more likely to capture this data.
  
4. It is possible that the greater variation in scoring within the dementia sample is related to the nature of organic change. This will be examined and reported in Study 4.

The present study has provided useful comparative data from three carefully selected samples of older adults from which to assess the clinical relevance of a set of scores on the RBMT. The data will be helpful when interpreting whether differences in scoring patterns reflect age-related cognitive decline, health status or early dementia. These results indicate a high degree of probability that scores in a given range will reflect abnormal memory aging. However, before examining the discriminative properties of the RBMT, there is also a need to determine what influence the key demographic variables of age, education and gender have on scores, particularly on subtest scores. This will now be addressed.

## CHAPTER 8

### STUDY 3: RELIABILITY ISSUES. EFFECTS OF AGE, GENDER AND EDUCATION ON RBMT SCORES

*“... if changes are subtle, the most fundamental obstacle to the adequate assessment of the older person becomes apparent. Age-appropriate norms based on a systematic comparison between elderly normal and pathological populations do not exist for most behavioural tests of brain damage.” (Albert, 1981, pp.835-836).*

#### 8.1 Introduction

Everyday memory is generally accepted as being a relatively stable skill during adulthood and has been likened to a species-wide capacity (van Balen et al., 1996). Such capacities according to Lezak (1995) are not much influenced by demographic variables and do not vary greatly in cognitively intact people. Accordingly, it follows that valid measures of everyday memory would not be expected to follow a normal distribution of test scores. This appears to be the pattern across the age range 16 to 70 years where the distribution of RBMT scores have been reported as J-shaped (Wilson et al., 1989). This was not found in the Oxford researchers' standardisation of the RBMT, where a normal distribution of test scores was reported for those over 70 years. This suggested that performance in the Oxford sample may have been more strongly influenced by cognitive aging in addition to certain demographic variables.

Initial studies from the Oxford researchers indicated that the variables most likely to influence RBMT scores were chronological age, fluid intelligence (as measured by Ravens Progressive Matrices) and level of social, domestic and leisure activity (Cockburn & Collin, 1988; Cockburn & Smith, 1989, 1991; de Wall et al., 1994). Of these, age was reported to make the most significant contribution to scoring. Given similar scores on fluid intelligence measures, the subtests likely to

cause more difficulty for older adults (aged 70 to 93) were identified as being Story Recall and the prospective memory subtests Belonging, Appointment and Message. Number of years of education was found to make little independent predictive contribution to RBMT scores except for the Story Recall subtests (Cockburn & Smith, 1991).

Each of the Oxford studies examined the same elderly standardisation sample. Concerns about the reliability of this sample relative to cognitively normal, well, independent older adults were discussed in Chapter 4 and have been highlighted recently by Fraser et al. (in press). Similar concerns about its lack of homogeneity led Cockburn and Smith (1991), to eliminate a subsample of 14 participants with a possible incipient dementia. This was thought prudent in order to improve reliability in their study of the relative effects of age and intelligence on RBMT scores.

Nevertheless, the data from these participants is included in the published norms for older adults.

Data presented in Study 2 (Chapter 7) is representative of three clearly defined populations of older adults, well, unwell and demented. The three samples allowed for a more controlled comparison of the effects of key demographic variables which is crucial if greater emphasis is to be placed on the diagnostic potential of subtest interpretation. Thus the likely contamination effects of ill health, increasing dependence, social isolation and early abnormal cognitive decline, present in the Rivermead researchers' elderly standardisation sample, were confined in the two clinical samples. Further, the current unwell sample excluded older adults with known cerebro-vascular pathology.

Age, education and gender effects will be examined in the following analyses. Gender differences had not been reported in the Rivermead standardisation study and a later analysis noted that gender was "only weakly related to memory performance... scarcely more than one would expect by chance ..." (Cockburn & Smith, 1991, p.33). However, the exploratory review of early clinical data

(Chapter 6) revealed a likely gender effect on the Story recall subtests amongst early dementia sufferers. To verify such effects, relevant RBMT subtest scores would be reexamined.

The Fraser et al. (in press) data suggested that chronological age had less influence on RBMT performance in normal, healthy older adults than the Oxford researchers had indicated. However, if age did influence performance, it seemed likely that the effect would be more apparent in an unwell group. In other words, the minor effects of aging on everyday memory might have an additive effect if ill health intervenes. Conversely, it could be that the variability in health status within a sample acts to flatten scores generally thus masking any individual variation due to age effects. A similar pattern might also apply to education effects.

In the case of a dementia, clinical observation indicates that when organic cerebral pathology intervenes, any effect of chronological age (or other variables) is largely irrelevant.

## **8.2 Hypotheses**

Three hypotheses were developed to examine these ideas. The first two hypotheses were formulated in line with the findings reported by the Rivermead researchers in the elderly standardisation study (Cockburn & Smith, 1989). The third hypothesis was drawn from the exploratory findings (Study 1) and from recent research which suggested that gender differences occur on prose recall tasks (see Chapter 6).

1. Decreasing scores with increasing age will be found in RBMT scoring patterns with the Profile, Screening, Belonging, Appointment, Message and Immediate and Delayed Story recall scores being those most affected.

2. Significant effects linked to education level will be found on the Story recall subtests with higher scores favouring the higher educated subsamples.
3. Significant gender differences favouring males will be found in scoring on the Story Recall subtests in the dementia sample but no such differences will be found in the well and unwell samples .

### **8.3 Method**

#### **Participants.**

The data is based on the same participants as used in Study 2; that is, a well sample, ( $n = 80$ ), an unwell sample ( $n = 51$ ) and a sample with a diagnosed dementia ( $n = 74$ ). The latter two samples were obtained retrospectively from clinical cases while the well sample was derived from a larger group of well, community-residing volunteers who participated in a RBMT normative study (Fraser et al., in press, see Appendix B). Other details are outlined in Chapter 7.

#### **Procedure.**

To examine age effects, the samples were grouped into three age categories; 60 to 69, 70 to 79 and 80 to 89 years. While some notation of years of schooling was available for the majority of cases, this was sometimes difficult to determine retrospectively for the two clinical samples and occupational history was also relied upon. Educational background had been recorded in a variety of ways, e.g., as an age at which schooling finished, as having sat the Proficiency Examination, or as actual number of years at secondary school. It was not uncommon to find that those who were raised in rural areas did not start at primary school until the age of eight or nine if they happened to be in mid-childhood towards the end of the First World War. Furthermore, many of those who had completed tertiary training did so part-time or by correspondence; no formal training existed for

some occupations which could be learned on-the-job but would now require full-time tertiary training. This problem did not arise with the volunteer sample because awareness of the need to record years of education more precisely lead to the information being collected at the time of testing.

To achieve consistency amongst the three samples in the analysis of education effects, years of formal schooling was grouped in the following three categories- -nine years or less, 10 or 11 years, and 12 years or more- -with 39%, 30% and 29% of the sample respectively falling into each category. (For three cases, education level could not be determined). A Chi-Square analysis for relatedness indicated significant gender differences in education category for both the dementia ( $\chi^2[2, N = 73], = 7.96, p < .05$ ) and unwell samples ( $\chi^2[2, N = 49], = 8.70, p < .05$ ). Female participants in the unwell sample were over-represented in the middle and highest education groups while males in the dementia sample were over-represented in the highest group. The well sample had almost equal gender representation in each of the three categories. (See section 7:3 for details of average years education within each of the samples).

### **Data analysis.**

The statistical analyses followed similar procedures as detailed in Chapter 7 using one-way ANOVA followed by Tamhane's post-hoc multiple comparison tests or an Independent Samples t-test as appropriate. In reporting results, Profile score data will precede comment on subtest results. Unless they differed significantly from the Profile scores, Screening scores will not be presented or commented on in this analysis.

## 8.4 Results

### Profile scores

#### Effects of age.

As is seen in Table 8:1, the decrease in mean Profile score occurring as a function of age is minimal although is a little more pronounced for the dementia sample. One-way ANOVA yielded only one F ratio which approached significance. This was obtained for the well sample ( $F[2,77] = 3.06$ ,  $p < .053$ ). Further exploration using post hoc comparisons indicated a significant alpha level for the difference between mean Profile scores for the 60 to 69 year olds and the 80 to 89 year olds in the well sample ( $p < 0.05$ ) but for no other between-group comparisons. Although the dementia sample appeared to have the largest differences between mean Profile scores, neither the F ratio nor post hoc comparisons were significant. It is noted that the scores for this sample contained the greatest variability as judged by the size of the standard deviations and that variability was greatest for the youngest age group.

**Table 8:1**

#### **RBMT Profile scores by age group: Means and F ratios for three samples of older adults**

Sample	Age groups									F
	60-69			70-79			80-89			
	<u>M</u>	<u>SD</u>	<u>n</u>	<u>M</u>	<u>SD</u>	<u>n</u>	<u>M</u>	<u>SD</u>	<u>n</u>	
Well	21.59	2.24	22	20.37	2.63	38	19.85	2.01	20	3.06
Unwell	18.20	2.73	15	18.12	2.52	25	17.81	3.19	11	0.07
Dementia	12.37	6.16	16	9.95	5.22	40	9.44	5.85	18	1.39

### Effects of education.

As set out in Table 8:2, years of formal education appeared to have a minimal effect on mean Profile scores with only the well sample recording a significant difference between the lowest and highest education group. There were no significant differences between the lowest and middle or between the middle and highest education groups.

Inspection of mean scores for the unwell sample indicated that the highest education group obtained lower mean Profile scores than the middle group; the 12+ years group were, in fact, more similar to the lowest education group. However, these differences were not statistically significant. A similar pattern is seen in the Profile scores by education level for the dementia sample although this sample has considerably wider variances in mean scores compared to both the well and unwell samples. None of the differences were statistically significant for either mean Profile or Screening scores.

**Table 8:2**

#### RBMT Profile scores by years of education: Means and F ratios for three samples of older adults

Sample	Years of education									F
	9 years or less			10 or 11 years			12+ years			
	<u>M</u>	<u>SD</u>	<u>n</u>	<u>M</u>	<u>SD</u>	<u>n</u>	<u>M</u>	<u>SD</u>	<u>n</u>	
Well	19.59	2.29	27	20.71	2.56	28	21.48	2.16	25	4.250*
Unwell <sup>a</sup>	17.67	2.96	21	19.06	2.27	17	17.81	2.52	11	1.514
Dementia <sup>b</sup>	11.37	5.51	32	7.82	6.07	17	10.58	5.13	24	2.344

<sup>a</sup>Two missing cases. <sup>b</sup>One missing case.

\* $p < .05$ .

### **Effects of Gender.**

As seen in Table 8:3, gender differences in profile scores were signaled by significant F ratios for both the well and unwell samples. An Independent samples t-test for each sample indicated that males in the well sample and females in the unwell sample obtained significantly higher mean Profile (and Screening) scores than their respective opposite genders (well  $t[78] = 2.03, p < .05$ ; unwell  $t[49] = 2.79, p < .01$ ). There were no significant gender differences in the Profile scores for the dementia sample.

**Table 8:3**

#### **RBMT Profile scores grouped by gender: Means and F ratios for three samples of older adults**

Sample	Gender						F
	M	Male SD	n	M	Female SD	n	
Well	21.16	2.27	37	20.07	2.51	43	4.12*
Unwell	17.11	2.95	26	19.08	1.95	25	7.76**
Dementia	11.03	4.93	33	9.80	6.11	41	0.87

\* $p < .05$ ; \*\* $p < .01$ .

## Subtest scores

Subtest data from the analysis by age, gender and education is summarised in Table 8:4.

### Effects of age.

Post hoc multiple comparisons of age effects on mean subtest scores indicated that only the Appointment subtest was influenced by age and only in the well sample. In this sample, the 60 to 69 year age group obtained significantly higher mean scores than the 70 to 79 age group ( $p < .05$ ) and the 80 to 89 year age group ( $p < .01$ ).

**Table 8:4**

### Summary of significant demographic effects on Subtest, Profile and Screening scores for three samples of older adults

Demographic Variable	Measures recording effects		
	Well	Unwell	Dementia
Age	Appointment Profile Screening		
Education	Names Belonging Story (I) Screening	Story (D) Profile	Story (I)
Gender	Belonging Route (D) Message Profile	Names Screening	Story (I) Story (D)

**Note.** All alpha levels at  $p < .05$  with exception of education effects on the Profile score for the unwell sample ( $p < .01$ ).

### **Effects of education.**

Post hoc analysis of education effects on mean subtest scores confirmed that the only consistent effect across the three samples occurred on either the Immediate or Delayed Story recall subtests but not on both. (See Table 8:4). The group with 12 (or more) years education in the well sample, recorded a significantly higher mean score on Immediate Story recall ( $p < .05$ ) but only in comparison with the lowest education group. There were no significant differences between the middle education group in comparisons with either the highest or the lowest group. This pattern was repeated on two additional subtests, Name and Belonging (both at  $p < .05$ ).

In the unwell sample, the 12 (or more) years education group obtained mean scores below both of the lower education groups on the Immediate and Delayed Story recall subtests. Post hoc multiple comparisons indicated that only the difference for Delayed Story recall was significant ( $p < .05$ ) in favour of the lower two education groupings.

In the dementia sample, the subtest scores for the middle education group were frequently below those of either the lower or the higher education groups. While significant F ratios were obtained for three subtests, Belonging, ( $F[2,70] = 4.69, p < .05$ ); Message, ( $F[2,70] = 4.44, p < .05$ ) and Immediate Story recall ( $F[2,70] = 3.46, p < .05$ ) post hoc comparisons indicated that only the Immediate Story recall subtest discriminated between the three education groups. Thus the group with 9 or less years education obtained a significantly higher mean score compared to each of the two higher educated groups ( $p < .05$ ). No significant differences emerged between the middle and higher groups nor when the highest group was compared with the middle and lower education groups on any of the subtest scores.

### **Effects of Gender.**

Males in the well sample recorded significantly higher mean scores on the Belonging, Delayed Route and Message subtests ( $p < .05$ ) but no other gender differences were found. In the unwell sample, females obtained a significantly higher mean score on the Name subtest ( $p < .05$ ) but no other gender differences were found. Although females in this sample had higher mean education levels, this was not reflected in subtest scores for Story recall.

As seen in Table 8:5, two gender effects were found in the subtest analysis for the dementia sample. These were for the Story recall subtests in which males obtained significantly higher mean scores than females. Further analysis indicated that the lowest education group (9 years or less) for the genders combined, obtained the highest average Story recall scores (significant at  $p < .05$ ) thus eliminating the possibility that education level may have influenced performance on these two subtests.

**Table 8:5**

**RBMT Story recall subtest scores for the dementia sample grouped by gender: Means and F ratios**

Subtest	Gender				F
	Males ( $n = 33$ )		Females ( $n = 41$ )		
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	
Story (I)	3.52	3.21	2.00	1.60	6.99**
Story (D)	1.95	2.81	0.86	1.14	5.10*

\* $p < .05$ ; \*\* $p < .01$ .

## 8.5 Discussion

### Effects of age.

There was limited support for the hypothesis that decreasing RBMT scores are associated with increasing age in these samples. From inspection of the summary data contained in Table 8:4, it is apparent that the current data from the well sample is dissimilar to the Oxford elderly data. In that study, statistically significant age effects were reported for six subtests- -Appointment, Name (Surname only), Belonging, Immediate and Delayed Story and Message in addition to the Profile score (Cockburn & Smith,1989). In the current study, however, age effects were found for only the Appointment subtest and for the Profile and Screening scores. Furthermore, on the two latter scores, this effect held only for comparisons between the youngest and oldest age groups with no differences found between the middle age group and oldest or youngest. Although mean scores fell slightly as decades increased, this was by no means a consistent pattern across all subtests. This lack of similarity with the Oxford normative sample could be seen to confirm that the present well sample is representative of cognitively normal, healthy, independent, older adults.

The absence of age effects in the dementia sample scores was also not unexpected because possible effects were presumably cancelled by the extent of cerebral pathology. This assumption is supported by the current study.

That age effects were not observed in the unwell sample may be a reflection of the differences between this group and the Oxford sample, as discussed in the previous chapter. Further, it was noted in Chapter 7 that the unwell sample was the only one of the three samples for which scores tended to be normally distributed. As shown in Table 8:1, the means for the three age groupings were approximately similar although the standard deviation for the oldest age group suggested

increasing variability with age. Given that age effects were minimal in the well sample, it may be that any differential effects of ill health acted to even out minor age effects in the unwell sample. If this is correct, it follows that the unwell scores would not differ in any significant way from those of the well sample had they been retested once general health had improved. There is support for the view that general ill health, other than cerebro-vascular disease, does not greatly affect everyday memory performance with increasing age. For example, Grubb et al. (1996) reported no significant correlations between RBMT Profile scores and age in their study of cases of cardiac arrest but only between Profile score and severity of arrest episode. Further, in their longitudinal study based on MMSE and NART scores, Starr et al. (1997) found no impact on cognition from the mix of disease incidence in their sample once dementia cases had been excluded.

The discrepancies between the current findings and those of Cockburn and Smith (1989), can be attributed to the differences between the samples studied. In the current studies, the samples were selected so as to confine the possible contamination effects of ill health, increased physical dependency, dementia and incipient dementia to the two clinical samples while ensuring the well sample was representative of only cognitively normal, healthy, older adults. While acknowledging that such variables are part of a representative older adult population, their inclusion may nevertheless give a spurious impression of the effects of aging on everyday memory. An aim in the current studies was to avoid this possibility. However, it is noted that van Balen et al. (1996) also reported age-related decline on RBMT scores for their oldest (69 years and above) sample (see Table 7:6). This was reflected in a mean difference of only 1.5 points in the Profile score and a 0.70 increase in the standard deviation between their younger and older healthy samples. A similar conclusion was reached in a recent study which examined only Screening scores and reported a mean difference of 3.2 points between the third and ninth decades (Ostrosky-Solis et al., 1998). The Screening score makes use of even less of the available information than the standard Profile score and neither provide any insight into the adequacy of individual constituent behaviours from

which the summary scores were derived. These seem very small differences upon which to make generalisations about everyday memory and aging considering the way in which the summary Profile and Screening scores are computed.

The current findings argue for the relative neutrality of chronological age on RBMT scores between the ages of 60 and 79, and only minimal effects through the next decade in the absence of dementia. A small decline may occur in the summary Profile and Screening scores with age and general ill health but this produces no clinically relevant effect on subtest scores except for the Appointment subtest. These findings support the view that everyday memory remains a stable skill into the ninth decade.

#### **Effects of Education.**

Education effects tended to follow the hypothesised pattern with the most consistent influence seen in mean scores on the Immediate Story recall subtest. This concurs with the Oxford researchers' findings that the effects of education level on RBMT performance is minimal and largely confined to the Story Recall subtests.

Thus those in the well sample with nine or less years formal education scored similarly to those with 10 or 11 years but slightly below those with 12 or more years on Profile, Screening and three subtest scores. There were no significant differences on any of the measures between those with 10 or 11 years and those with 12 or more years of education. Unwell older adults and those with a dementia obtained a more variable pattern with the highest education groups obtaining lower scores than those with less education on some subtests. However, the only significant differences were on Delayed Story recall for the unwell sample, and Immediate Story recall for the dementia sample. It is likely that differences in health status explain the pattern in the unwell sample while differences in the nature and extent of cerebral pathology account for the pattern in the dementia sample. This

finding is taken as further support for assuming that organic change is the predominant influence on subtest scores in early dementia and that demographic variables are largely irrelevant.

### **Effects of Gender.**

There appeared to be subtle gender effects on the RBMT although no gender effects have been reported from research using the RBMT to date. Small but significant gender differences were found on three subtest raw scores as well as the Profile score in the well sample with the differences favouring males. It is likely that the minor gender effects reported for the unwell sample are a reflection of variability in health status and that scores would resemble those of the well sample as health improved.

The finding of significant gender differences on the Story recall subtests in the dementia sample supports the hypothesis derived from earlier clinical observations (Chapter 6). Possible effects of education differences between male and female dementia sufferers was ruled out as influencing performance on these subtests as the higher educated groups obtained lower scores. The finding supports other studies which have suggested that female performance on prose recall tests declines more rapidly in the presence of a dementia than do male scores (Buckwalter et al., 1996). This has been linked to the nature of pathological change in language processing centres. Although no gender differences were reported in the initial standardisation of the RBMT for either younger or older participants, it may be that such differences will occur only in a defined subgroup such as the dementia sample.

## 8.6 Summary and Conclusions

This study was undertaken to clarify the effects of age, education and gender on RBMT performance with particular emphasis on subtest scoring patterns. The study was aimed at increasing the reliability of subtest interpretation. The results from this study allow the following conclusions:

1. Subtest scores on the RBMT were relatively unaffected by age in normal healthy adults up to the age of 89 years. A significant age effect was found on only the Appointment subtest. This was limited to comparisons between 60 to 69 and 80 to 89 year olds only. This was contrary to the Oxford findings for elderly aged 70 to 94 where age effects were reported for six of the subtests. Subtest scores were not affected by increasing age in either an unwell or dementia sample.
2. Summary Profile scores decreased slightly for normal healthy older adults between ages 60 and 89 but this decrease was significant only between the youngest and the oldest decade. There were no significant differences in Profile scores between either the eighth and ninth decades or between the seventh and eighth decades. Summary Profile scores were unaffected by age in unwell and dementia clinical samples.
3. Lower education level (nine years or less) was associated with lower scores on three subtests, Name, Belonging and Immediate Story recall, as well as the Profile (and Screening) score in the well sample. Education effects were both minor and inconsistent in the unwell and dementia samples. The pattern suggested that any likely group effects were annulled by the prevailing pathology, especially in the dementia sample.
4. Gender effects appeared to exert more influence on scoring patterns than had otherwise been reported. Males from the well sample obtained higher scores on the Profile score and the

Belonging, Delayed Route recall and Message subtests than their female counterparts. Gender effects favouring females occurred on the Name subtest and the Screening score in the unwell sample. These were thought to be a reflection of differential health status. Gender differences were found on both of the Story recall subtests in the dementia sample with males obtaining the higher scores.

Together with the findings from Study 2, this data supports the use of the RBMT as a reliable measure of everyday memory capacity in older adults up to the age of 89 years. These findings also support the view that everyday memory remains relatively stable in older adults between the ages of 60 and 89. While summary Profile scores decreased slightly through each decade, the subtest raw scores, which more reliably reflect everyday memory behaviours, were relatively unaffected by age and education. Gender may have more bearing than previously recognised and more significance should be attached to gender differences on the Story recall subtests.

The two studies have provided reliable raw score baselines from which to extend the earlier exploratory study to an investigation of the clinical relevance of differential score patterns in cases of abnormal memory aging.

## CHAPTER 9

### STUDY 4: COMPARISON OF RBMT SUBTEST SCORES IN CASES DIAGNOSED AS VASCULAR OR NONVASCULAR DEMENTIA

*“...we do not yet have the empirical data base necessary to characterise the cognitive deficits of specific dementia subtypes....The differential between Alzheimer’s and vascular dementias may have important implications for several dimensions of management, rehabilitation, and treatment.”(Cohen, 1986, pp.82-83).*

#### 9.1 Introduction

In Chapter 6, the results from a preliminary exploration of RBMT scoring patterns in unselected clinical data were summarised. Observations had indicated considerable variability in subtest scoring patterns even when Profile and Screening scores were relatively similar. There also appeared to be some qualitative differences in performance patterns. These differences looked to be grouped separately for VAD and suspected DAT cases and lead to speculation that the RBMT might contain some subtests which could reliably discriminate between the two types of dementia, particularly in the earlier stages (Glass, 1998, Appendix C).

As noted in Chapter 3, an array of reliable neuropsychological measures are available to detect memory impairment and to quantify signs of impairment from normal aging (Chouinard & Braun, 1993; see also, Table 3:4). However, traditional tests are unreliable in the diagnostic task of discriminating between different types of dementia pathology (Gregory, Orrell, Sahakian, & Hodges, 1997; Nixon, 1996). The failure to find specific differences between VAD and DAT samples in a series of studies led to the suggestion that neuropsychological batteries may best be used to identify strengths and weaknesses rather than as tools for differential diagnosis (Gfeller & Rankin, 1991). In a more recent review of some 30 studies, Almkvist (1994) reported slight

evidence for a deficit in attention, verbal fluency and in some motor and executive functions in the case of VAD and a mildly increased tendency for naming and intrusion errors to occur in DAT participants. Almkvist concluded that there was more evidence for functional similarity than divergence when results across a range of test performances at several stages of cognitive decline were examined. More recently, Bentham, Jones, and Hodges (1997) reported no differences between a VAD group and a DAT group on a detailed semantic memory test with both groups showing equal impairment compared to the control group.

On the other hand, some studies have reported promising results in distinguishing DAT from other dementias on the basis of clinical characteristics including neuropsychological tests. For example, Cummings and Benson (1986) were able to classify DAT cases with 100% accuracy and non-DAT cases with 94% accuracy. This was a retrospective study which relied on both qualitative and quantitative data to establish the clinical profile upon which the classification was based. Amongst the quantitative data were results from a variety of neuropsychological measures including memory. Furthermore, significantly lower performance for a DAT group compared to a VAD group on verbal memory tests including immediate and delayed recall have been reported (Barr et al., 1992; Gainotti, Parlato, Monteleone, & Carlomagno, 1989). Gainotti et al. also reported clear qualitative differences that distinguished between the two types of dementia. A later study supported this finding (Gainotti et al., 1992). Both the Barr and the two Gainotti studies were noted in Almkvist's review but were included amongst those studies for which findings were considered equivocal due to "large overlap" (p.208) between etiological groups.

Other studies have reported evidence for superior performance of DAT cases on such measures as sustained attention, executive function and fine motor control, compared to VAD cases who tended to perform better on measures of orientation, language and verbal recall (Kertesz & Clydesdale, 1994). A recent study (Bowler et al., 1997) reported evidence of greater loss on verbal memory

measures between early stage DAT and mixed dementia ( $p = .03$ ) than between early VAD and DAT ( $p = .06$ ). Furthermore, Zimmer, Hayden, Deidan and Loewenstein (1994) reported that a functional measure of delayed recall and recognition memory (memory for a grocery list) discriminated mild DAT from cases diagnosed with mild “multi-infarct cognitive disorder” (MICD, p.145). In this study, the latter group showed superior recall but no other differences were found on other functional measures.

Finally, there have been recent reports of differences in cognitive profiles between cases diagnosed with fronto-temporal dementia (FTD) and DAT (Gregory et al., 1997; Mendez et al., 1996; Pachana, Boone, Miller, Cummings, & Berman, 1996) and between cases diagnosed with FTD and VAD (Cherrier et al., 1997). Although not specifically comparing DAT and VAD, these studies suggest that memory function is less involved in FTD than DAT and support efforts to clarify differences in neuropsychological test profiles.

The Zimmer et al. (1994) study appears to be the only reported research to suggest that memory measures high in ecological validity may be able to discriminate between types of dementia.

Previous studies had not reported on the sensitivity of the RBMT in this way and detailed differential subtest analysis had not been undertaken. However, as Chapter 4 notes, two studies had examined the sensitivity of the RBMT in detecting dementia in general (Beardsall & Huppert, 1991; Huppert & Beardsall, 1993). In those studies, it was reported that the Route (Immediate and Delayed), Story (Immediate and Delayed), Name and the three prospective memory subtests (Message, Belonging and Appointment) were particularly sensitive to the early stages of dementia. These studies also suggested the potential benefits of more detailed subtest analysis.

The major obstacle to examining the sensitivity of subtests in this way was the absence of reliable data on subtest performance. As noted, published data had focussed on Profile and Screening

scores (Summary scores) and the available norms were later found to underestimate the limits of normal performance in well older adults (Fraser, et al., in press). Furthermore, reliable subtest data was a prerequisite not only for well older adults but also for unwell and dementing elderly people because stratified data would enable verification of the uniqueness of subtest scoring patterns in the two diagnosed dementia samples. The studies described in Chapters 7 and 8 produced such data for three samples of older adults. These studies confirmed that unwell older adults obtained very similar subtest scoring patterns to well older adults even though there were significant differences between their Profile and Screening scores. This was not the case with the dementia sample which differed significantly on all subtests as well as on the Profile and Screening scores. Furthermore, the subtest differences were large and clearly distinguished the dementia sample from both the well and the unwell samples.

These studies also established that changes due to pathology are the predominant influence on subtest scores in early dementia and that demographic variables are largely irrelevant. However, significant gender effects were found in the dementia sample on the two Story Recall subtests. This finding was seen as potentially significant in view of research that had suggested such effects may reflect subtle differences in disease pathology and progression.

Having established the limits of performance for normal and unwell older adults on RBMT subtests and their relative neutrality to the effects of age, education and gender, a final study was designed. This study sought to determine whether there were systematic between-group differences in the subtest scoring patterns of the dementia sample when data was reanalysed according to the diagnosis of dementia type. For this study, the dementia sample was reorganised into a VAD sample and DAT sample to determine whether reliable and systematic differences could be identified. In addition, this study sought to clarify whether false positive responses and gender differences were associated equally with the DAT and VAD samples.

## 9.2 Hypotheses

1. Significant differences that discriminate between cases diagnosed as VAD (vascular dementia sample) and cases diagnosed as DAT (nonvascular dementia sample) will occur on some subtest scores and in false positive responses on the Recognition subtests.
2. Females in the vascular dementia sample will obtain significantly higher mean scores on the Immediate and Delayed Story recall subtests than females in the nonvascular dementia sample.

## 9.3 Method

### Participants.

The dementia sample described in Chapter 7 (see Table 7:3) comprised the participants for this study. Initial selection was based on whether both neuroimaging data and a RBMT profile were available and whether a case met DSM-III-R (1987) third edition, revised, criteria for dementia. A total of 91 cases met these criteria. To establish diagnosis of dementia type, each of the neuroimaging reports was classified by a consultant geriatrician into probable vascular (Vascular Dementia Group VDG) or probable nonvascular (Nonvascular Dementia Group NVG). This classification was based on the scan report and relevant medical history including evidence of treatment for hypertension, cardiac disease, and history of diabetes (Skoog, Nilsson, Palmertz, Andreasson, & Svanborg, 1993). In 14 cases, the medical data was indeterminant and the history of onset of cognitive symptoms, the neuropsychological test pattern and behavioural reports from relatives or carers were used to decide the classification.

In total, thirteen cases were discarded either because the pathology was complicated by such factors as known alcoholism, Parkinson's Disease, Huntington's Chorea (one case) and severe depression or because a reasonable probability of dementia type could not be agreed. A further four younger cases (age < 60) were removed to preserve the homogeneity of the sample. No attempt was made to separate cases according to lesion location and spread or to stage of dementia at the time of testing. The NVG was comprised predominantly of DAT cases but four to six cases were later thought to be probable FTD. The available data indicated that the majority of cases were in the early to mildly demented stage. Thus the mean MMSE score for the NVG sample was 22.74 (range 12 to 29, SD 4.15) and for the VDG sample 23.60 (range 17 to 30, SD 3.42). The F ratio did not suggest that the difference in means was significant ( $F[1,72] = .926, p > .05$ ).

In ten of the vascular and eleven of the nonvascular cases, repeat neuropsychological measures had been completed as part of case monitoring. It was decided in each of these cases to use only the most recent data set for the present study.

Sample details by diagnosis of dementia type are summarised in Table 9:1. The total sample had a mean age of 74.79 years (range 60 to 89). No significant age or gender differences were indicated between the VDG and NVG groups ( $F [1,72] = .000, p > .05$  for age, and  $(F[1,72] = .416, p > .05$  for gender). Average years education was 10.19 years (see Table 7:3 in Chapter 7 for further details of education).

**Table 9:1****Summary of demographic characteristics by diagnosis of type of dementia**

<u>Diagnosis</u>	<u>n</u>	<u>Male</u>	<u>Female</u>	<u>Mean age</u>	<u>SD</u>
Vascular	35	17	18	74.28	6.97
Nonvascular	39	16	23	75.26	6.80
Totals	74	33	41		

**Measures.**

The RBMT as described in detail in Chapter 4, had been administered to all participants as part of a more comprehensive assessment process.

**Procedure.**

All participants had completed the RBMT as part of a full assessment process following reports of behavioural or cognitive deficits or both. Only RBMT results are reported in this study.

Assessments were completed either in an outpatient facility or in the home of the client as reported in Chapter 7.

Preliminary analysis indicated that an assumption of normal distribution could not be sustained for some of the subtest data. Since requirements for using a parametric statistical analysis were questionable, a nonparametric format, the Mann-Whitney U Wilcoxon Rank Sum W Test, was employed. However, following the suggestion of Allison, Gorman and Primavera (1993), one-way ANOVA was also completed.

Means and standard deviations were computed for the Profile and Screening scores and for each of the subtest raw scores for the two groups. Nondirectional hypotheses were specified. The

significance level was set at  $p < .05$ . These analyses were run using the SPSS software package, version 6. To explore the sensitivity of subtest differences, a nonparametric nearest neighbour discriminant analysis was performed using the SAS statistical package (Hand, 1981).

#### 9.4 Results

##### Analysis of Profile, Screening and sub-test scores.

The means and standard deviations for Profile, Screening and individual subtest scores are shown in Table 9:2. The range of Profile scores for the VDG was 1 to 21 and for the NVG 0 to 19; the range of Screening scores for the VDG was 0 to 11 and for the NVG 0 to 9. The mean VDG Profile score is almost four points higher, at 12.40, compared to the NVG. The mean Screening score also showed significant differences depending on vascularity.

As indicated in Table 9:2, the means on a number of the subtests are similar irrespective of the type of dementia. However, five subtests recorded moderate to strong differences, each exceeding the set alpha level. These subtests were Appointment, Story recall (Immediate), Route recall (Immediate), Route recall (Delayed) and Message. When a one-way ANOVA was computed, probabilities remained unchanged for the five listed subtests but a significant F ratio was also obtained for the Delayed Story subtest ( $F[2,70] = 4.94, p < .02$ ).

Table 9:2

**RBMT mean Profile, Screening and Subtest scores for vascular (VDG) and nonvascular dementia (NVG) samples**

Measures	VDG ( $n = 35$ )		NVG ( $n = 39$ )		Mann-Whitney U Wilcoxon W	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>z</u>	<u>p</u>
Names	1.74	1.59	1.54	1.41	-0.464	0.64
Appointment	1.03	0.75	0.67	0.70	-2.092	0.03 *
Date	1.20	0.93	1.05	0.94	-0.687	0.49
Face	4.31	0.83	4.23	0.96	-0.236	0.81
Message	4.83	1.51	3.79	1.88	-2.440	0.01**
Orientation	7.49	1.63	7.18	1.36	-1.299	0.19
Picture	9.03	1.92	8.54	2.29	-1.383	0.16
Route (I) <sup>a</sup>	4.51	0.09	3.72	1.28	-2.946	0.003**
Route (D) <sup>b</sup>	4.37	0.94	3.41	1.33	-3.272	0.001***
Story (I) <sup>a</sup>	3.34	3.01	2.05	1.87	-1.992	0.04 *
Story (D) <sup>b</sup>	1.91	2.73	0.85	1.17	-1.580	0.11
Belonging	2.94	1.14	2.67	1.22	-1.078	0.28
Profile Score	12.40	5.20	8.51	5.39	-2.929	0.003**
Screen Score	5.23	3.01	3.46	2.69	-2.579	0.009**

<sup>a</sup> Immediate recall; <sup>b</sup> Delayed recall.

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

In addition, the pattern of false positive responses was reanalysed (see Chapter 7, 7:4) to follow-up on suggestions of greater within-group variance in the false positive scores made by the combined dementia sample. Table 9:3 presents the results of a nonparametric analysis designed to examine whether there were systematic differences in false positive responses between the NVG and VDG. As shown in Table 9:3, false positive errors on the Picture Recognition subtest were significantly higher for the NVG than for the VDG. While differences were not significant on the Face recognition subtest, the means suggest that the NVG is also more prone to such errors on this subtest.

**Table 9:3**

**Comparison of mean false positive errors on Picture and Face recognition subtests in samples representing two types of dementia**

Subtest	Mean false positive errors					
	VDG ( $\underline{n} = 35$ )		NVG ( $\underline{n} = 39$ )		Mann-Whitney U Wilcoxin W	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>z</u>	<u>p</u>
Picture Recognition	0.11	0.40	0.72	1.70	-2.143	0.03*
Face Recognition	0.40	0.55	0.82	1.21	-1.142	0.25

Note. For this analysis, four outlying false positive scores in the NVG (two each for Face and Picture) were reduced to 1 point each for Face (from original scores of 4 and 5), and 2 each for Picture (from original scores of 6 and 8).

\* $p < .05$ .

### Sensitivity of subtests.

Table 9:2 demonstrates that there are a number of subtests on which the two groups differ significantly thus confirming the earlier observations outlined in Chapter 6. This finding allowed speculation about the sensitivity of some combination of the subtests to reliably classify cases as VDG or NVG. A nonparametric discriminant analysis, based on nearest neighbour estimation, was used to explore which combination of subtests allowed the lowest error rate in classifying cases (Hand, 1981). Nearest neighbour estimation takes each single set of subtest scores and compares it with a predetermined number of cases nearest to it to determine whether the case most closely resembles a VAD or DAT profile. As experimentation indicated that it made little difference whether three, five or seven nearest cases were compared, the analysis was set to run on three nearest neighbour comparisons.

In the initial analysis, all 12 of the subtests were included for each case. The analysis was run repeatedly, testing all possible combinations of the subtests taken one at a time, two at a time, three at a time (up to all 12) comparing the error rates. Varying error rates were obtained depending on the number and combination examined. The highest error rates reached 38% (i.e., the proportion of cases impossible to classify into one or other of the two dementia types). However, it was found that six subtests yielded consistently low error rates. These were the five already identified (above) as well as the Delayed Story recall subtest (identified by ANOVA). These six together resulted in just two of the 74 cases not being correctly classified, giving an error rate of 2.7%. However, a similar result could be obtained by using only four of the subtests, Appointment, Route (Immediate recall), Story (Immediate recall) and Message. An example of the results from this analysis when four subtests were grouped, is set out in Table 9:4.

**Table 9:4****Error rates in classifying cases as vascular or nonvascular dementia based on selected RBMT subtest scores using nearest neighbour discriminant analysis**

Error rates (%) using four subtests for classification					
Subtest	Appoint	Route(I)	Route(D)	Story(I)	Story(D)
Appoint					
Route(I)	13				
Route(D)	9	4			
Story(I)	12	9	8		
Story(D)	13	5	3	17	
Message	10	8	10	11	6

Note. Reading across to Route (Delayed) and down to Story (Immediate), an 8% error rate in classifying cases would be predicted if these two subtests were excluded and the analysis made on the remaining four subtests. The lowest error rate (3%) results when the two delayed recall subtests (Route and Story) are omitted.

**Gender effects on Story recall subtests.**

Neither parametric nor nonparametric analysis supported the hypothesis that gender effects on the two Story recall subtests were associated more with the scores of NVG females than VDG females. This analysis compared differences in scores for males and females on the Story recall subtests within the NVG and VDG, as well as scoring by gender between the NVG and the VDG samples. Nonsignificant  $z$ -scores were obtained on all analyses with only those for Immediate Story recall approaching the significance level ( $z = -1.904$ ,  $p < .057$ ) in the between-group comparison for female participants (Table 9:5).

Table 9:5

**Comparison of Mean scores obtained by females on Story recall subtests between two types of dementia**

Subtest	VDG ( $n = 23$ )		NVG ( $n = 18$ )		Mann-Whitney U Wilcoxon W	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>z</u>	<u>p</u>
Story (Immediate)	2.50	1.86	1.61	1.27	-1.90	.057
Story (Delayed)	1.25	1.49	0.54	0.65	-0.96	.34

### 9.5 Discussion

The findings from this study support the first hypothesis but not the second. As well as differences in overall Profile and Screening scores between the two groups, significant differences were found in scoring on 6 of the 12 subtests that make up the RBMT. An analysis of these differences indicated that a particular combination of subtests, Appointment, Message, Immediate Story recall and Immediate Route recall, was able to discriminate between the two types of dementia with an error rate as low as 3% in this sample. The data also inferred that Delayed recall subtests are less effective as discriminators. On the other hand, there were no significant differences found in the mean Story recall subtest scores between females in either of the two samples. Neither of the Recognition subtests discriminated on the basis of the number of correct identifications but a significant difference was found in the number of false positive responses made by the NVG on the Picture subtest. Furthermore, errors were not associated with age although some studies have suggested general aging effects account for false positive responses on these types of tasks (Crook & Larrabee, 1993). This will be discussed again in Chapter 10.

The sensitivity of the RBMT in discriminating type of dementia has not been examined previously, although the Beardsall and Huppert studies (Beardsall & Huppert, 1991; Huppert & Beardsall, 1993) are relevant. In those studies, 15 of the 17 participants in the two demented groups (minimal and mild) had been diagnosed with DAT. Based on their findings, it could be predicted that any differences in performance between subtests in the present study would show up more strongly on the eight subtests identified by Beardsall and Huppert. The current studies support such a prediction with Immediate and Delayed Route recall, Immediate Story recall and two of the prospective memory subtests (Message and Appointment) proving the most sensitive discriminators. Additionally, Delayed Story recall was identified in the parametric and discriminant analyses. However, Name and Belonging did not discriminate between the two types of dementia in this study.

It may well be that each of the identified subtests is a sensitive indicator of dementia generally, but when screening for type of dementia, only certain subtests discriminate. Furthermore, there may be a critical period in the onset of dementia when the subtests are maximally sensitive in detecting memory changes. There is support for this assertion from a recent study which reported greater loss of memory in patients in early stage DAT (diagnoses were confirmed by autopsy) than in those in the early stages of VAD (Bowler et al., 1997). By the time the VAD cases reached the moderate stage, similar levels of memory impairment were found. The memory measures used by Bowler and colleagues included verbal memory, design recall and information and only combined summary data is presented. It is not therefore possible to compare measures of memory.

Finding that there were no significant gender differences exclusive to DAT on the Story recall subtests may be partly a reflection of smaller sample sizes when the groups were split by gender and dementia type. Buckwalter et al. (1996) found evidence of a significant gender difference favouring males on a semantic memory (naming) task using average sample sizes of 69 participants

in each of their four groups. Since studies of normal older adult samples suggest that women generally perform at higher levels than men on memory tasks which call on word storage, (e.g., Hart, Colenda, Dougherty, & Wade, 1992), the current data suggests that further research is warranted to clarify whether these subtests have discriminative validity.

On the other hand, some researchers have suggested that impairment in semantic memory is a feature of both VAD and DAT with vascular patients having a disorder of access to semantic knowledge, while DAT cases suffer a dilapidation or loss of stored knowledge (Bentham et al., 1997). The current findings, together with those reported in Chapter 8 (Section 8:4), support the likelihood of dilapidation in semantic memory irrespective of gender, with early changes more likely to be detected in female than male dementia sufferers, irrespective of dementia type. These data could be viewed as supporting both the Bentham et al. and the Buckwalter et al. hypotheses. However, it is probable that the measurement of differences depends on both the stage of disease progression as well as on the type of measure used. In the meantime, therefore, the role of gender differences as a further marker to DAT on test items such as prose recall remains unreliable.

The current findings must await replication in a more carefully selected sample because it is possible that a number of factors introduced bias. For example, stricter exclusion criteria may have controlled for such factors as comorbidity of depression, size and site of vascular lesion(s), coexistence of both a vascular and a nonvascular pathology and severity of dementia. Additionally, in classifying cases it may have been prudent to have applied a more formal measure such as the scale developed by Hachinski and colleagues (Hachinski et al., 1975). On the other hand, the classification proposed by Skoog et al. (1993) appears suitably inclusive and, in practice, formal methods have not proved consistently satisfactory compared to a clinical assessment (Amar, Wilcock, & Scott, 1996). The possibility that bias was introduced by using only the most recent data of participants who had repeated the RBMT as part of follow-up case monitoring was

considered. These case records were reexamined. The longest follow-up interval was 12 months between first and second administration. A reanalysis using only the initial scores confirmed that mean scores in the two groups did not alter significantly and all alpha levels remained unchanged. However, individual variation was apparent within each group which tended to be more pronounced for the VDG than the NVG.

If future studies are able to replicate the current findings, the question arises as to why these particular subtests discriminated between the vascular and nonvascular samples when so often, research has produced equivocal results. The types of measures used may be one reason for the mixed results obtained by many of the studies. Reports indicate that memory performance is the cognitive function most likely to be compromised in the early stages of DAT while frontal lobe functions are those more likely to be affected in the earlier stages of VAD (Bowler et al., 1997; Cherrier et al., 1997; Hart & Semple, 1990; Rosenstein, 1998). However, in the search for measures to test for sensitivity to type of dementia, a range of cognitive functions including memory have been assessed (Almkvist, 1994; Rosenstein, 1998). Furthermore, when memory measures have been used, there has been an overreliance on conventional measures using experimental material tied to structure and process theories of memory function. It may be that the unfamiliar and largely irrelevant content of conventional tests similarly disadvantages older adults, irrespective of the type of dementia. This might subsequently reduce the reliability of the measure when used as a discriminator. A detailed theoretical explanation will be offered in Chapter 10.

## **9.6 Summary and Conclusions**

This study was undertaken to investigate clinical observations that had suggested RBMT subtest scores discriminated systematically between early vascular (VDG) and Alzheimer-type (NVG) dementias. The results support the following conclusions:

1. Six subtests- -Message, Appointment, and Immediate and Delayed Story and Route recall- - recorded significant differences between the NVG and the VDG with lower raw scores being obtained by the NVG. In addition, there was a significantly higher rate of false positive responses recorded on the Picture recognition subtest by the NVG.
  
- 2 A combination of four subtests was found to produce an error rate of approximately 3% in discriminating NVG cases from VDG cases in these samples. This low error rate was obtained by excluding the two Delayed recall subtests, Story and Route.
  
- 3 Although female dementia sufferers as a group recorded significantly lower mean raw scores than males on Story recall subtests, the hypothesis that NVG females would record lower scores than VDG females was not supported.

## CHAPTER 10

### THEORETICAL CONSIDERATIONS

*“No theory is true; at best, a theory can be an approximation to the truth. The best we can do is cast better theories.” (Petrinovich, 1989, p. 20).*

#### 10.1 Introduction

One of the most significant findings from the current studies was the different subtest score patterns that emerged between the two dementia samples when so much of the literature has been equivocal on the discriminative validity of conventional tests. All 12 subtests clearly distinguished the combined dementia sample from both the well and the unwell samples, which raises the question as to what is different about VAD and DAT that would account for the different response patterns between the two groups? Furthermore, what do these subtests have in common that sets them apart from the remaining six subtests? Theoretical explanations will draw on both the neural mechanisms thought to be involved and on functional interpretations of working memory.

#### 10.2 Neural mechanisms

At least part of the explanation for subtest differences could relate to the different neural mechanisms known to be involved in DAT and VAD. The temporal and parietal lobes have been found to be disproportionately involved in the early stages of DAT (Brinkman et al., 1986; Rosenstein, 1998), in particular the component structures of the hippocampal complex which are critical for long-term memory. In early VAD, by contrast, localized subcortical and frontal lobe regions are more likely to be affected with the temporal lobes not especially involved (Arriagada et al., 1992; Bowler et al., 1997; Rosenstein, 1998). In the early stages, some level of memory

impairment may be common to both types of dementia but more pronounced in DAT. However, should the vascular damage progress, VAD cases also develop serious memory impairment (Bowler et al., 1997). In the current studies, the RBMT results could simply be reflecting these differences in the early stages of disease pathology. On the other hand, many of the dementia sample obtained similar or near similar overall Profile scores and only some of the subtests discriminated between the two dementia groups. This suggests other processes must also have contributed to the differences.

### **10.3 Working memory**

Further explanation may lie in the neuropsychological theory of working memory. As noted in Chapter 2, the core component of working memory is the central executive which has been implicated in the deficits that occur in complex attention and executive functions early in DAT. These deficits are reflected in the difficulties that those with early DAT experience in performing everyday tasks (Baddeley et al., 1991; Perry & Hodges, 1999). Frontal regions are known to be involved in both of these functions (Cohen et al., 1997; Courtney et al., 1998; Perry & Hodges, 1999; Rosenstein, 1998) including the task of constantly up-dating the limited resources of the central executive from long-term memory (Salmon et al., (1996). In the early stages, subtle but additive effects on attention processes and such executive functions as planning, strategy forming and evaluation of feedback may be produced in both pathologies but, given the different neural mechanisms involved, these effects are compounded in DAT by reduced access to deteriorating memory processes. In other words, as suggested by Bowler et al. (1997), in the earlier stages of VAD, memory strategies are affected more than memory components, whereas access to both strategies and memory components are progressively compromised early in the course of DAT. These differential early effects could help to account for the pattern of subtest performances obtained in the current studies.

#### 10.4 Working memory and RBMT subtests

Selective and divided attention as well as executive functions such as checking, evaluating and forming strategies for remembering are likely to be involved in at least four of the RBMT subtests which discriminated between the two dementia samples- -Immediate Route, Message, Appointment and Immediate Story recall. For example, registration of the route and message involves selectively processing and integrating spatial and verbal detail as well as registering the order in which stops are made and discarding irrelevant “landmarks”. This may be similar to what others have called “wayfinding” (Kirasic, 1991; Kirasic, Allen, & Haggerty, 1992) and the observed difficulties that older adults sometimes experience in finding their bearings especially in unfamiliar environments. Furthermore, studies of spatial operations have been linked to working memory processes (Courtney et al., 1998).

Immediate Story recall has also been linked to complex attention processes (Haut, et al., 1998). It is likely that this subtest places high demands on simultaneous processing and the selective and integrative processes of the central executive. As well as attending to the story, content must be compared and integrated with learned information so that meaning can be assigned to facilitate immediate recall. Similar processes could be seen to be involved in the Appointment subtest. This subtest requires selectively attending to some cues while temporarily discarding others to ensure a correct response out of the five possible responses that can be made. Cockburn and Smith (1994) suggested that responses on the Appointment subtest are linked to a self-checking system which “competes” for working memory capacity. They proposed that the differential effects of competing demand and possible anxiety might lower central executive capacity making response selection less effective.

## 10.5 Working memory and long-term memory

Given the above explanations, the role of the two Delayed recall subtests which presumably depend more on long-term memory than working memory, and the remaining six subtests should also be considered.

A possible explanation for the Delayed recall subtests being among those which discriminated is found in the observation that a deficit in working memory does not necessarily cause a problem in long-term memory (Banich, 1997; Perry & Hodges, 1999). As noted, there continues to be some access to long-term memory in early VAD. With the Delayed recall subtests, processing of information on immediate presentation was presumably slower and less efficient for both groups but the slightly better access to long-term memory may have facilitated translation into meaning (Immediate recall) and learning (Delayed recall) in the VDG relative to the NVG. If, as suggested, the Immediate Story recall subtest depends heavily on selective and integrative processes, it follows that both groups would experience increased difficulty retaining the Story for later recall.

Therefore, this subtest could be expected to be less reliable as a discriminator in early-stage dementia because the differences in recall would be very small. This might explain why the Delayed Story recall subtest did not discriminate on the initial parametric analysis and produced lower alpha levels than the Route recall subtests. It might also help to explain why the Story recall subtests were the only subtests to discriminate between the unwell and the well samples, because presumably, complex attention capacities in the unwell were generally less robust due to health status. On the other hand, the Route recall subtest possibly facilitates learning as it calls on verbal, visuo-spatial and motor skills in the initial task presentation. The VDG, having better access to long-term memory, was therefore advantaged in learning this task which explains the high alpha loading on Delayed recall.

This explanation is consistent with the view that working memory and long-term memory work as parallel systems, one maintaining information in an active state to support on-line processing while the other creates enduring records of experience for later use (Banich, 1997). In early VAD, access to the longer-term records which help to integrate meaning are more likely to be intact thus improving working memory efficiency even in the presence of some impairment in prefrontal areas. In early DAT, the more diffuse pathology may produce compromise in both prefrontal regions and in access to longer-term records.

Such explanations would favour the use of measures of working memory as more reliable discriminators between different dementia pathologies. However, Malec et al. (1990) reported that the RBMT was not correlated with tests sampling the frontal lobe functions of divided and selective attention. Obviously further research is needed to examine the explanations advanced for the current findings but it is suggested that failure to examine individual subtest scores and reliance on only the total raw score might account for the findings of Malec and colleagues. Further, as noted earlier, others have established links between frontal area functions and working memory processes although not specifically in relation to the RBMT.

#### **10.6 Why did some subtests not discriminate?**

There remains the question of why only six subtests discriminated. What is different between these and the remaining six subtests? Of the subtests that did not discriminate, only the Belonging subtest fits closely with what is known about working memory processes. This subtest could be seen to place similar demands as the Appointment subtest on the central executive and it was one of the subtests identified by Huppert and Bearsdsall (1993) as being more sensitive to dementia generally. A possible explanation for its failure to discriminate in the current studies is the high demand that the Belonging subtest places on both long-term memory and working memory processes such that it

produces early overload on the limited resources of the central executive. The subtest is presented as the second item when the client is already grappling with remembering the name and must deal with the Appointment information immediately following. Some clients are noted to be actively rehearsing the name while receiving details about the Appointment task. And it is quite common to find that the client asks for the Belonging when they hear the cue for the Appointment. It is suggested that the temporal presentation of these two sets of information compete for the processing resources of the central executive with the result that the middle subtest (Belonging) is equally difficult for both VAD and DAT to recall.

There is no obvious link between the Name, Orientation and Date subtests and working memory processes and therefore significant differences would not be predicted in these scores. However, the role of the Picture and Face recognition subtests is less clear. Recognition tasks are thought to be sensitive indicators of memory capacity as they “render an active search strategy unnecessary...so make fewer processing demands” (Hart & Semple, 1990, p.152). If this is so, and based on the present explanations, VAD and DAT sufferers would be expected to have about equal advantage on these subtests. This is consistent with the current results as neither of the two subtests discriminated. However, the significant difference in false positive responses on the Picture subtest suggests failures in both working memory and long-term memory and increases the relevance of the two recognition subtests as possible discriminators. Such patterns on what are considered to be relatively simple tasks, have been linked to executive functions including a failure to initiate efficient search strategies and a break-down in response inhibition (Barr et al., 1992; Hart & Semple, 1990). As noted, the key working memory component, the central executive, has been implicated in failures in executive function. It may be that the higher incidence of false positive responses in the NVG is reflecting greater compromise in the interaction between the central executive and long-term memory in early DAT.

## 10.7 Linking working memory and everyday memory

Assuming that the explanations above are able to account for the apparent discriminative properties of the six subtests, a further issue needs to be considered. There is evidence that working memory, as measured by conventional laboratory-based tests, is impaired in the early stages of DAT (see Chapter 3, Table 3:3). It should follow, therefore, that conventional memory tests would be equally successful in discriminating between dementia pathologies provided test material was mediated via the central executive component of working memory. Given the general inconsistency of results in this area, why did the RBMT subtests discriminate between the two types of dementia?

The RBMT measures the ability to remember familiar everyday tasks which mimic the essential daily demands on the memory processes of older adults. Content relates to the natural environment of the older person. It has been suggested that the discriminative subtests in the RBMT are those which appear to draw upon working memory central executive functions. Being more content and context relevant than conventional measures, these subtests might facilitate access to familiar information from vulnerable long-term memory processes via the central executive. In this way, they might have more success than conventional and experimental measures in detecting subtle differences between clinical pathologies.

As memory function becomes less reliable (for whatever reason), older people tend to depend more on the familiar external aids in their environment (for example, a calendar, clock, newspaper, radio, telephone, neighborhood sounds and routines and memory note books). As a result, memory performance is more efficient than it might have been. There is some solid research evidence to support such observations. For example, Poon and colleagues reported data from the Georgia Centenarian Study involving community-dwelling nondemented adults, which indicated that when cognitive activities were dependent on everyday experiences, no age-related cognitive decline was

found (Poon et al. 1992). Similar conclusions were reached by Youngjohn and Crook (1993) (see Chapter 3, 3:2), by Liu, Gauthier, & Gauthier (1991) in their study of wayfinding, and by Zimmer et al. (1994) using the everyday task of recalling a grocery list.

The use of familiar, everyday content in memory measures might then, improve their discriminative validity. Thus Zimmer et al. (1994) also reported that the grocery list task discriminated between their MICD and DAT samples. And Gregory et al. (1997), in reporting that traditional neuropsychological tests were “poor” at differentiating cases of FTD and DAT, noted that the recall of a short story in which a relevant social dilemma was imbedded, was potentially useful as a discriminator. The Ostrosky-Solis et al. (1998) cross-sectional study of 20 to 89 year olds, reported substantially greater declines (up to 76%) on most of their conventional memory tests than on the RBMT Screening score (29%), in comparisons between their youngest and oldest participants. The RBMT was reported as “relatively stable across age groups” (p. 161) with a slower rate of decline than that “observed in laboratory psychometric test scores” (p.161). It is possible therefore, that short, composite measures relevant to everyday memory experiences will provide the tools Huppert and Wilcock (1997) saw lacking. Such measures may ultimately prove more successful in discriminating between “normal aging and the cognitive deficits that are a feature of one or other of the dementias” (p.21).

It is suggested that continued emphasis on the use of experimental material and failure to take account of the special considerations important for memory assessment with older adults, will continue to produce inconsistent results. Consistency will be further compromised if measures fail to consider the constituent behaviours advocated by Hunt (1986) that help to determine whether the older person’s memory is adequate for independent living. Discussing the question of prediction versus understanding, Mook (1989) noted that if laboratory studies of aging “... deny external memory aids to the elderly, [they will] inflate the performance deficits relative to what occurs in

real life” (p.32). Away from the laboratory, the same problems of inconsistency are likely to compromise the practitioner who relies too heavily on conventional memory measures for a reliable estimate of memory function in their older clients. Everyday measures of memory relevant to the natural environment of the older adult may reduce inconsistencies in both experimental and clinical settings. The application of general systems theory to memory research in older adults also needs reemphasising. Sinnott (1989) makes a strong case that broader consideration be given to the natural environment of the older adult in memory measurement:

The human system is not operating in a vacuum; it operates in a context and is defined by interactions in that context. Within a systems view, every laboratory study of memory is a study of memory in context, the context of the laboratory. In that context, the analysis and manipulation of other systems levels are minimised to achieve control, but the cost is large. Interactions with other systems are trivialized, and the purpose - survival - is distorted. (p. 67).

## 10.8 Summary

In summary, it may be that the discriminative validity of the RBMT subtests can be attributed to increasing dependency amongst early DAT sufferers on working memory function rather than long-term memory as they seek to adapt to failing cognitive components and memory strategies. In contrast, VAD sufferers in the early stages retain some access to long-term memory components while experiencing vulnerability in working memory. This formulation predicts that early clinical cases would show similar or near similar levels of impairment on tests using unfamiliar or meaningless content due to compromised ability to integrate the unfamiliar material with what is already in store. With familiar material, VAD sufferers who retain relatively intact memory component systems would be differentiated from DAT sufferers whose hippocampal complex is compromised. It follows that measures of everyday memory which use familiar content relevant to the natural environment of the dementia sufferer, would be more likely to produce clinical data that assists with screening, diagnosis, disease staging, and treatment planning.

## CHAPTER 11

### CONCLUSIONS

*“We would like to emphasise that there is no one correct way of solving the maze of clinical memory assessment and that integrating cumulative information from different perspectives can stand us all in good stead.” (Poon et al., 1986, p.9).*

#### 11.1 Summary of the present studies

This research arose out of dissatisfaction with conventional memory measures as used to assess memory function with older adults. Few tests satisfied the requirements for ensuring reliable and valid psychometric assessment and results often failed to tally with behavioural reports of day-to-day memory function. Further, the tests available did not consistently predict capacity for continued independent living and were not reliable in discriminating between different types of pathology underlying memory impairment.

Clinical observation suggested that the RBMT addressed some of these limitations and an exploratory study indicated that raw scores might also have discriminative validity when used in dementia assessment. However, further investigation was hampered by limitations in the scoring system and in the published normative data for older adults.

The scoring system required the conversion of raw scores to standard Profile and Screening scores. This resulted in the loss of potentially useful information by disguising variation in subtest performance. It was uncertain whether the variation in raw scores was random, whether specific patterns might be associated with a particular brain pathology or whether variation might be a consequence of general ill health. The available normative data was not helpful in interpreting

subtest variations and highlighted the need for raw score data based on the performance of specific clinical groups, especially if discriminative validity is at issue. To be fair, the RBMT had been designed as a screening measure and its potential as a possible diagnostic aid had not been considered.

The present studies were designed to clarify these scoring and normative issues prior to examining the question of discriminative validity. The initial studies sought to establish reliable score profiles for a well, independent-living older adult sample and two clinical samples- -one diagnosed as having a dementia and the other representing unwell older people. As noted, special care was taken in stratifying the samples so as to ensure that the well sample included only healthy, cognitively normal older adults and the unwell sample only a representative mix of medical problems of old age excluding cerebro-vascular illness and incipient dementia. The dementia sample was also carefully selected and only those with a formal diagnosis of dementia and neuroimaging data were included. Stratified samples were considered essential to enable a reliable evaluation of discriminative validity based on differential subtest score patterns.

In the initial studies, reliable comparison data was established for the three samples based on raw scores rather than standard scores and the effects of age, education and gender on subtest scores was clarified. A further study was then undertaken to investigate discriminative validity. In this study, the raw scores obtained from the dementia sample were reanalysed according to the diagnosis of dementia type.

From the initial studies, it was concluded that the raw scores on all 12 of the RBMT subtests discriminated older adults with an early dementia from both well and unwell samples irrespective of the summary profile score obtained. Furthermore, the dementia sample could be distinguished on the basis of a significantly higher rate of false positive responses on the Picture and Face

recognition subtests. On the other hand, only the Immediate and Delayed Story recall subtests (and the summary Profile and Screening scores) discriminated between the well and unwell samples.

Demographic variables were found to have surprisingly little effect on RBMT summary Profile and Screening scores or on raw subtest scores across the three samples. Age had no influence on the summary scores or on any of the subtest scores in the two clinical samples, but was associated with both summary scores and the Appointment subtest in the well sample. Education effects were found on Delayed Story recall and the Profile score in the unwell sample and on the Immediate Story recall in the dementia sample. However these effects were variable and did not favour the higher educated groups in either sample. In the well sample, education effects favoured higher educated groups and were associated with three subtests, Name, Belonging and Immediate Story recall and also with the summary Screening score. Females obtained higher mean scores on the Name and Screening scores in the unwell sample and males in the well sample obtained significantly higher mean scores on the Belonging, Delayed Route and Message subtests and on the summary Profile score. In the dementia sample, males scored significantly higher on the two Story recall subtests.

In the final study, raw scores on six subtests- -Appointment, Message, Route (Immediate and Delayed) and Story (Immediate and Delayed)- -as well as false positive responses on the Picture Recognition subtest, discriminated between a group diagnosed with an early vascular dementia (VDG) and another with early Alzheimer's-type dementia (NVG). Between-group analyses confirmed earlier findings from Study 3 that demographic variables had little effect overall on subtest scores and it was concluded that the prevailing pathology was the dominant influence on scores.

It was concluded that the RBMT could be used as a screening test for abnormal memory impairment and as a diagnostic aid to supplement other clinical investigations in differentiating between early vascular and Alzheimer's-type dementias. The findings also supported the development of normative data based on defined clinical groups in neuropsychology practice with older adults, and the use of raw score rather than standard score data. Furthermore, the finding of few effects associated with aging or general ill health on subtest performance supported others who have reported relative stability in everyday memory over the normal life span in the absence of abnormal brain pathology. The RBMT overcomes many of the limitations found in conventional memory tests when assessing older adults.

## **11.2 Implications for the RBMT**

The following modifications are now suggested to enhance the use of the RBMT as both a screening and a diagnostic tool when used with older adults.

1. Modify the system of summary scoring to better reflect the screening and diagnostic potential of the RBMT. The present Screening score is redundant in clinical practice and should be dropped. The present Profile scores should be retained as these have become the standard for comparison used in most publications to date. It is suggested that the raw scores become the Screening scores for each subtest and that these be summed to provide a total Screening score.<sup>4</sup> A Discriminative score should be added based on the total raw score obtained on the six subtests identified in Study 4. The proposed scoring system would summarise all of the data from which to evaluate what additional input might be required while at the same time highlighting diagnostic markers when assessing for early dementia. Such a system would also have the advantage of

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<sup>4</sup>The notion of a total raw score is not new. It has already been adopted by some researchers who used the RBMT as a criterion variable for measuring change (e.g., Jhaveri, 1989; Malec et al., 1990; Yuan et al., 1993).

increasing the test ceiling and probably eliminate floor effects, which would further enhance the use of the RBMT as a sensitive indicator of change over time. An outline of a revised Score Summary Sheet is set out in Appendix E and discussed in detail in Appendix F.

2. Establish norms for normal, mild, moderate and severe memory impairment based on the total raw score for stratified clinical and nonclinical groups.
3. Combine normative data for age 60 to 79 years but maintain separate norms for age 80 to 89 years. These norms should be based on both the total raw score average (Screening score) and on average raw scores for each individual subtest (Discriminative profile) and presented within the above age bands.
4. Reduce the maximum raw score for each of the Story Recall subtests to 10 points but without changing content. The Fraser et al. study (in press) confirmed that well, community-dwelling older adults achieve an average raw score and standard deviation of approximately seven and two respectively on the Immediate Story and about two points less on both scores on the Delayed Story subtest.<sup>5</sup> The current maximum score of 21 is therefore redundant when the test is used with older adults and could distort the revised Screening score proposed above.
5. Introduce a format for cueing on the Story recall subtests so that when spontaneous recall has exhausted, a set of standard comments are available to check for retrieval of additional

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<sup>5</sup> These scores are approximately three points lower than those obtained by the normal control group aged 16 to 69 and reported in the initial standardisation of the RBMT (Wilson, Baddeley et al., 1989).

material, (if any).<sup>6</sup> A proposed set of cues is presented in Appendix G. It is suggested that only the uncued raw score would be used in the summary Screening score.

6. Score false positive responses on the Picture Recognition and Face Recognition subtests separately from the total score for the number of correct identifications on each subtest. The modified score summary includes provision for the specific recording of false positive responses.

### **11.3 Future research**

A number of areas for future research arise out of the current studies. Firstly, there is a need to replicate Study 4 using a similar research design but ensuring control of additional variables which may have had some influence on the current findings. For example, stricter exclusion criteria may have been advisable to control for such factors as comorbidity of depression, size and site of vascular lesions, coexistence of both a vascular and nonvascular pathology and also for stage of dementia. Additionally, in classifying cases, a more formal measure could be considered.

If replicated by independent studies, the complementary issues of discriminative and predictive validity are in need of more detailed research. Theoretical explanations for subtest discrimination in the present studies might be advanced initially, by clarifying similarities in subtests which discriminated between type of dementia and theoretical working memory processes. The difference between these subtests and those which did not discriminate also needs to be confirmed. For example, it would be interesting to vary the order of initial presentation of the Belonging, and Appointment subtests. The Belonging subtest may be found to discriminate if it was not presented immediately before the Appointment subtest but perhaps after the Picture Recognition subtest. If it

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<sup>6</sup> Both research and clinical observation indicates that ability to improve verbal recall with the provision of cues favours a diagnosis of early VAD rather than DAT (e.g., Cummings & Benson, 1986; Rosenstein, 1998).

was found to discriminate, this could be taken as support for the “overload” hypothesis. From such research, further ecologically valid measures known to mimic working memory function may emerge. Furthermore, both theoretical and clinical interest would be served by investigating the merger points in RBMT subtest scores between vascular and Alzheimer’s-type dementia cases such that subtests no longer reliably discriminate between the two pathologies. Such research would be helped by the revised Screening score suggested in 11:2 (above) and could potentially assist in staging disease progression.

The predictive validity of the RBMT is a major clinical issue for further research. Although there has been support for the test’s validity in predicting rehabilitation outcomes, its predictive validity when applied to dementia assessment and disease progression has not been well reported to date. The only study of partial relevance appears to be that of Goldstein et al. (1992) which was outlined in chapter 4 (4:8). Such research should simultaneously evaluate falling RBMT raw scores together with social and environmental variables and their relationship to maintaining independent living arrangements.

The dementia samples used in the current studies were mainly in the mildly demented stage but sufficiently advanced for concerns to be raised about cognitive function. It would now be useful to research the earliest possible stage at which everyday memory changes are detected using the RBMT and follow through to document the stages at which care needs alter. Such changes might include both qualitative and quantitative variables. This would require early reporting and long-term follow up. Such a study is underway on a small scale. Early findings suggest that failure to score the maximum points on either of the two Recognition subtests when vision is adequate, is almost invariably a significant early sign of abnormal memory aging. So too is a score on Immediate Story recall approximately one and a half standard deviations below the age group mean reported for the well sample in the Fraser et al. study (in press). False positive responses are also

highly indicative but appear to occur more often when other memory failings are also apparent. The Immediate Route recall subtest is of special interest in this study and it is planned to examine the results of increasing the number of stops used in this subtest since a small increase in difficulty may well improve its early discriminative properties. It is possible that the recently published Extended Version of the RBMT may be helpful in this regard (de Wall et al., 1994; Wilson et al., 1999).

The unresolved question of gender differences on the Immediate Story subtest is also in need of continued investigation. Women dementia sufferers as a group obtained significantly lower scores on the two Story recall subtests than their male counterparts in the current study. Nevertheless, there were indications that this deficit may be greater for female DAT sufferers in the early stages.

#### **11.4 Concluding comments**

With improvements in its normative data, the RBMT comes very close to fulfilling the considerations essential when testing memory function in older people. It has adequate content validity being a short yet reasonably broad measure of the skills older adults need to manage everyday cognitive demands. The test has sound face validity and is acceptable to older adults. It seldom elicits suspicion or counter-productive anxiety and avoids exposing older adults to experimental material that appears difficult and meaningless. The current studies have provided further support for the construct validity of the RBMT as a test of everyday memory with scores of well-independent participants remaining relatively stable into the ninth decade. Even the scores of those who were unwell at the time of testing did not fall substantially below those of the well participants and remained clearly distinguishable from those obtained by participants with an early dementing condition. There is some support for the test's predictive validity but further research is needed to determine its reliability in predicting maintenance of independent living in dementia

sufferers. Finally, the current studies have provided evidence supporting the test's discriminative validity when raw score subtest profiles are analysed.

In practice, the addition of only two or three other short measures to supplement an RBMT profile, together with behavioural reports, provides a reasonably adequate and useful summary of memory function in most older clients. The test is suitable for use as a measure of everyday memory across a wide age range and results are relatively unaffected by key demographic variables.

The initial impetus for these studies arose from dissatisfaction with most of the clinical measures available for memory assessment with older adults. The reasons for this and the problems it presented have been explored. As an outcome from the current investigations, it was hoped that progress would be made towards the availability of a memory assessment tool that could be used with confidence even in those cases where it might have to stand as the only psychometric information obtainable. If this were to be achieved, a starting point had to be the aim of making memory assessment a more relevant and less exhausting experience for older adults. The everyday memory approach undoubtedly does this. Although further work is needed, the RBMT has potential as a multi-purpose instrument capable of providing the practitioner with reliable and clinically valid information when used with older adults. The current findings indicate a high level of probability that a particular raw score profile represents normal or abnormal memory aging.

This dissertation began with reference to the challenge faced by clinicians when evaluating cognitive function in the older adult. Could it be that the challenge Albert referred to is due less to difficulties disentangling the interaction between aging and disease as was suggested, but more to the relative neglect that experimental neuropsychology has accorded the cognitive problems of older age? For most older adults, the typical demands on cognitive processes are about maintaining rather than extending function. While this distinction is very apparent in the day-to-day work of the

clinician, it seems to have been overlooked by the theoretician. Thus the RBMT developed from a clinical need which reflected frustration with the lack of progress from the laboratory method in developing suitable measures of memory, and the growing interest in measuring memory function under realistic everyday conditions.

A challenge suggested from the current studies, is to develop tests which focus on working memory function in real life settings. This will likely progress through both applied and controlled laboratory-based research. The goal for the clinician is a valid, reliable and client-centered memory assessment protocol while for the theoretician, the goal is a coherent and integrated model of memory function. These goals are not incompatible since ultimately both will founder unless the end product reflects the special needs and furthers the well-being of older adults.

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• 7 Faces

Action

Present the five presentation cards for 'Face recognition'.

• 8a Route (immediate)

Action

Demonstrate the route for 'Remembering a short route' (immediate). (Leave the 'Message' envelope for 'Remembering to deliver a message' at the location marked by an asterisk below.) Then ask the subject to reproduce the route. Record each of the stages reproduced correctly below. The subject's response to 'Remembering to deliver a message' should be recorded in the next section.

Response

Tick each stage of the route correctly recalled:

- A Chair door window table\* chair
- B Door window\* table chair door
- C Window table chair\* door window
- D Table chair door\* window table

--	--	--	--	--

Scoring

- Raw Score  
Total number of stages recalled correctly (Maximum = 5)
- Standardised Profile Score  
Raw Score                    ≤3    4    5  
Standardised Profile Score    0    1    2
- Screening Score  
All five stages of the route recalled in the correct order = 1  
(Otherwise = 0)

• 9a Message (immediate)

Action

When demonstrating the route, leave the 'Message' envelope for 'Remembering to deliver a message' (immediate) at the location marked by an asterisk above.

Response

Tick as appropriate:

- 'Message' envelope picked-up spontaneously
- picked-up after prompt
- left at correct location

Scoring

- Raw Score  
'Message' picked-up spontaneously = 2  
picked-up after prompt = 1  
left at correct location = another 1  
(Maximum = 3)
- Standardised Profile Score  
Score later
- Screening Score  
Score later

SPECIMEN

• 7 Faces

Action

Present the ten recognition cards for 'Face recognition'.

Response

Tick each face identified correctly. (Those faces which were previously presented are indicated by superior figures on the reverse of the face cards.)

1	2	3	4	5
<input type="checkbox"/>				

Total

Record the number of false positives

Scoring

- Raw Score  
Subtract the number of false positives from the total number of faces correctly identified (Maximum = 5)
- Standardised Profile Score  
Raw Score                    ≤3    4    5  
Standardised Profile Score    0    1    2
- Screening Score  
All five faces identified correctly with no false positives = 1  
(Otherwise = 0)

• 10 and 11 Orientation and Date

Action

Ask the ten questions for 'Orientation' and 'Date' in the order given below:

Response

Record the subject's responses in the spaces provided:

1 Year	2 Month	3 Day of week
<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>
4 Date	5 Place	6 City or town
<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>
7 Age	8 Year born	9 Prime Minister
<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>	<input style="width: 100%;" type="text"/>
10 President	<input style="width: 100%;" type="text"/>	

Scoring

- Raw Score  
Score one point for each correct response.
- Total number of correct responses to Orientation questions i.e. excluding Date (Maximum = 9)
- Correct Date (Maximum = 1)
- Standardised Profile Score  
Orientation questions
- Raw Score                    ≤7    8    9  
Standardised Profile Score    0    1    2

**SPECIMEN**

<input type="checkbox"/>	• Date			
	Raw Score	≥ Two days out	One day out	Correct
	Standardised Profile Score	0	1	2

*Screening Score*

- Orientation questions  
All nine Orientation questions answered correctly = 1  
(Otherwise = 0)
- Date  
Correct Date given = 1  
(Otherwise = 0)

**• 4 Appointment**

**Action**

Engage the subject in conversation until the timer sounds for 'Remembering an appointment'. Prompt if necessary.

- A 'When do I have to see you again?'
- B 'When does this session end?'
- C 'When will I know the results of the test?'
- D 'What time do we finish today?'

**Response**

Tick as appropriate:

Subject asked appropriate question spontaneously	<input type="checkbox"/>
after prompt	<input type="checkbox"/>
Subject remembered that something had to be asked but could not remember what it was	<input type="checkbox"/>

**Scoring**

<input type="checkbox"/>	<i>Raw Score</i>			
	Subject asked appropriate question spontaneously = 2			
	after prompt = 1			
	Subject remembered that something had to be asked but could not remember what it was = 1			
	(Maximum = 2)			

<input type="checkbox"/>	<i>Standardised Profile Score</i>			
	Raw Score	0	1	2
	Standardised Profile Score	0	1	2

- Screening Score*  
Appropriate question asked without prompt when timer sounded = 1  
(Otherwise = 0)

**• 6b Story (delayed)**

**Action**

Ask the subject to recall the prose passage for 'Delayed prose recall'. Give opening prompt if necessary.

**Response**

Record each of the 'ideas' correctly recalled or partially recalled against the appropriate passage on the Story Sheet.

**Scoring**

Score exactly as for 'Immediate prose recall' but deduct one point if the subject needed an opening prompt.

<input type="checkbox"/>	<i>Raw Score</i>			
	Each 'idea' recalled word-perfect or using a close synonym = 1			
	Each 'idea' partially recalled, or recalled with approximate synonym = ½			
	(Maximum = 21)			

<input type="checkbox"/>	<i>Standardised Profile Score</i>			
	Raw Score	≤1.5	2-3.5	≥4
	Standardised Profile Score	0	1	2

- Screening Score*  
If the subject recalled at least six 'ideas' on 'Story (immediate)' and at least four 'ideas' on 'Story (delayed)' = 1  
(Otherwise = 0)

**• 8b Route (delayed)**

**Action**

Ask the subject to reproduce the route for 'Remembering a short route' (delayed). Record each of the stages reproduced correctly below. The subject's response to 'Remembering to deliver a message' (delayed) should be recorded in the next section.

**Response**

Tick each stage of the route correctly recalled:

A	Chair	door	window	table*	chair
B	Door	window*	table	chair	door
C	Window	table	chair*	door	window
D	Table	chair	door*	window	table

--	--	--	--	--

**Scoring**

<input type="checkbox"/>	<i>Raw Score</i>	
	Total number of stages recalled correctly	
	(Maximum = 5)	

<input type="checkbox"/>	<i>Standardised Profile Score</i>			
	Raw Score	≤3	4	5
	Standardised Profile Score	0	1	2

- Screening Score*  
All five stages of the route recalled in the correct order = 1  
(Otherwise = 0)

**• 9b Message (delayed)**

**Action**

Remind the subject, if necessary, about the 'Message' envelope for 'Remembering to deliver a message' (delayed). The location is marked by an asterisk above.

**Response**

Tick as appropriate:

'Message' envelope picked-up spontaneously	<input type="checkbox"/>
picked-up after prompt	<input type="checkbox"/>
left at correct location	<input type="checkbox"/>

**Scoring**

<input type="checkbox"/>	<i>Raw Score</i>	
	'Message' picked-up spontaneously = 2	
	picked-up after prompt = 1	
	left at correct location = another 1	
	(Maximum = 3)	



**Standardised Profile Score**

The Standardised Profile Score for 'Remembering to deliver a message' is based on the sum of the Raw Scores obtained for the immediate and delayed recalls (therefore maximum Raw Score = 6).

Sum of Raw Scores	≤4	5	6
Standardised Profile Score	0	1	2



**Screening Score**

If the subject spontaneously picked-up the 'Message' envelope and left it at the correct location in the immediate and delayed recalls = 1

(Otherwise = 0)

**• 1 and 2 First and Second Name**

**Action**

Re-present the portrait for 'Remembering a name'.  
Give first letter prompt if necessary.

- A Catherine Taylor
- B Henry Fisher
- C Pauline Roberts
- D Philip Goodwin

**Response**

Tick as appropriate

First Name recalled without prompt

recalled with prompt

Second Name recalled without prompt

recalled with prompt

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

**Scoring**

**Raw Score**

• First Name recalled without prompt = 2  
recalled with prompt = 1

(Maximum = 2)

• Second Name recalled without prompt = 2  
recalled with prompt = 1

(Maximum = 2)



**Standardised Profile Score**

The Standardised Profile Score for 'Remembering a name' is based on the sum of the Raw Scores obtained for the recall of the First and Second Names (therefore maximum Raw Score = 4).

Raw Score	≤2	3	4
Standardised Profile Score	0	1	2

**Screening Score**

• If the subject recalled the First Name without prompt = 1  
(Otherwise = 0)

• If the subject recalled the Second Name without prompt = 1  
(Otherwise = 0)

**• 3 Belonging**

**Action**

Inform the subject that 'We have finished this test'.  
Wait for recall of 'Remembering a hidden belonging'.  
Prompt if necessary.

- A Desk drawer
- B Cupboard
- C Filing cabinet
- D Brief case or bag

**Response**

Tick as appropriate:

Place recalled without prompt

recalled with prompt

Item recalled without prompt

recalled with prompt

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

**Scoring**



**Raw Score**

Place recalled without prompt = 2  
recalled with prompt = 1

Item recalled without prompt = 2  
recalled with prompt = 1

(Maximum = 4)



**Standardised Profile Score**

Raw Score	≤2	3	4
Standardised Profile Score	0	1	2



**Screening Score**

If the subject spontaneously recalled the item and the place where it was hidden = 1

(Otherwise = 0)

**Score summary**

	Standardised Profile Score (2,1 or 0)	Screening Score (1 or 0)
1 First Name	<input type="checkbox"/>	<input type="checkbox"/>
2 Second Name		<input type="checkbox"/>
3 Belonging	<input type="checkbox"/>	<input type="checkbox"/>
4 Appointment	<input type="checkbox"/>	<input type="checkbox"/>
5 Pictures	<input type="checkbox"/>	<input type="checkbox"/>
6a Story immediate	<input type="checkbox"/>	<input type="checkbox"/>
6b delayed		
7 Faces	<input type="checkbox"/>	<input type="checkbox"/>
8a Route immediate	<input type="checkbox"/>	<input type="checkbox"/>
8b delayed	<input type="checkbox"/>	<input type="checkbox"/>
9 Message (immediate & delayed)	<input type="checkbox"/>	<input type="checkbox"/>
10 Orientation (not including date)	<input type="checkbox"/>	<input type="checkbox"/>
11 Date	<input type="checkbox"/>	<input type="checkbox"/>
<b>Total</b>	<input type="checkbox"/>	<input type="checkbox"/>

maximum = 24

maximum = 12

## APPENDIX B

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Manuscript in press.

### EVERYDAY MEMORY IN AN ELDERLY NEW ZEALAND POPULATION: PERFORMANCE ON THE RIVERMEAD BEHAVIOURAL MEMORY TEST.

An earlier draft of this paper was presented at the 14<sup>th</sup> International Australasian Winter Conference on Brain Research, (1996), Queenstown, New Zealand

**Abstract:** Assessment of memory is critical for evaluation for possible dementia. The Rivermead Behavioural Memory Test (RBMT) is one of the few measures known to have ecological validity when used with older adults. However, the norms for ages 70-94 may underestimate normal performance in well elderly people due to the sampling procedures adopted. This study reports RBMT normative data for 131 elderly, nondementing, community dwelling volunteers in New Zealand, in three age specific bands: 60-69, 70-79, 80-89 years.

Results showed significant differences between the data collected in Oxford and New Zealand. New Zealand results were higher on the summary Profile score and on six subtests with all but one of the probabilities at the  $p < 0.001$  level. In addition, the New Zealand data favoured the use of separate norms for the 60 to 69 age group. Factors contributing to the differences are discussed. It is concluded that the New Zealand data is representative of well, independent-living older adults in contrast to the Oxford data which represents a cross-section of elderly of varying health and dependency status. This study supports the collection of normative data for specific clinical groups.

### Introduction

The increase in average human life expectancy from less than 50 years at the turn of the century to almost 80 years at its end, has increased the impact of age related dementias on individuals, families, caregivers and professionals. Dementia is a mind robbing, body sparing condition, responsible for large health care expense in developed countries. It results in considerable disability and emotional trauma and leads eventually to death. The increase in cases of dementia has resulted in the condition being referred to as the epidemic of the century (Plum, 1979).

The only published prevalence study of dementia in New Zealand estimated that between 1992 and 2016, prevalence will increase by 96% to 100% (National Advisory Committee on Health and Disability [NACHD] 1997) compared to the estimated rise in the population of 18% to 26%. Early diagnosis is essential for treatment planning and relies heavily upon clinical examination, neuro-imaging data and neuropsychological testing (Kaszniak, 1986; Rosenstein, 1998). Testing is

essential for determining the extent of memory loss, which is a primary requirement for diagnosis (Diagnostic and Statistical Manual of Mental Disorders [4<sup>th</sup> ed.], American Psychiatric Association, 1994). Test results are also useful for providing a catalogue of cognitive strengths and weaknesses from which disease progression can be objectively measured.

Despite the obvious need for reliable memory assessment, there are surprisingly few tests suitable for assessing an elderly population (Lezak, 1995). This lack has contributed to neuropsychological assessment with elderly being recognised as one of the greatest challenges facing the neuropsychologist (Loewenstein, Argüelles, Argüelles & Linn-Feuntes, 1994). But there are also a range of special considerations important when using tests with older populations which complicate the process ( see Woodruff-Pak, 1997 for a discussion of these). Furthermore, it is likely that results from conventional tests of memory overestimate the level of deficit when used with elderly populations (Kausler, 1992). Measures with high functional (face) validity would appear to improve reliability and to overcome many of the practical difficulties encountered when faced with an elderly client referred for assessment of memory function (Cunningham, 1986). The Rivermead Behavioural Memory Test (RBMT) (Cockburn & Smith, 1989; Wilson, Baddeley, Cockburn & Hiorns, 1989) is an example of a limited number of functional measures and has proven useful in clinical work with older adults in a New Zealand setting (Glass 1996). The RBMT focuses on practical memory tasks, such as recalling a short news item, remembering to do something at a certain time and putting a name to a face. An extra feature of the RBMT is that it has four parallel forms thus enabling repeat administration of the test without a practice effect.

But there are weaknesses associated with the RBMT. The normative sample of older adults gathered in Oxford, England attempted to be representative of all elderly with the result that it is probably not representative of well, independent older adults. The Oxford participants were recruited from the general population ( $n = 85$ ), and from a local geriatric day hospital and occupants of floating beds in a community hospital ( $n=34$ ). Although 106 (89%) were living in their own homes or in sheltered housing, the full sample were reported as receiving regular help to live independently from an average of 2.6 sources. It is also noted (Cockburn & Smith, 1989) that four participants were unable to complete all of the RBMT due to vision or speech limitations and a further 11 were unable or unwilling to complete the corollary tests used in the validation study. It is likely, therefore, that the Oxford norms over-represent the performance of unwell and semi-dependent elderly. This seems even more probable when, in a 1991 study of the same data, Cockburn and Smith discarded a total of 25 data sets from the original 119 because of difficulties participants had experienced in completing one or more of the measures used in the development protocol. Still later they discarded a further 15% (approximately 14) of the data sets from the final part of their analysis since it was thought the RBMT scores might represent an incipient dementia (Cockburn & Smith, 1991).

Formal norms have been published which provide summary Profile and Screening scores based on 106 subjects in the 70 to 94 year age group living in their own homes or sheltered housing (Cockburn & Smith, 1989). The manual also presents a summary of the standard scores for each subtest for numbers varying from 94 to 114 participants but no raw score data is provided. The norms for elderly excluded the 60 to 69 age group since earlier work had indicated that normal, cognitively intact people between the ages of 16 and 69 obtained similar or near similar scores (Wilson, Baddeley, Cockburn & Hiorns, 1989).

The current study reports a set of normative data for well, independent-living older adults in three age bands between the ages of 60 and 89 years. Data is compared with the Oxford data for the two age bands 70-79 and 80-89 and the assertion that people in the 60-69 age group obtain similar scores to those aged 16-69 is also examined.

The main aim of the study was to produce a set of New Zealand performance standards for well, independent older adults while also clarifying whether there is a bias towards unwell and semi-dependent elderly in the Oxford normative data. In addition, the study sought to produce raw score subtest performance data for each of the three age bands. Glass (1996) observed a certain regularity in subtest failures when inspecting raw score clinical data obtained from clients diagnosed with a dementing condition. He suggested that increased attention to differential subtest scoring patterns could extend the use of the test to both a screening and a diagnostic tool. However, the lack of raw score normative data hampered further investigations since it could not be certain whether similar regularities occurred within the normal elderly population. One further purpose will be served through the current study. Literature searches indicate that the RBMT has been successfully translated for use in a number of countries, including Holland, China, Italy, Spain and Germany, but not specifically for use in the New Zealand culture. Comparative data would also be useful to validate minor changes made to terminology in the Story recall subtests to ensure their relevancy in the New Zealand context.

## Method

### Participants

Participants comprised 131 volunteers recruited from the wider New Plymouth region which has a population of approximately 45000. Several methods were used to recruit participants. These included speaking to various community groups, publicity on community radio and in local newspapers including a community newspaper which is delivered without charge to every household in the region, and notices placed at clubs where older adults were likely to meet. Word-of-mouth advertising was also effective and resulted in the inclusion of a number of people who would not usually volunteer, thus increasing the heterogeneity of the sample.

All participants were required to be between the ages of 60 and 89 years, to be living independently in the community, to be generally well and mobile and to report having no concerns about their everyday memory. A score of 9 or above was required on the short form of the Mini Mental Status Examination (Braekhus, Laake, & Engelkdal, 1992). In addition, participants were required to have no current cardiac or respiratory problems, no known history of cerebro-vascular disease and to report no history of major cardiac or respiratory illness in the preceding three year period.

All older adults who volunteered were contacted and invited to take part in the study if they considered they met the inclusion criteria. Initial contact identified some who had concerns about their everyday memory and wished to have this tested. These people were invited to make an appointment with the second author for follow-up and were not included in the study. In total, 138 predominantly Caucasian volunteers were entered in the formal test protocol and completed the two measures (see below). All volunteers were English speaking.

Data from 131 participants was used in the analysis. Seven data sets were removed as each scored more than 2.5 standard deviations below the mean summary Profile score of the relevant age group. In addition, one of these had obtained a score of 8 on the MMSE. Each of the seven later acknowledged concerns about their day-to-day memory which had led them to volunteer (or be encouraged to by a spouse). Five of the seven took up the option of referral for more comprehensive assessment with the second author. Four were later diagnosed as having a dementing condition following medical and neuropsychological investigations, while the fifth was found to have a depressive disorder and a possible incipient dementia.

Table 1 summarises relevant demographic characteristics of the 131 participants. The average age of the sample was 72.71 years (71.91 and 73.85 females and males respectively). Average years education (that is, primary and secondary school combined) was 10.46 years. The range in years of education was 6 to 16 for males and 7 to 18 years for females. There were no significant differences between age groupings and education or between gender and education. The mean MMSE score was 11.78 (range 10-12). The seven participants whose data was removed from the analysis comprised four females and three males with a mean age of 73.42 years (range 65-89), and mean education of 10.57 years (range 10-12). This group's mean MMSE score was 10.57 (range 8-12).

**Table 1**

**Characteristics of Participants grouped by gender**

Characteristic	Male	Female	Male + Female
Age (Mean years)	73.85	71.91	72.71
Age groupings (%)			
60-69 years	9.90	21.40	31.30
70-79 years	20.60	28.20	48.90
80-89 years	10.70	9.20	19.80
Education (Mean years)	10.40	10.63	10.46
Education by age group			
60-69 years	10.82	10.34	10.50
70-79 years	10.19	10.58	10.42
80-89 years	10.37	10.46	10.47

**Measures**

**12 Item Version of the Mini Mental Status Examination (MMSE-12):**

The MMSE (Folstein, Folstein & McHugh, 1975) is one of the most widely used brief screening instruments for dementia (Morris, Heyman, & Mohs, 1989). It is a 20-item measure, taking about 10 minutes to administer and with no significant gender biases (Tombaugh & McIntyre, 1992). However, Braekhus, Laake & Engelkdal (1992) hypothesised that not all the items in the original 20-item MMSE were equally efficient in identifying cognitive impairment and isolated the 12 items with greatest sensitivity to dementia. Their 12-item version correlated at .96 with the full MMSE and a cut-point of 9 was established as giving a sensitivity of .98 and a specificity of .91 in 831 adults with a mean age of 81.5 years. An advantage of the 12 item version is that it takes only 5 minutes to administer making the test process less strenuous for the older adult.

**The Rivermead Behavioural Memory Test (RBMT)**

This test is comprised of 12 subtests, (recall of name, recall and whereabouts of a belonging, remembering to make an appointment, immediate and delayed recall of a story and a route traced

around the room, recall of faces and objects, orientation and knowledge of the date).

Raw scores are converted to Profile scores of 0 (abnormal), 1 (borderline) or 2 (normal) adding to a total possible Profile score of 24. Screening scores are determined on a pass (1) or fail (0) basis. The measure has high inter-rater and alternate-form reliability and validity was confirmed by a  $<.001$  correlation between RBMT results and therapists' ratings on a behavioural-memory checklist (Wilson et al., 1989). Full details of the test can be found in the test manual and elsewhere (Cockburn & Collin, 1988; Cockburn & Smith, 1989; Cockburn & Smith, 1991).

### **Procedure**

Special care was taken to keep anxiety levels of participants to a minimum. Participants were engaged in general non-test related conversation for a few minutes before being presented with a page of information outlining the reasons for the study and the process involved. Before being asked to complete a consent form, each participant was given the chance to ask any questions relating to the procedure. Participants were given the choice of taking the tests in their own homes or at an outpatient facility away from the main hospital complex. Thirty-two chose their own homes and the remainder the outpatient facility. The former group obtained a slightly lower mean summary Profile score (19.47) compared to those who attended the outpatient facility (20.03) but there were no differences in subtest raw scores.

Version B of the RBMT was administered to 80% ( $n=105$ ) of the participants and Version A to the remaining 20% ( $n = 26$ ). This was to check for possible gender bias identified in the Story recall subtest and a possible lack of clarity in gender identification in the Face recognition subtest in Version A (Glass, 1996), although the Oxford researchers had reported a correlation of .86 between the two versions. The summary Profile scores and subtest raw scores were compared between the 26 who completed Version A and an age, education and gender matched group who had completed Version B. Independent samples  $t$ -tests indicated no significant differences on any of the comparisons. The summary Profile scores for the two versions correlated at 0.94.

The RBMT was administered irrespective of the MMSE score. All subtests were administered according to the manual. Once the measures were completed, each participant was invited to comment on the test and procedure and asked not to discuss the test with anyone else. Couples who volunteered were tested consecutively. No other formal measures were administered to determine whether participants might be experiencing daily memory problems. If participants had concerns about their performance, they were invited to discuss these with the second author.

## **Results**

### Comparison with Oxford norms

Table 2 presents a comparison between the Oxford standard Profile scores and the current data. Data for both the summary Profile scores and for each of the 12 subtests are summarised. Because the data available for the Oxford sample is for a 70-90 year old population only, the 60-69 year age group was removed for this analysis to enable a direct comparison to be made. An Independent-samples  $t$ -test was used to compare the two sets of means. As shown in Table 2, the mean scores on 6 of the 12 subtests and on the summary Profile score were significantly higher for the New Zealand sample.

Table 2

**Comparison of Oxford and New Zealand norms**

<u>Subtests</u>	<u>New Zealand</u> ( <u>n</u> = 90)		<u>Oxford</u> ( <u>n</u> = 114)		<u>t</u>	<u>p</u>
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>		
Names	1.14	.94	0.87	.93	1.44	
Belonging	1.48	.77	1.20	.78	1.89	
Appoint	1.47	.75	1.16	.77	2.11	
Pictures	1.90	.37	1.71	.60	2.41	
Story I <sup>a</sup>	1.61	.61	1.13	.89	3.85	***
Story D <sup>b</sup>	1.83	.43	1.19	.89	5.98	***
Faces	1.72	.56	1.53	.69	2.07	*
Route I <sup>a</sup>	1.61	.65	1.41	.79	0.10	
Route D <sup>b</sup>	1.59	.72	1.62	.69	0.89	
Message	1.42	.82	0.86	.83	4.20	***
Orientn	1.86	.40	1.46	.76	4.55	***
Date	1.90	.40	1.35	.85	5.43	***
Total Profile	19.50	3.00	15.54	5.54	4.81	***

<sup>a</sup> Immediate recall; <sup>b</sup> Delayed recall.

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

**Age group comparisons for New Zealand data**

Table 3 presents summary data by age grouping for each of the subtest raw scores and for the summary Profile scores. A decrease in mean scores was associated with increasing age on many of the subtests though the variation in the summary Profile score was approximately only one point between the youngest and the oldest age grouping. A nonsignificant F ratio was obtained for the differences between the summary Profile scores. When the subtest scores were analysed separately, a significant F ratio was obtained for the differences between the three age groupings on the Appointment subtest ( $F[2,128] = 3.235$ ,  $p < .05$ ) but for no other subtests. Further investigation using Tamhane's post hoc multiple comparison method (Coakes & Steed, 1996), revealed no significant differences on any of the comparisons between subtests and age groups. While the Appointment subtest approached significance ( $p = .07$ ) this was only for the comparison between the 60 – 69 and the 80 – 89 year age groups. Multiple comparison methods tend to be conservative in assessing significance (Everitt, 1996). As a further check, a t-test analysis was run which did report a significant difference for the above age comparison on the Appointment subtest, but for no others.

**Table 3:**

**Means & standard deviations of RBMT sub-test raw and profile scores for the New Zealand sample.**

Subtest	Age groupings											
	60-69 n = 41 Scores				70-79 n = 64 Scores				80-89 n = 26 Scores			
	Raw		Profile		Raw		Profile		Raw		Profile	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Names	3.37	(0.99)	1.44	(.81)	2.89	(1.38)	1.11	(.96)	2.96	(1.28)	1.23	(.91)
Belong	3.49	(0.71)	1.51	(.71)	3.39	(1.14)	1.53	(.78)	3.08	(1.35)	1.34	(.75)
Appointment	1.68	(0.61)	1.71	(.60)	1.55	(0.71)	1.55	(.71)	1.23	(0.86)	1.27	(.83)
Pictures	9.93	(0.26)	1.90	(.30)	9.91	(0.39)	1.89	(.40)	9.88	(0.33)	1.92	(.27)
Story.I	6.63	(2.55)	1.59	(.67)	6.76	(2.36)	1.55	(.67)	6.58	(1.90)	1.77	(.43)
Story.D	5.70	(2.43)	1.83	(.44)	5.67	(2.06)	1.80	(.48)	5.21	(1.95)	1.92	(.27)
Faces	4.78	(0.48)	1.80	(.46)	4.66	(0.76)	1.73	(.54)	4.73	(0.72)	1.69	(.62)
Route.I	4.76	(0.49)	1.76	(.49)	4.58	(0.66)	1.56	(.69)	4.77	(0.43)	1.73	(.53)
Route.D	4.73	(0.55)	1.73	(.55)	4.56	(0.73)	1.56	(.73)	4.65	(0.63)	1.65	(.69)
Message	5.63	(0.66)	1.51	(.78)	5.39	(0.97)	1.45	(.83)	5.12	(1.31)	1.35	(.80)
Date	1.90	(0.37)	1.90	(.37)	1.84	(0.51)	1.88	(.45)	1.92	(0.39)	1.96	(.20)
Profile	20.61	(2.62)			19.55	(3.18)			19.62	(2.47)		

## Discussion

As expected, significant differences emerged between the Oxford and New Zealand data across the age groups 70-89 which applied to the summary Profile scores and to six of the standardised subtest scores. In addition, the 60-69 age group obtained a mean Profile score substantially below that predicted by the Oxford normative data for normal controls aged between 16 and 69 years.

The 70-89 year old volunteers in the current study scored an average of 4 points higher on the Profile score compared to the Oxford 70-89 year olds. Based on this finding it is likely that the Oxford norms underestimate normal performance in this age range. Furthermore, comparison of Profile scores between the current sample's 60-69 age group and the Oxford broader 16-69 age group, indicates that the Oxford data may overestimate normal performance in the 7<sup>th</sup> decade. Wilson et al, (1989) concluded that elderly norms were necessary only for the oldest decades beyond 69 and published a Profile score for the 16-69 age group of 22-24 (standard deviation: 1.74). Based on this estimation, the Profile score for the well-normal 60-69 year olds in the current sample is almost one standard deviation below the mean. According to Wilson et al, (1989) such a result is classified as "poor memory". However, it seems more likely that a normal Profile score for a person in this age range is closer to 20.57 as obtained in the current study. This conclusion is supported by data from the van Balen et al, (1996) study in which similar Profile scores of 20.50 for the 60-69 group were obtained. These findings would support the provision of separate norms for older adults from approximately the seventh decade.

There were a number of factors which could account for, or contribute to, these differences. As noted, the Oxford sample appeared to have at least a moderate level of dependency and may have been overrepresentative of unwell, semi-dependent older adults. Further support for this assertion is found in both the initial standardisation study and in later studies of the same sample where it becomes apparent that approximately 39 (33%) of the data sets were discarded from various analyses because of doubts about reliability. As 5-8% of individuals over the age of 65 can be expected to develop dementia, (Rosenstein, 1998) it could be assumed that a number of the participants in the Oxford sample were in the early stages of a dementia at the time of testing. No mention is made in the Oxford study of screening for dementia prior to testing but as noted, a later study from the Oxford group identified 14 cases suspected of having an incipient dementia. Although discarded from some of the later data analyses, this subgroup were nevertheless included in their normative data.

By comparison, the New Zealand participants were all community dwelling. All participants were administered a cognitive screen as part of the research protocol although only one obtained a score below the cut-point of 9. However, as noted earlier, seven of the volunteers were excluded due to obtaining abnormally low RBMT summary Profile scores and each later acknowledged some degree of concern about their everyday memory. This number comprised approximately 5% of the total volunteer sample which equates with prevalence estimates of dementia in adults over 65 years of age (Rosenstein, 1998).

Test fatigue is a further factor that may have contributed to the differences between the Oxford and New Zealand data. The Oxford participants were asked to complete a battery of 5 comprehensive tests taking a total of 1.5 hours to complete (Cockburn & Smith, 1989). It could be assumed that fatigue over this period had some effect on results. In contrast, the New Zealand participants were involved for only 35 minutes.

The effects of anxiety on test performance with older adults have been well documented (e.g., Beech & Harding, 1990; Woodruff-Pak, 1997) and may have been a further influence on RBMT

performance between the two samples. Efforts were made in the current study to reduce possible anxiety by using a quiet office, with a large window overlooking a garden. Participants were engaged in general conversation and were offered tea, coffee or water prior to testing. Whether such steps to minimise anxiety levels were taken in the Oxford study is not stated. On the other hand, not all studies report anxiety to have a negative effect, (Koenders, Passchier, Teuns, & van-Harskamp, 1993) and there is evidence that severity of memory impairment on the RBMT is not significantly associated with results obtained from formal measures of anxiety and depression (Grubb, O'Carroll, Cobbe, Sirel, & Fox, 1996). Whether or not anxiety had an effect on test scores is therefore debatable, especially as observations indicate less evidence of anxiety amongst older adults taking the RBMT than with many conventional tests which use unfamiliar material.

It could be argued that the New Zealand group were not representative of the general population either. All were volunteers and represented a well, generally active older adult population, especially the 80-89 year age group. They could therefore be seen to represent a stratified cross-section of older adults. Furthermore, the average level of formal education in the current sample at 10.46 years was approximately one year higher than that of the Oxford sample's 9.51 years. While this may have had some impact, there is evidence that education level has little effect on subtest performance in well-normal older adults other than on the Story recall subtests (Cockburn & Smith, 1991; Glass, 1999). It could also be argued that the seven outlying scores represented the false positives rate associated with the RBMT and that their removal reduced the generalisability of the current findings. As four of the five who opted for further investigations were diagnosed over the ensuing 12 month period as having a dementing condition, it seems that the decision to remove such low scorers was valid even in the absence of a low MMSE score. Furthermore, it has been noted that most cognitively intact people up to the age of at least 69 should obtain normal or near normal scores on the RBMT (Wilson et al., 1989), and there is evidence that this age range can be extended to age 89 years (Glass, 1999; Ostrosky-Solis, Jaime, & Ardila, 1998). The use of the MMSE-12 could be seen as a possible limitation in the current study since it identified only one of the seven participants found to have memory difficulties. For future studies, the addition of the Behavioural Memory Checklist (Wilson et al. (1989) is being considered.

If the purpose of using a measure of memory is to determine the extent to which the scores of any one individual deviates from those of a group with intact memory, the New Zealand data would appear to be clinically helpful. It summarises the performance of a sample of well, reasonably active older adults and provides raw score standards for a range of everyday memory behaviours. Both the Oxford and current data could be used as benchmarks as part of more comprehensive stratified norms for different elderly clinical groups. For example, a large-scale Dutch study incorporated norms for well, independent elderly alongside those for nonclinical groups (van Balen, Westzaan & Mulder, 1996) but did not extend these to cover subtest raw scores.

The current study supports the conclusion that the Oxford normative data underestimates the performance of well, independent-living older adults aged 70-89 on the RBMT and slightly overestimates the performance of people in the age range 60-69. The study supports the need for separate norms for this age group. The study has produced a set of data reflecting the performance of generally well, mobile older adults. Comparisons can be made with the summary Profile scores and also with raw scores obtained on individual subtests.

In addition to being of use clinically, the current study lays the groundwork for future research examining the performance of patients from different diagnostic groups on this measure.

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**APPENDIX C****DIFFERENTIAL SUBTEST SCORES ON THE RIVERMEAD BEHAVIOURAL MEMORY TEST (RBMT) IN AN ELDERLY POPULATION WITH DIAGNOSIS OF VASCULAR OR NONVASCULAR DEMENTIA****JOHN N GLASS**

**An earlier draft of this paper was presented at the 14<sup>th</sup> International Australasian Winter conference on Brain Research, (1996), Queenstown, New Zealand.**

## APPENDIX D

### CHANGES IN STORY RECALL SUBTESTS TO IMPROVE CONTEXTUAL RELEVANCY TO NEW ZEALAND OLDER ADULTS

(Original versions with changes in *italics*)

#### Story A

Mr Brian Kelly/a Security Express employee *Security Guard*/was shot dead/on Monday/during a bank raid/in Brighton *Thames*/. The four raiders/all wore masks/and one carried/a sawn-off/ shotgun/. Police detectives/were sifting through/eye-witness accounts/last night/. A police spokesman said/ “He was a very brave man/. He went for/the armed raider/and put up a hell of a fight”.

#### Story B

Fireman/and volunteers/worked all day/yesterday/beating out/ a moorland fire *scrubfire*/six miles/south/of Keswick *Darfield*/ in the Lake District *South Canterbury*/. Fire engines/were unable to reach the area/so fire fighting equipment/was brought in by helicopter/. Livestock/was evacuated/from the neighbouring/Highlands Farm *sheep farm*/as it was engulfed/in clouds/of dense white smoke.

#### Story C

Two hundred/men at a shipyard/on Tyneside *at Devonport*/went on strike/this morning/ The men walked out/over a dispute/concerning fifty/ redundancies/. The shop steward *union official*/Mr Thomas/Lindsay/ told reporters/ “it is outrageous!/. The Company has full order-books/ for the next two years”./ A management spokesman said/ “we are hoping to begin/fresh negotiations/at head-office/tomorrow”.

#### Story D

A Dutch/oil tanker/sank/10 miles/off the Norfolk coast *Northland coast*/ last night/. The crew/were picked up/by a coast-guard patrol boat *coastal naval vessel*/. An oil-slick/is already forming/and conservationists/ are worried/about the effects/on wildlife/. Local enthusiasts/are mounting an operation/to save/any birds/found stranded/on the beaches.

## APPENDIX E

**SCORE SUMMARY FOR USE WHEN USING THE RBMT AS BOTH A SCREENING  
AND DIAGNOSTIC INSTRUMENT**

<b>Subtest</b>	<b>Profile scores (Standard score 0 1 2 )</b>	<b>Screening scores (Raw scores) Maximum/Obtained</b>	<b>Qualitative Scores</b>
Name (First & Second)	<input type="checkbox"/>	4 <input type="radio"/>	
Belonging	<input type="checkbox"/>	4 <input type="radio"/>	
Orientation	<input type="checkbox"/>	9 <input type="radio"/>	
Date	<input type="checkbox"/>	2 <input type="radio"/>	
Pictures	<input type="checkbox"/>	10 <input type="radio"/>	False positives <input type="checkbox"/>
Faces	<input type="checkbox"/>	5 <input type="radio"/>	False positives <input type="checkbox"/>
	ND-Score subtotal	34	<input type="checkbox"/>
Story (I)	<input type="checkbox"/>	10 <input type="radio"/>	Cued score <input type="checkbox"/>
Story (D)	<input type="checkbox"/>	10 <input type="radio"/>	Cued score <input type="checkbox"/>
Route (I)	<input type="checkbox"/>	5 <input type="radio"/>	
Route (Delayed)	<input type="checkbox"/>	5 <input type="radio"/>	
Message	<input type="checkbox"/>	6 <input type="radio"/>	
Appointment	<input type="checkbox"/>	2 <input type="radio"/>	
	D-Score subtotal	38	<input type="checkbox"/>
Totals	<input type="checkbox"/>		<input type="radio"/>
	<b>(Maximum Profile 24)</b>	<b>(Maximum Screening 72)</b>	

## APPENDIX F

Glass, J. N., & Leathem, J. M., (1999).

The Rivermead Behavioural Memory Test (RBMT): An alternative scoring system for use with older adults.

Manuscript submitted for publication.

### **THE RIVERMEAD BEHAVIOURAL MEMORY TEST (RBMT): AN ALTERNATIVE SCORING SYSTEM FOR USE WITH OLDER ADULTS.**

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**Abstract:** The RBMT is a widely used measure of everyday memory performance in older adults. Some subtests have been reported to be especially sensitive to the changes that occur in early dementia and may also have discriminative properties when used in early-stage dementia assessment. Using subtest raw scores rather than the recommended standard scores, Glass (1998) demonstrated that six subtests distinguished cases with a formal diagnosis of early vascular dementia from cases with a diagnosis of early Alzheimer's-type dementia. A low error rate was obtained in classifying cases using a discriminant analysis technique.

This paper presents an alternative scoring system designed to facilitate broader use of the RBMT. The revised system is based on raw scores rather than the standard profile scores. Clinical data for four stratified groups of older adults will be presented to assist comparative analyses and to encourage replicative research.

### **Introduction**

The Rivermead Behavioural Memory Test (RBMT) was developed as a test of everyday memory with content drawn from observations of the types of memory failures experienced by patients with traumatic brain injuries (Wilson, Cockburn, Baddeley, & Hiorns, 1989). The test was not initially developed for older adults but subsequent research indicated that it had potential as a measure of abnormal memory aging (Cockburn & Collin, 1988; Cockburn & Smith, 1989). The RBMT has high ecological validity (de Wall, Wilson, & Baddeley, 1994) and is therefore especially suited to assessment with older adults. Performance is not greatly influenced by demographic variables such as education or intelligence level (Cockburn & Smith, 1991), and does not vary greatly with normal aging (Glass, 1999).

The RBMT was designed to screen for adequacy of day-to-day memory function and to highlight strengths and weaknesses. The scoring method uses a standard score (Profile score) for each of the 12 subtests which equates the differences in raw score values. The 12 standard scores are summed to provide a maximum summary Profile score of 24. A summary Screening score of 12 can also be calculated based on one point for each subtest for which the full standard score had been obtained. The published normative data is based on only the summary Profile scores and has been found to

underestimate normal everyday memory performance in well, independent-living older adults (Fraser, Glass, & Leathem, 1999).

Much of the clinical application of memory tests with older adults is aimed at differentiating between changes due to disease and those due to aging. As noted, the RBMT is relatively unaffected by aging based on analysis of subtest raw scores and changes in everyday memory on the RBMT are more likely to occur in older adults due to cerebral pathology. Therefore, stratified clinical norms for different pathologies as well as norms covering both well-normal and generally unwell older adults are likely to be of more value to the clinician using this test than demographically based norms. However, the use of standard profile scores for equating subtest scores can result in the loss of potentially useful information, particularly when discriminative validity is at issue. Further, the summary Screening score is redundant in clinical practice although is sometimes employed as the criterion measure in research

Some RBMT subtests are particularly sensitive to the changes which occur in early dementia (Beardsall & Huppert, 1992; Huppert & Beardsall, 1993) and at least one report suggests that certain subtests might discriminate between early vascular dementia (VAD) and dementia of the Alzheimer's-type (DAT) (Glass, 1998). This study demonstrated that by using subtest raw scores, rather than the summary Profile and Screening scores, six subtests discriminated between a sample formally diagnosed as VAD and a sample diagnosed as mainly DAT. In addition, false positive responses on the two Recognition subtests were associated with dementia generally.

Using a nearest neighbour discriminative analysis (Hand, 1981) to explore which combination of subtests allowed the lowest error rate in classifying cases, Glass reported error rates varying between 3% and 38% depending on the combination of subtests examined. The six subtests that gave the lowest error rate were the Message, Appointment, Story (Immediate and Delayed) and Route (Immediate and Delayed) subtests. Further analysis revealed a similar result could be obtained by eliminating the two Delayed recall subtests. These findings were explained in terms of the different neural mechanisms known to be involved in the earlier stages of the two diseases and their links with the attention deficits characteristic of impairment in working memory. It was suggested that memory measures which used familiar everyday content might be more sensitive to the changes that occur in early dementia provided they draw on working memory processes.

To better reflect both the screening and potential diagnostic capabilities of the RBMT, an alternative scoring method is suggested in this paper. The data from Glass (1998) has been reanalysed and presented in a format which will allow clinicians to compare their data against that of two dementia samples, an unwell older sample and a normal, well, independent-living sample of older adults. Such comparisons will assist in distinguishing between age-associated memory impairment (AAMI), cognitive slowing due to ill health and the abnormal memory aging which occurs in early VAD but is more pronounced in the early stages of DAT (Bowler et al., 1997).

## Method

### Participants

Participants comprised 205 older adults aged between 60 and 89 years. The sample was made up of 80 well, normal, independent-living participants (well), 51 unwell participants suffering from a range of medical or surgical conditions but not involving any known cerebral pathology (unwell), and 74 participants with a diagnosed dementia. Of the latter, 35 were classified as vascular dementia (VAD) and 39 as mainly Alzheimer's-type dementia (DAT). Details of each of the samples are fully described elsewhere (Fraser, Glass, & Leathem, 1999; Glass 1998, 1999) and only brief demographic characteristics are presented here (see Table 1). The clinical samples (unwell and dementia) had been referred for assessment as part of a full clinical work-up. The well sample

was part of a larger sample of 138 older adult volunteers recruited as part of a normative investigation of the RBMT (Fraser et al., 1999). All participants had completed a full or shortened version of the Mini Mental Status Examination (Braekhus, Laake, & Engelkdal, 1992; Folstein, Folstein & McHugh, 1975).

**Table 1**

**Summary of demographic characteristics of participants**

Characteristic	Well ( <i>n</i> = 80)	Unwell ( <i>n</i> = 51)	Dementia ( <i>n</i> = 74)
Age (Mean years)	73.03	75.45	74.79
Education (Mean years)	10.64	9.89	10.19
Age groupings (%)			
60-69	27	29	22
70-79	48	47	53
80-89	25	24	24
Gender (%)			
Male	43	51	45
Female	57	49	55

**Measures**

The RBMT was the only measure used in this reanalysis. Although most of the clinical sample had completed other measures as part of a comprehensive assessment, these results form no part of the present study.

**Procedure**

Each test form was scored again by totaling the raw scores over the 12 subtests. For this exercise, the total raw score on each of the Story recall subtests was set at 10 as the maximum score of 21 used in the conventional scoring method was found to be redundant with older adults (Fraser et al., 1999). In Fraser et al., community-dwelling older adults achieved an average raw score and standard deviation of approximately seven and two respectively on the Immediate Story and about two points less on both scores on the Delayed Story subtest. In the odd case when a score greater than 10 was obtained, its use in the scoring system proposed in this report would distort the revised Screening score. The maximum raw score obtainable using this method was 72. The score on the two Recognition subtests (Picture and Face) was the actual number of correct responses rather than the number correct less the number of false positives. In the present scoring system, false positive responses are scored separately as this method better identifies the type of error making up the raw score result.

A revised score summary sheet is presented in Table 2. The Profile score is the same as that proposed by Wilson et al.(1989) and is compiled from the individual standard scores for each subtest. The maximum Profile score is 24. It is suggested that the present Profile scores be retained in the meantime since they have become the standard for comparison used in research and normative data to date. The second set of scores, the Screening score, is compiled from the total of all 12 raw scores (with the exceptions outlined above for the Recognition and Story recall subtests). The maximum is 72. (A similar method of scoring has been adopted by some researchers [e.g., Jhaveri, 1989; Malec, Zweber, & DePompolo, 1990] as a criterion variable for measuring change). As is seen from Table 2, this score is divided into two parts. The first part (the ND-score) is the sum of the six subtests that were not found to discriminate in Glass (1998). The maximum subtotal for the ND-score is 34. The second part comprises the subtests that did discriminate (D-score). The maximum D-score is 38. In addition, the score sheet makes provision for recording false positive responses on the two Recognition subtests and for noting whether the use of cues improves recall on the Story recall subtests (see discussion section).

**Table 2**

**Score summary for use when using the RBMT as both a screening and diagnostic instrument**

Subtest	Standard Profile scores (0 1 2)	Screening scores (Raw scores) Maximum/Obtained		Qualitative Scores
Name (First & Second)	<input type="checkbox"/>	4	<input type="checkbox"/>	
Belonging	<input type="checkbox"/>	4	<input type="checkbox"/>	
Orientation	<input type="checkbox"/>	9	<input type="checkbox"/>	
Date	<input type="checkbox"/>	2	<input type="checkbox"/>	
Pictures	<input type="checkbox"/>	10	<input type="checkbox"/>	False positives <input type="checkbox"/>
Faces	<input type="checkbox"/>	5	<input type="checkbox"/>	False positives <input type="checkbox"/>
ND-Score subtotal		34	<input type="checkbox"/>	
Story (I)	<input type="checkbox"/>	10	<input type="checkbox"/>	Cued score <input type="checkbox"/>
Story (D)	<input type="checkbox"/>	10	<input type="checkbox"/>	Cued score <input type="checkbox"/>
Route (I)	<input type="checkbox"/>	5	<input type="checkbox"/>	
Route (Delayed)	<input type="checkbox"/>	5	<input type="checkbox"/>	
Message	<input type="checkbox"/>	6	<input type="checkbox"/>	
Appointment	<input type="checkbox"/>	2	<input type="checkbox"/>	
D-Score subtotal		38	<input type="checkbox"/>	
Totals	<input type="checkbox"/>		<input type="checkbox"/>	
	<b>(Maximum Profile 24)</b>		<b>(Maximum Screening 72)</b>	

### **Data analysis**

Means and standard deviations were obtained for each of the samples grouped as outlined above. Data for the total screening score tended to follow a normal distribution overall for the total sample of  $n = 205$  but this changed when the ND-scores and D-scores were examined separately. The well sample distribution was strongly J-shaped, the unwell tended to maintain a normal distribution while the dementia sample was congregated more in the tail and lower stem of the J. Both parametric and nonparametric analyses were computed but with the appropriate corrections for nonnormally distributed data, equivalent significance levels were obtained. The analysis presented here is based only on the parametric statistical analysis. One-way Analysis of Variance (ANOVA) was employed to examine mean differences as appropriate. To establish which of the means contributed to findings of significant F Ratios, Tamhane's pair-wise post hoc multiple comparisons were computed for three or more comparisons and paired-samples t-tests were used when two means were being compared. Tamhane's multiple comparison method is particularly useful with the current data since it does not assume equal variances and is known to be conservative in assessing significance level (Coakes & Steed, 1996; Everitt, 1996).

## **Results**

### Mean subtest raw score comparisons

The data in Table 3 summarises the raw score means and standard deviations for each subtest for the four samples. Earlier analyses (Glass, 1998) had indicated that the combined dementia sample differed at the  $p < .01$  level from both the well and unwell samples on all subtests while the VAD and DAT samples differed significantly on six subtests. These were Message ( $p < .01$ ), Appointment ( $p < .05$ ), Immediate Story recall ( $p < .05$ ), Delayed Story recall ( $p < .05$ ), Immediate Route recall ( $p < .01$ ) and Delayed Route recall ( $p < .001$ ). The means obtained by the well and unwell samples did not differ significantly except for the two Story recall subtests on which the scores of the unwell sample were significantly lower ( $p < .001$ ).

**Table 3****Means and standard deviations for RBMT subtest raw scores for four stratified samples of older adults**

Subtests	Subtest scores							
	Well (n = 80)		Unwell (n = 51)		VAD (n = 35)		DAT (n = 39)	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Names	3.10	1.21	2.66	1.45	1.74	1.59	1.54	1.41
Appointment	1.58	0.67	1.43	0.54	1.03	0.75	0.67	0.70
Date	1.91	0.40	1.67	0.68	1.20	0.93	1.05	0.94
Face	4.79	0.52	4.74	0.59	4.31	0.83	4.23	0.96
Message	5.54	0.79	5.27	0.91	4.83	1.51	3.79	1.88
Orientation	8.94	0.24	8.76	0.47	7.49	1.63	7.18	1.36
Picture	9.91	0.28	9.72	0.60	9.03	1.92	8.54	2.29
Route (I) <sup>a</sup>	4.77	0.45	4.90	0.36	4.51	0.09	3.72	1.28
Route (D) <sup>b</sup>	4.78	0.44	4.76	0.76	4.37	0.94	3.41	1.33
Story (I) <sup>a</sup>	7.01	2.56	5.21	2.09	3.34	3.01	2.05	1.87
Story (D) <sup>b</sup>	5.80	2.36	3.70	2.00	1.91	2.73	0.85	1.17
Belonging	3.42	0.95	3.41	0.72	2.94	1.14	2.67	1.22

<sup>a</sup> Immediate recall; <sup>b</sup> Delayed recall.

### Revised Screening score comparisons

In Table 4, data is presented for the revised Screening score. As noted, the maximum score is 78. The F ratio indicated that the differences between the samples were significant. A series of post hoc multiple comparison tests confirmed that differences exceeded the  $p < .001$  level for comparisons between the well and unwell samples and between both of these samples and the DAT and VAD samples. The latter two samples differed at the  $p < .01$  level on the Screening score. Variability in the dementia samples was considerable as indicated by the high standard deviations. Further investigation indicated that the range of scores was wider for the VAD sample (20.5 to 66.5) than for the DAT sample (22 to 57.5). The median scores were 46 and 40 respectively.

**Table 4**

#### Revised Screening score: Means, standard deviations, and F ratio for four samples of older adults derived from alternative scoring system.

Sample	<u>n</u>	<u>M</u>	<u>SD</u>	<u>F</u>
Well independent	80	61.34	5.20	123.80***
Unwell	51	56.16	4.84	
VAD	35	45.93	10.31	
DAT	39	39.61	9.38	

Note. Maximum score obtainable = 78.

\*\*\* $p < .001$

### Discriminative score comparisons

Comparisons between ND-scores and D-scores for the four samples are presented in Table 5. Post hoc multiple comparison tests confirmed that the difference in D-scores between each of the samples was significant at a level exceeding  $p < .001$ . Further analysis indicated that by eliminating the Story recall subtests, the difference between the well and the unwell means was no longer significant but this was not found for the dementia samples.

A different pattern emerged from post hoc comparison tests between the samples on the ND-score. While the difference between the well and unwell samples was significant, both in comparisons with each other ( $p < .05$ ) and with the two dementia samples ( $p < .001$ ), the difference between the two dementia samples on the ND-score was not significant.

**Table 5****Means, standard deviations and F ratios for ND-scores and D-scores for four samples of older adults.**

Scores	Well ( <i>n</i> = 80)		Unwell ( <i>n</i> = 51)		Vas ( <i>n</i> = 35)		Dat ( <i>n</i> = 39)		F
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	
D-scores	29.31	4.24	25.27	3.79	19.90	6.67	14.51	6.27	108.55***
ND-scores	32.04	1.94	30.90	2.33	26.34	5.49	25.10	4.62	70.195***

\*\*\**p* < .001**Recognition subtests**

As noted, the recognition subtests were scored differently to the conventional method for the RBMT with number correct and false positive errors being scored separately. Table 6 presents the results of ANOVA to determine the significance of mean differences in false positive responses amongst the three samples. In this analysis, the scores for the two dementia groups were combined since earlier analysis had indicated that the occurrence of false positives is more an indicator of dementia generally than of VAD or DAT. As shown, significant F-ratios were indicated for both of the Recognition subtests. Post hoc multiple comparisons confirmed that these were accounted for by the higher frequency of false positive responses made by the dementia group. The means for the well and unwell samples were similar on the Picture subtest and almost similar on the Face subtest. The highest alpha level (*p* < .01) was obtained for the comparison between the well and dementia samples on the Face Recognition subtest. All other alpha levels fell between *p* < .02 and *p* < .04. The range of summary Profile scores for cases with one false-positive was 0 to 23 (median 12); the range of Profile scores for cases making two false-positive errors was 3 to 21 (median 10)

**Table 6****Face Recognition and Picture Recognition subtests: Comparison of mean false positive responses between three samples of older adults**

Subtests	Mean false positive responses						
	Well ( <i>n</i> = 80)		Unwell ( <i>n</i> = 51)		Dementia ( <i>n</i> = 74)		F
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	
Face Recognition	0.19	0.45	0.24	0.55	0.62	0.98	8.254***
Picture Recognition	0.02	0.11	0.02	0.28	0.43	1.29	6.267**

\*\**p* < .01; \*\*\**p* < .001.

## Discussion

A revised summary scoring format together with raw score comparison data has been outlined aimed at assisting the clinician who wishes to examine subtest scoring of older adults on the RBMT. Three methods of analysing and interpreting results were presented. In effect, results can be compared against:

- 1 The standard profile scores as originally presented by the Rivermead developers for which normative data is summarised in the Test manual (Cockburn & Smith, 1989).
- 2 The mean raw scores obtained for the four stratified samples as presented in Table 3.
- 3 The total possible screening score of 72, using raw scores to compute, and compared against the data presented in Table 4 and the subtotals for the ND-score and D-score presented in Table 5.

In addition, it has been shown that the occurrence of false positive responses is a sensitive indicator of the presence of dementia generally and the addition of cues to the Story recall subtests can further enhance score interpretation. There is evidence from several sources that the ability to improve recall with the provision of cues favours an early VAD rather than DAT pathology (Cummings & Benson, 1986; Rosenstein, 1998). (See Appendix A for a structured set of cues).

Clinical experience has shown that a scoring system based on raw scores generates more useful quantitative and qualitative information than the standard score system. The score profile can serve as an aid to diagnosis of dementia generally and in cases of suspected early dementia, assist in the process of distinguishing between the type of dementia when medical and neuroimaging data is inconclusive. In addition, the administration of the RBMT early in the assessment process facilitates decisions about what other testing might be required in order to provide a suitably comprehensive assessment of memory function. In practice, this might require the administration of only two or three other short measures. The multi-comparison method may be particularly helpful in interpreting a lower overall score profile obtained by an unwell client when the summary score overlaps with that of dementia cases. From a careful analysis against each of the comparison data outlined, useful interpretations can be made. A further advantage in using a Screening score as suggested here is that it increases the test 'ceiling' and largely eliminates 'floor' effects. This enhances the use of the RBMT as a sensitive indicator of change over time without the need to introduce additional test material for older adults as has been done with the Extended Version of the RBMT (Wilson et al., 1999).

The findings in relation to false-positive responses on the Recognition subtests in the dementia sample correspond to other reports which have suggested that dementia sufferers in general record lower identification rates and/or more false positive errors on recognition-type tasks (Cockburn & Smith 1991; Hart & Semple, 1990; Gianotti & Marra, 1994). On the other hand, it has been suggested that this may simply reflect a characteristic of normal aging (Crook & Larrabee, 1992; Diesfeldt, 1990; Diesfeldt & Vink, 1989; Flicker, Ferris, Crook, & Bartus, 1990). If this were so, higher rates of false positive responses could have been expected in the response patterns of the other samples in the present study, especially in the older groups. Such a pattern was not found

(Glass 1999). Furthermore, false-positive responses occurred across the whole range of scores in the combined dementia sample including normal or near normal scores. There have been no previous reports of false-positive scoring patterns on the RBMT

The use of the RBMT as a discriminative measure appears to be maximally useful with older adults who have behavioural and medical histories suggesting the possibility of an early dementia, who may or may not have a history of treatment for hypertension and who have essentially normal neuroimaging data. The main limitation in using the RBMT as suggested here is that there appears to be a critical period during which the RBMT is maximally sensitive to the differences in subtest scores. The current dementia samples were predominantly in the early stages based on their MMSE results and behavioural reports. However, it is apparent from clinical assessment of older adults at various stages of a dementing process that scoring differences gradually become blurred as the condition progresses. The point at which the D-score differences become unreliable is currently being investigated in a small longitudinal study.

The evaluation of memory in older adults is still largely reliant on conventional measures developed for younger age groups. The relevance of such measures and the theoretical concepts underpinning them, is questionable when applied in an elderly setting (Cunningham, 1986; Woodruff-Pak, 1997). It is likely that the day-to-day demands on memory processes that most older adults experience is significantly less than is suggested by the largely experimental content of formal memory tests. The call for ecological validity in memory assessment with older adults has gained support over the past ten years (Bahrck, 1989; Baddeley, 1995; de Wall, Wilson, & Baddeley, 1994; Garcia, Garcia, Guerrero, Triguero, & Puente, 1998). It has been argued that memory measures must consider the constituent behaviours that help to determine the adequacy of an older client's memory and failure to do this exposes the clinician to the risk of inflating performance deficits relative to what occurs in real life (Hunt, 1986; Mook, 1989). Unfortunately, there is a shortage of measures containing content that could be considered appropriate to the day-to-day experiences of older adults and to the cognitive demands they typically face. The RBMT is one exception but there are indications that other measures are gradually becoming available (e.g., Garcia et al., 1998). Such measures will be of most value to the clinician working with older adults if the provision of stratified normative data is emphasised, in contrast to the usual emphasis on demographic norms. Such short, composite measures relevant to everyday memory experiences may ultimately prove more successful in discriminating between normal aging and the cognitive deficits that are a feature of one or other of the dementias.

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## APPENDIX G

**SUGGESTED CUES FOR USE WITH STORY RECALL (IMMEDIATE AND DELAYED)  
SUBTESTS**

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*(Use cues selectively to test recovery of information which was not recalled or only partially recalled as appropriate)*

STORY A

1. What was the name of the person mentioned in the story? *(first name/second name)*
2. Was anybody hurt? *(if answers yes)*
3. How serious were the injuries?
4. Was there a weapon mentioned? *(if answers yes or has mentioned a non-specific type of weapon)*
5. What sort of weapon was mentioned?
6. When did it happen?
7. Where did it happen?
8. How many people attacked him?

STORY B

1. What sort of fire was it?
  2. In what part of New Zealand was the fire?
  3. Was there a town mentioned?
  4. Did the story mention when the fire happened?
  5. How did they fight the fire?
  6. Was anything endangered by the fire? *(if yes)* what?
  7. What did they do to ensure their safety?
-