A NORMATIVE STUDY OF NEUROPSYCHOLOGICAL TEST PERFORMANCE OF A NORMAL ELDERLY SAMPLE

by

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ABSTRACT

A sample of 85 normal elderly people were administered a battery of neuropsychological tests chosen to represent those functions which may first signal the onset of a dementing process. Tests included were the Vocabulary subtest of the WAIS, Mattis Dementia Rating Scale (MDRS), Boston Naming Test (BNT), Rey Auditory Verbal Learning Test (RAVL), Benton Visual Retention Test - Multiple Choice form (BVRT), Controlled Word Association Test (CWA), and Hooper Visual Organization Test (HVOT). Frequency distributions of scores on each test are provided. The sample mean score on each test was compared to either published norms for elderly samples or for younger samples. The range of scores on the MDRS was greater than suggested by its author, though still above that of brain-damaged patients. The test measures showing the greatest change from the performance levels of younger subjects were the BNT, RAVL, and HVOT. Other measures showed little change. Two methods of assessing overall performance are presented. Anomia and deficits in memory and visuoperceptual analysis may be a normal part of the aging process.

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INTRODUCTION

The proportion of the population over the age of 65 has greatly increased in the last 150 years and will continue to increase. As the proportion rises, so will the prevalence of diseases related to advanced age. Examples of such diseases include various forms of dementia which is a generalized loss of mental ability usually characterized by a gradual onset of deterioration (Miller, 1976). Early detection of some forms of dementia may allow proper treatment to arrest its progression. Health care specialities responsible for the diagnosis, treatment and management of dementing patients will expend a greater percentage of available resources in meeting this obligation.

As one of the specialities concerned with dementia, clinical neuropsychology will be required to devote more investigation into changes related to aging. It is known that decrements in mental ablility seen in moderately advanced dementia far exceed that deterioration commonly thought due to old age. Yet the character and magnitude of normal change to be expected among the elderly in the absence of pathology is not well established. Without this information, early diagnosis and referral for possible treatment can not be conducted proficiently.

In the past normative data on mental ablities in the elderly population had not been a critical need since any diagnosis of dementia carried a rather grim prognosis. Medical evaluation was not conducted until an advanced stage. Patients with a dementing illness were considered essentially untreatable. Currently, some causes of dementia are potentially treatable, making the ability to distinguish early dementia from normal aging quite important. Medical techniques exist to partially remedy the effects of dementing illnesses such as normal pressure hydrocephalus, multi-infaract dementia, pseudodementia, endocrine disorders, nutritional imbalances, and drug induced difficulties (Wells, 1971).

Seltzer and Sherwin (1978) demonstrated that 45% of a previously unclassified sample of demented patients could be shown to have diseases responsive to therapeutic intervention. Conditions which are susceptible to medical treatment must be detected and treated early in their course if the greatest benefit is to be obtained. Allowed to progress unchecked, a reversible condition may reach a point where it produces irreversible damage. The need for early diagnosis is clear. A clinician can not assume that a dementing illness is untreatable, and should make every effort to recognize early dementia. Yet how can early diagnosis be accomplished?

Two avenues of investigation are medical evaluation and psychological assessment.

Medical evaluation typically includes physical examination, laboratory studies and specialized procedures such as CAT scans and EEG. In some cases, clear indication of marked pathological changes in the brain may be demonstrated. Other cases present a more difficult diagnostic problem. Distinguishing between normal age related brain changes and early stages of dementia is particularly difficult. Atrophy and dilated ventricles are commonly observed in both normal aged and early dementia patients. A radiologist can not predict from CAT scan whether or not an individual is likely to be demented until the disease is moderately progressed (Wells & Duncan, 1977). Huckman, Fox and Toppel (1975) quantified the amount of atrophy seen on CAT scans and reported the same degree of atrophy was present in 60% of their dementing patients and 15% of aged normal controls. CAT scan intrepretation accompanied by knowledge of cognitive status could be of greater diagnostic utility in distinguishing normal from early pathological changes.

Psychological assessment is another avenue toward the investigation of cognitive change in elderly patients. Unfortunately the diagnostic tools able to distinguish normal from pathological performance in elderly clients are sadly lacking. The clinician's diagnostic repetoire, while filled with many useful tools, contains almost no tests with adequate norms for clients over age 65, and hence can not readily distinguish normal from pathological aging.

The need for normative data on the performance of normal elderly subjects has been recognized for some time. Numerous longitudinal studies have been conducted, but have largely concentrated on the collection and analysis of general medical data. Though psychological assessments have been included, they've generally not been used to provide normative data. The two most publicized studies, the NIMH (Birren, 1959, & Birren et al., 1963; Granick & Patterson, 1971) and Duke Longitudinal (Palmore, 1970 & 1974) studies, have yielded information regarding intellectual change with age, but not in a manner readily adaptable to clinical test interpretation. Less ambitious investigations have actually been more useful in making available normative data.

Numerous studies have been reported where widely used neuropsychological tests were administered to elderly subjects in an atttempt to establish norms (Benton, Eslinger, &

Damasio, 1981; Borod, Goodglass & Kaplan, 1980; Farver, 1975). Yet these studies have been of limited utility in that careful definition of the normal elderly subject was not addressed. It is largely assumed that an elderly individual, free of neurological or psychiatric diagnosis, is not showing signs of mental deterioration in excess of normal age related changes. However, a report by Arie (1973) estimated that a large percentage of moderately demented elderly people were not recognized as such by their physicians and, therefore, carried no diagnosis. The inclusion of occult dementia cases in studies hoping to establish normative data hinders possible discrimination between pathological and normal performance. A more useful approach might be to identify and exclude those elderly subjects showing decrement on some independent scale, and then only use their peer's performance as a basis for norms.

Even when normative data for elderly populations are available for a particular test, the standardization group from which the data are derived is frequently not as soundly based as that for younger groups. The Wechsler Adult Intelligence Scale (WAIS), probably the most widely used psychological test instrument in existence, is an example. Its standardization groups for ages 16-64 were drawn from a national sample of approximately 200-300 subjects per age decade. In constrast, the older standardization group, (aged 60 to over 75, N=352) was drawn exclusively from the elderly of Metropolitan Kansas City (Doppelt & Wallace, 1955). But as Eisdorfer and Cohen (1961) have demonstrated, the Kansas City sample is unlikely to be representaitve of the general population. They administered the WAIS to a sample of 239 elderly subjects in Durham, N. C. Comparison of their sample to the Kansas City sample showed significant differences. The Durham sample had a higher verbal IQ than the Kansas City sample, with results reversed for performance IQ. Such a discrepancy points to the need for national samples. The WAIS-R norms are based on national samples (Wechsler, 1981).

Benton, Eslinger, and Damasio (1981) report test performances of a sample of 162 normal elderly volunteers, age 65-84 years. Nine neuropsychological tests were administered, and the resulting scores were examined for the incidence of deficient performances, defined as those scores exceeded by 95% of previous standardization samples. Yet the standardization samples had not included subjects over age 65. Hence Benton et al., are comparing elderly subjects to younger subjects, not directly reporting normative data available from their study. They do not indicate the mean scores achieved by the elderly sample on the various instruments. Their study more directly addresses the question of age related decline in cognitive performance than that of the level of ability demonstrated by the majority of elderly subjects. Though a clinician is presented with the percentage of elderly subjects who would show deficient scores based on younger norms, little could be garnered from the Benton et al.'s study in terms of how an elderly subject stands in relation to his or her peers.

Data of normative elderly performance would have the greatest applicability for detecting dementia if it represented those functions most affected by early dementia. It is generally accepted that aspects of higher cortical functioning which first signal the onset of dementia include components of verbal ability, memory and visuospatial ability. Obtaining normative data on well known tests of these abilities, appropriate for use with elderly people, would therefore be of great value. The present investigation was prompted by the desire to gather such data.

NEUROPSYCHOLOGICAL TEST BATTERY

The intent of this study is an investigation of elderly subject's normal range of performance on a brief battery of neuropsychological tests. Such a body of data can be used to provide normative information useful in clinical settings. It can also be used to infer changes in mental ability associated with normal aging.

Determination of subjects as being appropriately classified as normal elderly was attempted. In addition to the usual considerations about subject suitability, a dementia rating scale was utilized. A normal elderly subject should clearly do well on a dementia rating scale. Those who do not may represent members of the elderly community with occult dementia. Such individuals were excluded from subsequent data analysis.

Tests selected for inclusion in the battery are relatively well known neuropsychological instruments which measure functioning thought to be affected by a dementing process, and are sensitive to age related changes. Deficient scores were defined as those falling below two standard deviations from the mean.

Each instrument, and a relevant body of literature, will be discussed below. An attempt was made to select those tests readily available or known to clinicians and having face validity to potential subjects.

MATTIS DEMENTIA RATING SCALE

This scale was developed to provide a quick index of elementary level higher cortical functioning (Coblentz, Mattis, Zingesser, Kasoff, Wisniewski & Katzman, 1973; Mattis, 1976). Items are similar to those used by neurologists in bedside mental status examinations, and include measures of attention, initiation and perseveration, construction, concepualization and memory. Administration requires approximately 10-15 minutes for normal elderly subjects. Possible scores range from 0-144.

Mattis (1976) claimed that the Mattis Dementia Rating Scale (MDRS) is sensitive to both focal and diffuse brain damage. Poor performances on any subsection are likely to be indicative of brain damage, while adequate performance is unlikely to be seen in any patient with structural brain damage. Test-retest reliablility over a one week period is above .90. In Mattis's normal elderly population, those subjects with a WAIS IQ score greater than 85 and a Wechsler Memory Scale Memory Quotient within one standard deviation of IQ score achieve scores on the MDRS in excess of 140.

Suggested classification of scores is as follows: 137 cutoff; 125-136 mild impairment; 110-124 moderate impairment; and below 110 as severe impairment (Mattis, personal communication). Also a score below 100 indicates that, without superb nursing care, survival longer than one year is doubtful. Importantly, serial examination of known dementia patients over a reasonable time period shows a noticeable decrement in total score related to progression of disease process.

Considering that this scale is relatively new and is not formally published, it has attracted quite a respectable amount of attention. Reports of the clinical application of the MDRS have been quite favorable and tend to substantiate Mattis' claims.

One such report by Fuld (1978) described the use of the MDRS with three patients where a diagnosis of dementia was made. The first patient, a 67 year old man, was administered the MDRS and achieved a score of 112. Subsequent to a shunting procedure which resulted in improved gait and mentation, his retest score rose to 136. He was shown to have multiple infaracts by post mortem examination. A second patient, 66 years old, whose progressive dementia was diagnosed as Alzheimer's disease was also tested twice. His scores dropped from 106 to 96, the direction to be expected in progressive disease. The third patient, a 55 year old man with a final diagnosis of aqueductal stenosis, had a MDRS score of 96 when other neuropsychological measures also indicated the severity of his dementia. These three cases show the MDRS to yield a score consonant with clinical expectations in known conditions, and two of them underscore the scales sensitivity to bidirectional change in mentation.

Lijtmaer, Fuld and Katzman (1976) report on the use of the MDRS in a follow-up study of 20 patients diagnosed as having presenile dementia. Lijtmaer, et al. had 11 patients with extremely low scores, eight of whom died within 30 months. Five patients with higher, though abnormal, scores survived longer than 30 months. A 56 year old woman diagnosed as having an organic dementia followed the expected clinical course. In the five year follow-up time, her MDRS went from 100 to 6. Another patient whose original diagnosis of dementia was changed to depression had a MDRS score on follow-up of 136. A third patient, originally diagnosed as Alzheimer's disease, though actually suffering from Korsakoff's disease went from a MDRS score of 95 to 124. The MDRS was again shown sensitive to both improvement or deterioration. It may show a depressed score in a variety of neuropsychological syndromes. It may be related to survival time.

Careful examination of the MDRS by Hersch (1979) suggested some improvements to the MDRS, which unfortunately came to attention too late to be incorporated. However, his study showed the MDRS to have a high level of internal consistency.

Gardner, Oliver-Munoz, Fisher and Empting (1981) investigated the internal reliability of the MDRS. They split the original protocol into two forms by placing alternate items in each half. The whole protocol was administered to 25 nursing home patients selected for diagnosis of organic brain syndrome or senile dementia. Patients ranged in age from 65-94 years. The two forms yielded a correlation of .90, which indicates high internal reliability. Mean total MDRS score was 63.70 with a standard deviation of 34.24.

The MDRS was used in an attempt to separate from normal elderly those subjects showing change in excess of that attributable to age.

VOCABULARY SUBTEST OF THE WAIS

This measure was included in order to obtain some index of general intelligence. Vocabulary is the Wechsler Adult Intelligence Scale (WAIS) subtest having the highest correlation with IQ (Wechsler, 1958). It was administered and scored according to standard procedures for the WAIS. Both scaled scores (VSS) and age corrected scores (VACS) were determined.

Verbal skills are thought to be less affected by aging than other skills (Birren et al., 1963). Wechsler claimed that Vocabulary held up well with age and that the more difficult words are adequately defined by a greater proportion of older age groups. This effect has been replicated by many subsequent studies, and vocabulary is actually believed to improve with increasing age. Improvement has been demonstrated in both cross sectional (Botwinick, 1967), and longitudinal studies, (Granick, 1971, Jarvik & Blum, 1971; Eisdorfer, 1963). Yates (1956) provides a thorough review of vocabulary test use in both aging and organic conditions.

BOSTON NAMING TEST

Numerous authors have emphasized the anomia commomly observed in dementing patients, especially those diagnosed as having Alzheimer's disease (Barker & Lawson, 1968; Ernst, Dalby, & Dalby, 1970; Lawson & Barker, 1968; Miller, 1976; Miller & Hague, 1975). Yet the normal elderly are also thought to evidence more of the "tip of the tongue" phenomenon than do younger subjects. A clinician would like to be able to distinguish a normal increase in anomia from a pathological or excessive amount.

Few neuropsychological tests are available to directly assess naming ablility. A newly developed test devised for just this purpose is the Boston Naming Test (Kaplan, Goodglass & Weintraub, 1978). The subject is presented with a series of black and white drawings of various objects ranging in sophistication from a tree, comb and house to a zodiac, palette and yoke. The subject's task is to supply the exact name of the object. If the object can not be named spontaneously the examiner can provide a cue, of which there are two types. Semantic cues are those where the examiner provides information as to the category or use of the object. Examples include the cue "mythical animal" for the item unicorn and the cue "used for counting" for the abacus. Phonemic cues are ones where the examiner provides the first sound of the object name, so for zodiac, the examiner would say the first sound is "Z".

The score can range from 0-85. The number of objects spontaneously named is summed up and then the number of additional items named after a cue are added to give a total score.

Borod, Goodglass and Kaplan (1980) report performance of subjects age 60-69, and 70 years and over, on the BNT. The range of scores was 17-81 items correct. It is possible that those subjects with the lowest test scores are showing pathological changes, but no screening test was administered.

Obler and Albert (1981) characterize the performance of normal elderly subjects on the BNT. Elderly subjects sometimes misperceive the objects, for instance, the flippers are sometimes called aprons and the pretzel called a snake. As this qualitative information is also valuable, the BNT was also scored for the number of misperceptions in each protocol.

The performance of some dementing groups on the BNT is known to be poor. Alzheimer patients do poorly as one would expect. Patients with brain damage of any sort may evidence an anomia. However, there are dementing processes which apparently spare naming ability. Huntington's disease is a dementing illness, yet as Butters, Sax, Montgomery and Tarlow (1978) have demonstrated, naming ability is preserved in these patients even when the disease is fairly advanced. Evidence of preserved naming ability does not preclude the possibility of a dementia.

Goodglass (1978) notes that though an elderly subject's conversation may be rich in information and no anomia apparent, confrontation naming may expose a good number of unnamed items. While such a discrepancy may go unrecognized in a normal elderly subject, the clinician should not assume anomia is either absent or not increased from the level of younger subjects. Without normative data to rely on, a clinician could err in classifying a normal elderly subject as anomic.

CONTROLLED WORD ASSOCIATION

Numerous tests of verbal fluency have been devised since the time of Thurstone, 1938. His verbal fluency test required writing down all possible words beginning with a given letter in a five minute period. The Controlled Word Association Test (CWA) was introduced by Borkowski, Benton and Spreen (1967) and Benton (1968). The task is again to produce as many words as possible beginning with a given letter but the time limit is sixty seconds and responses are recorded by the examiner, not the subject. The subject's performance is therefore not contaminated by writing speed. Subjects are instructed not to produce words which are proper names of people or places. The letters F, A and S are usually chosen. Raw score is the number of acceptable words produced, excluding those repeated or not allowed. A number of points are added to adjust for the effect of age, education and sex. The adjusted score can then be translated into a percentile standing. In this study, scores were not adjusted for age, education or sex as the proper adjustment is not known for subjects over 65.

For the purposes of the present study two additional scores were tabulated. One is the number of repeated words and the other is the number of not accepted wrong words, which includes both words beginning with a wrong letter (e. g., "phone" for F) and words which are proper names. It was hoped that this qualitative information might be enlightning.

Norms have been available for subjects aged 25-64 years with educational levels less than nine years to more than sixteen years, as published in Lezak (1976). A recent article by Benton, Eslinger, and Damasio (1981) claims 97% of their normal elderly sample achieved a total score higher than 22. The CWA is also part of the Neurosensory Center Comprehensive Examination for Aphasia, and percentiles are listed for various total scores.

Rosen (1980) showed that normal elderly subjects produce more acceptable words than mildly demented subjects who in turn produce more words than moderately demented subjects. Miller and Hague (1975) also showed the same results.

REY AUDITORY VERBAL LEARNING TEST

Deterioration of memory ability is probably the single feature most shared by dementing illnesses. It is also an area thought to be sorely affected by normal aging processes. Clearly some assessment of memory ability is necessary for any neuropsychological battery purporting to be useful in establishing the level of normal elderly functioning.

The Rey Auditory Verbal Learning Test (RAVL) is composed of two lists of fifteen words each. The examiner reads list 1 to the subject and then requests the subject to recall as many words as possible. This is repeated for a total of five trials. The examiner then reads list 2 to the subject and again asks for recall of as many words as possible. At the end of recall, the examiner requests recall of list 1 without rereading it. The usual score is the number of words correctly recalled on each trial. English instructions for administration of the RAVL are provided by both Taylor (1961) and Lezak (1976).

The RAVL is a relatively brief measure of memory ablility that can provide a great deal of information. As Lezak says in her review, the RAVL shows an immediate memory span, provides a learning curve, elicits proactive and retroactive interference, can show a tendency to confusion or confabulation, and retention following interpolated activity. It may also be used to demonstrate any perseverative tendency if the number of repetitions in each trial's response is noted. One would be hard put to think of another single measure of memory providing such economy.

Since so much information is available from RAVL administration, additional scores were tabulated and are outlined below.

REPETITIONS In the course of recalling the presented words, many subjects repeat words already given in the present trial. It's possible that this represents a perseverative tendency, and that such a tendency may be seen only in pathological states and not as a result of normal aging. For each trial, the number of repeats was tabulated.

INTRUSIONS Words not actually on the list are sometimes recalled as being on the list. Such words were labeled intrusions and were tabulated separately for each trial.

WORDS GIVEN TO THE WRONG LIST Words from list 1 are sometimes recalled as part of list 2 and vice versa. All such instances were also tabulated, again separately for each trial.

Such scoring enables one to make better use of the available information from the RAVL. In this way, one can evaluate, in quantitative terms, each of the types of information Lezak states as being shown by the test. For example, total words recalled (TWR) for the first trial demonstrates an immediate memory span, while TWR for the first five trials shows a learning curve. Proactive and retroactive interference can be examined by comparing TWR for List 1, trials 5 and 6, versus List 2. Confabulation or confusion may be evident in either intrusion of words not on the lists or giving a word as part of the wrong list. In this way qualitative memory ability can be evaluated.

On an individual basis, a clinician may also be able to discern whether or not a given client makes use of a systematic strategy for learning the word list. For instance, one strategy for learning would be to group together associated words like "school, house, bell, and parent" and recall them as a unit. Another strategy would be to learn a few words on one trial, and then add words to the store on each subsequent trial.

Taylor (1961) and Lezak (1976) both present Rey's 1964 norms for elderly laborers and professionals, who were administered the test in French.

Lezak suggests that TWR trial 5 minus TWR trial 6 greater than three is an abnormal amount of shrinkage in a young population and probably reflects a retention or retrieval problem.

Werner (1946) suggests two types of perseveration may be seen in recalling two lists of words. One is when repeated list words are given to a new list, and the other is when words within a list are repeated during its recall. He says that the second type does not discriminate groups, whereas the first type is more common in brain injured patients.

HOOPER VISUAL ORGANIZATION TEST

This test requires subjects to look at jigsaw-type puzzle pieces printed on a page and determine what the pieces would be if put together correctly (Hooper, 1958). Objects are quite familiar to most people and include a kettle, handsaw and mouse. The subject need only identify the object, not explain how the pieces would fit together. There are a total of thirty items and the score is the number correct. Half credit is given for some responses.

In addition, another type of score tabulated represents the number of "isolate" responses. Such a response is one where only a single piece or feature lead to a subject's response. For example, the item correctly identified as a flower is comprised of three pieces. Two of the pieces represent a total of half the petals. The third piece is made up of half the petals and the stem. The third piece is situated on the page such that the stem is oriented toward the top of the page and the lower half of the flower toward the bottom of the page. The third piece is sometimes identified as a desert island and palm tree, with the petal half seen as the island and the upright stem as the palm tree. So, for the item flower, the response "island" is an isolate response.

The advantage in tabulating an isolate score is demonstrated by a study reported by Walker (1956). He divided a sample of 38 neurological patients into those with definite cortical involvement, suspected cortical involvement, and no cortical involvement. While the total number of items correct did not differ significantly between groups, the number of isolate responses allowed differentiation at a statistically significant level.

Lezak (1976) considers the Hooper Visual Organization Test (HVOT) to tap visuoconceptual function, but, importantly, to allow separation of a perceptual component from a visuopractic one in a manner not possible on similiar more commonly used measures, such as Object Assembly. The HVOT might be viewed as a purer measure of visuoconceptual ability uncontaminated by practic disturbances which are frequent among elderly subjects. Eisdorfer and Cohen (1980) claimed the HVOT's minimization of speed and recent memory requirements made it an instrument well suited for use with elderly subjects. Further, Aftanas and Royce (1969) investigated the possibility that some test instruments are more efficient in the differential diagnosis of presence or absence of brain damage among older people. They included the HVOT in their battery, and factor analysis showed it to load most highly on factor 1, labelled "ability to integrate or organize the relevant aspects of the perceptual field" (p. 479). They concluded that the HVOT was quite efficient for the purpose.

Examination of numerous studies suggests that the HVOT is quite sensitive to both the effects of age and the presence of brain damage. Spreen (1968) in his review of the HVOT commented that though scores do not correlate with age up to 60 years, beyond that point the correlation is relatively high. The manual mentions a sample of 28 subjects from a home for the aged. Hooper found 67% had moderate impairment, 15% mild impairment and 18% no impairment. Results from Farver (1975) showed significant declines in HVOT scores with each decade beyond the fifth in a sample of community dwelling subjects ranging in age from 40-89 years. Wentworth-Rohr, Mackintosh and Fialkoff (1974) showed the HVOT to have an increasingly negative correlation with age. Mason and Ganzler (1964) administered the HVOT to subjects 25-75 years of age. They found that age alone accounted for nearly 20% of the variance in HVOT scores and that education accounted for 5%. They underscore the need for normative data by stating "an elderly patient . . . may achieve scores which would have indicated impairment by previous standards but may be performing quite normally for his age" (p 423).

Wang (1977) provides a clear example of Mason and Ganzler's statement. He administered the HVOT to three patient groups (right, left, and bilateral cerebral damage) and a normal control group. He concluded that since the patient's scores were significantly lower than those of the controls, the HVOT was sensitive to the types of brain damage. However, another interpretation is possible. Examination of the patient groups' mean ages (approximately 60 years) shows two of them to be twenty years older than the controls! It's possible that age related changes in HVOT ability greatly contributed to, or accounted for, the group differences found by Wang. What Wang believed evidence of deficit by patient groups could instead be normal performance by older patients. Only comparison to a peer group would resolve the discrepancy, clearly illustrating the need for normative aging studies.

In addition the HVOT may be differentially sensitive to combined effects of advanced age and the presence or absence of brain damage. We have established the effect of age on HVOT scores. But, when age and brain damage are combined, further score reduction may result. Support for this contention comes from three studies. Storandt, Wittels and

Botwinick (1975) rated the functional capacity of elderly community dwelling clients and administered the HVOT. As functional level declined, so did HVOT score. Another study, Storandt and Wittel (1975) showed HVOT score reliable over a one year period, with a mean score of approxiamately 17 correct of 30 items. In constrast, mean scores achieved by cognitively impaired elderly patients investigated by Eisdorfer and Cohen (1980) were approximately 6 correct.

BENTON VISUAL RETENTION TEST - MULTIPLE CHOICE VERSION

The Benton Visual Retention Test (BVRT) (Benton & Collins, 1949; Benton,1950) taps visual perception and memory. Though the BVRT is usually employed as a drawing test, it's possible that such use over-estimates the proportion of defective performances in elderly clients as periheral disorders like arthritis may slow the drawing process and interfere with optimal performance. For this reason, the multiple choice form was chosen. Several studies suggest the BVRT, with drawing response, may be sensitive to age, (Brilliant & Gynther, 1963; Arenberg, 1978), but whether or not the deficit may be attributed to actual poor visual memory or increased drawing difficulty or slowness has not been established.

The subject is shown a series of cards each of which has one to three geometric figures on it. The subject is instructed to try to remember the card and is later shown a multiple choice card with four similiar figures, one of which is identical. There are two forms, one being an immediate choice (BVRT-I) with a five second exposure and the other being a delayed choice (BVRT-D) where ten second exposure is followed by fifteen second delay. Half the subjects received the immediate form, followed by the delayed form; while the other half received the reverse order of administration. Score is the number correct on each form of a possible total of 15.

SUBJECTS

Subjects were volunteers recruited from three sources: the James Bay and Fairfield New Horizons groups and the British Columbia Retired Goverment Employee's Association. The examiner gave a brief speech at each group's general meeting and requested potential volunteers to write down their name and phone number. These people were later contacted and any questions about the study answered. Then an appointment was arranged to conduct the test session at the University, home of the volunteer, or at the referring group's facility and required approximately two hours time per subject.

Information was gathered to judge the suitablity of a subject for inclusion. Appropriate subjects were those who met the following criteria: age over 65 years, health reasonable enough to permit independent living (i.e., no residential facility or family care members), no history of central neurologic or psychiatric disease, and hearing and visual ablity adequate for testing requirements. Data from unsuitable subjects was not included.

Sixty females and twenty-five males were tested. The 85 subjects ranged in age from 65-89 years with a mean age of 74.04. Education ranged from 4 years to Master's degree level, with a mean of 12.42 years.

Subjects reported few health problems. Diseases very prevalent among aged populations, such as diabetes and hypertension were reported by few subjects. Those who did report a health problem usually indicated compliance with treatment recommendations, e. g., carefully taking medication to control hypertension on a regular basis.

This sample is not presented as being representative of the general elderly population at large. Only those people attending the referral sources were potential subjects, not the elderly population. Membership may be affected by health status, socioeconomic background, and other factors. Subjects tended to be better educated and of higher socioeconomic background than their age mates.

Participation was motivated by an altruistic concern about the health care of peers, concern about one's performance, interest in education of the examiner, and curiosity.

For data analysis purposes, the sample was divided into two age groups, 65-74 and 75-89 years of age. Mean age and educational levels were as follows: younger group 69.88

years with 13.04 years education; older group 79.84 years, with 12.00 years education.

RESULTS AND DISCUSSION

In order to conduct a proper neuropsychological assessment of an elderly patient, a clinician would like to have answers to two questions: (1) What is the normative performance of an elderly group on a particular test? (2) How can the overall performance of an individual elderly subject on a given battery of neuropsychological tests be assessed? If a dementia rating scale is used, a third question could be added: (3) How does that rating compare to overall test battery performance? These questions will each be addressed in sections below. Normative performance will be reported first, and percentile distributions for each test appear in tables at the end. Two ways of assessing overall performance will be presented. Comparison between MDRS rating and the remaining tests will be discussed.

WHAT IS THE NORMATIVE PERFORMANCE OF AN ELDERLY GROUP ON A PARTICULAR TEST?

MATTIS DEMENTIA RATING SCALE

The mean total MDRS score for the whole sample of 85 subjects was 137.28. This mean is actually equal to the cutoff suggested by Mattis. In Mattis's sample of 11 normal controls (age 58-71) all subjects scored above 140. In the present sample only 49.4% score above 140. Twenty-nine percent of the present sample scored below his cutoff of 137. Normative information is presented in Tables 6-11.

Four subjects (4.7%) fall below two standard deviations from the mean of the present sample. Were the distribution normal one would expect 2.3%. Actually the distribution is not normal, but shows a considerable amount of left skew, ($g_1 = -2.624$). These four subjects are quite deviant and might be considered "outliers." All four were from the older age group.

Since the MDRS distribution is not normal, a log transformation was performed. Log transformation is a way of approximating a normal distribution. After this was done, only one MDRS score falls below two standard deviations from the sample mean. The other three outliers have scores very close to but not equal to two standard deviations below the mean. This suggests that the nature of the distribution, or skewness of sample, results in the these three outliers appearing so unlike their peers.

For further analysis, results will be reported for the younger group (N=50), the older group with the outliers removed (N=31), and the outlier group (N=4), as well as for the whole sample (N=85). In this way it may be possible to determine whether the outliers are unlike peers on other measures as well.

A danger with many neuropsychological measures is that age and education may contribute the largest amount of variance to the score. This is unlikely with the MDRS as the observed Pearson r with age is .25, and that with education is .21; hence age accounts for 6.25% of the variance and education 4.41%.

Speculation about the validity of the MDRS can be made. Examination of the neuropsychological test battery scores of the four outliers generally shows other scores to be lowered but not deficient. This suggests five possibilities.

1. Perhaps MDRS and other instruments measure very different constructs and hence those subjects showing reduced performance on one need not show reduced performance on another. However, this is unlikely to be the true case as the observed Pearson r of the MDRS and other neuropsychological test measures are quite reasonable.

2. Perhaps the MDRS tells us nothing useful. Score differences could possibly reflect differential levels of fatigue or boredom, but this was not the examiner's impression.

Most subjects said the test sessions were stimulating and had numerous questions about the project's general results which they asked at the conclusion of testing. It's possible that a random variable had a significant effect on MDRS score though every effort was made to exclude such an effect.

Evidence against the position that the MDRS provides no information can be provided by comparison to Gardner et al. 's patient sample. Their mean score was 63.70 with a standard devaition of 34.24 and clearly has little overlap with the present sample.

3. Perhaps the MDRS is a sensitive and early indicator of cognitive decline. It may dip below two standard deviations prior to the time other scores fall outside this range. The excluded group performs differently on the MDRS in that examination of subsection scores showed that while most subjects lost points across the subsections in an even manner, the outliers lost points largely on memory and on initiation and perseveration. Memory impairment can be an early indicator of cognitive decline.

Yet it would be hard to believe that a rating scale expected to show a ceiling effect could actually be more sensitive to early pathology than a number of tests thought to be capable of finer discrimination.

4. Perhaps low MDRS scores are the combined result of older age, low educational level, and low vocabulary subtest scores. Table 1 shows that this is quite unlikely for one outlier and plausible for the other three.

5. Low MDRS scores represent either cases appropriately classified or cases misclassified by the test. Comparison of MDRS rating to performance on other measures in the test battery may allow distinction between appropriately and misclassified cases. One would consider poor standing on both indices (MDRS and test battery) as indicative of appropriate classification while those cases with adequate test battery, but poor MDRS, standing would appear misclassified.

TABLE 1

OUTLIERS

MDRS	Z	AGE	Z	EDUC*	Z	AGE SCALED SCORE**	Z
118	-2.78	77	- .49	12	- .14	13	- .71
122	-2.20	76	- .32	8	-1.46	10	-2.56
118	-2.78	89	-2.47	4	-2.77	12	-1.33
100	-5.37	82	-1.31	8	-1.46	11	-1.95

Z = Z SCORE
* EDUCATION
** VOCABULARY SUBTEST OF THE WAIS

Re-evaluation in one year's time would be helpful in determining which of the five possibilities most likely. Were other test scores to drop, the possiblity of sensitivity would be supported. If they remain the same, low MDRS scores might be due instead to interaction of age, education and verbal ability, or other factors.

VOCABULARY SUBTEST

The younger group had a mean vocabulary scale score of 13.44 and age-corrected scale score of 14.30. The older group had a mean scale score of 13.10 and age-corrected scale score of 14.26. The outliers had a mean scale score of 10.00 and age-corrected scale score of 11.50. Scale score Pearson r correlation with MDRS was .47; and age-corrected scale score with the MDRS was .50. Norms are presented in Tables 12 and 13.

BOSTON NAMING TEST

As is the case with many tests in this battery the older group's mean score (66.71) is slightly lower than that of the younger group's (70.51) but the standard deviations of both groups are relatively large, and the distributions overlap considerably. The BNT shows a Pearson r of -.43 with age, .18 with education, and .62 with MDRS score. Means are presented in Table 14.

Deficient performances are seen in 4% of the younger group and 3.2% of the older group. Two of the outliers have scores close to the mean of the older group and two have deficient scores.

These results compare nicely to those of Borod et al., (1980), as shown in Table 2.

TABLE 2

COMPARISON OF BOSTON NAMING TEST RESULTS

	AGE GROUP	MEAN	RANGE	CUTOFF*
Borod et al.	60-69	70.3	18-81	47
	70 +	63.2	17-81	31
Present sample	65-74	70.5	46-83	58
	75-89	66.7	37-84	44

* 2 standard deviations below the mean

They reported the mean, range and cutoff score (two standard deviations below the mean) for two groups of normal elderly subjects. Borod et al. show that a deficient score is one below 65 for subjects under 40 years, or below 61 for subjects 40-59. A comparison of cutoff scores from Borod et al. and the present sample shows a discrepancy of 11-13 points. This discrepancy may be due to both sample selection procedures and the differing age breakdown, given the test's sensitivity to age (Pearson r -.43). Once again such results underscore the need for age appropriate and local norms.

Misperceptions, such as "aprons" for the item correctly identified as flippers, were made by 51% of the younger group, 71% of the older group and three of four outliers. However, the number of misperceptions made was too small to account for the reduced mean score in comparison to younger subjects. Rochford (1971) claimed that "naming impairment in demented patients may be largely attributable to an impairment of visual recognition" (p. 437). In the present sample, subjects with known visual problems were excluded, and impaired visual recognition is unlikely to be the sole cause of reduced naming ability as few misperceptions were seen in those protocols where they were present. Pearson r correlation between misperceptions and the total score on the HVOT was -.62; that between misperceptions and isolate HVOT responses was .51, and suggests a common underlying factor.

CONTROLLED WORD ASSOCIATION TEST

The younger group has an unadjusted mean score of 41.12, compared to the older group's mean of 36.97. Standard deviations are large (12.41, 11.60) and distributions clearly overlap greatly. Pearson r with age is -.22, with education

.30, and with MDRS .42. Deficient scores are seen in 3.2% of the older group, and one of the four outliers. Norms are presented in Table 15.

Repeated words are observed in 84% of the younger group, 80.6% of the older group, and in three of the outliers. Excessive repeating, defined as number of repeats exceeding two standard deviations above the mean, was observed in 4% of the younger group and 3.2% of the older group.

Wrong words (e. g., phone for F) were observed in the minority of subjects, the percentages being 38% for the young group, 41.9% for the older group, and two outliers. Three or more wrong words were given by 6.00% of the younger group, 16.2% of the older group, and three of four outliers.

In Benton et al.'s 1981 study, 3% of his sample of normal elderly had deficient scores relative to younger adults, defined as those scores below a total score of 22. By his criteria, 8.2% of the present sample have deficient scores.

REY AUDITORY VERBAL LEARNING

Since listing the mean number of words per trial would be too cumbersome, RAVL results are given in Table 3, and presented visually in Figure 1. A learning curve is clearly demonstrated.

COMPARISON OF PRESENT SAMPLE AND REY'S RAVL NORMS

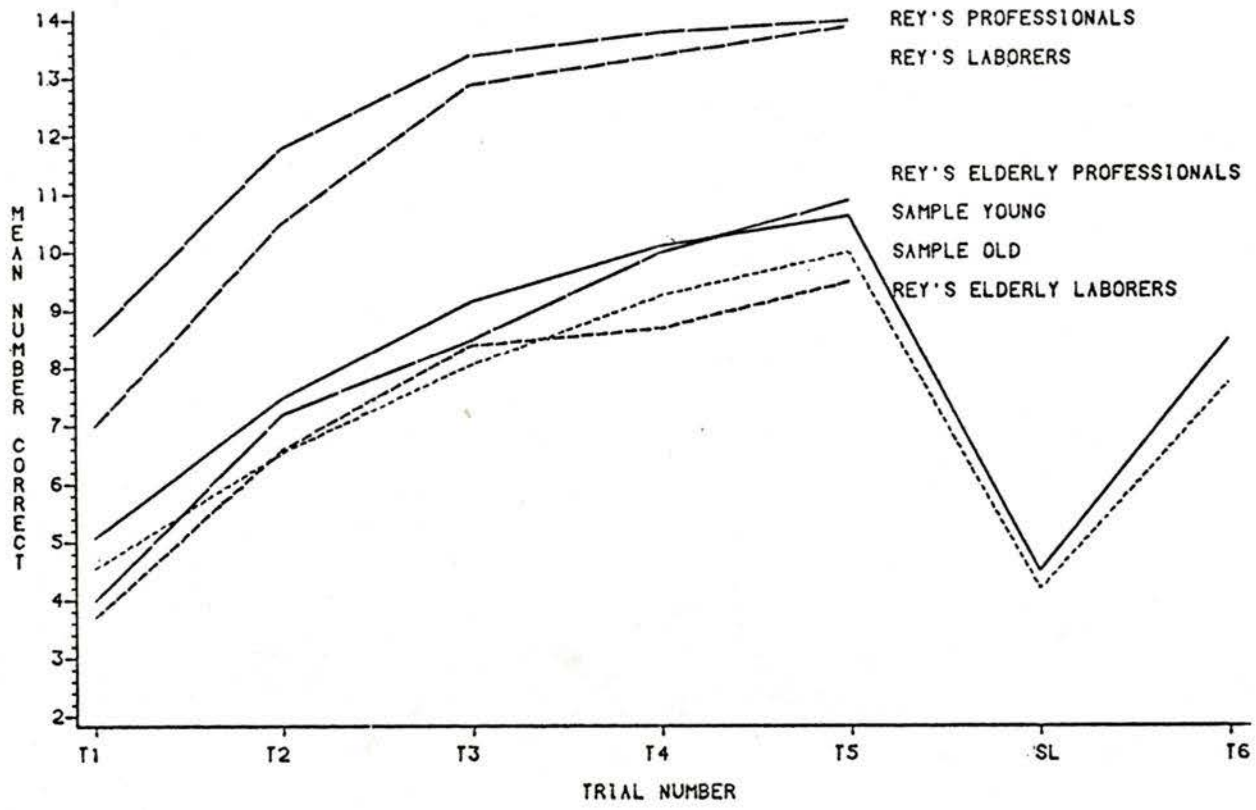

TABLE 3

RAVL TEST MEAN SCORE AND S.D. PER TRIAL

TRIAL		1	2	3	4	5	SL	6
PRESENT SAMPLE								
YOUNG	X	5.08	7.48	9.16	10.12	10.64	4.50	8.50
	S.D.	1.35	1.91	2.04	2.44	2.31	1.57	2.89
OLD	X	4.55	6.55	8.07	9.26	10.00	4.19	7.74
	S.D.	1.36	2.01	2.34	2.94	2.27	1.52	3.25
REY'S NORMS								
LABORERS	X	3.7	6.6	8.4	8.7	9.5		
	S.D.	1.4	1.4	2.4	2.3	2.2		
PROFES-	X	4.0	7.2	8.5	10.0	10.9		
SIONAL	S.D.	2.9	2.9	2.5	3.3	2.9		

Scores attained by the present sample conform very closely to those reported by Rey (1964) for his elderly groups, and are lower than those reported for younger adults. Rey's scores were based on administration in French. Although outliers do not have deficient scores, they fall at the lower end of the distribution.

The first recall of each of the two lists of words yields very similar results. One might consider this score some indication of immediate memory.

Lezak (1976) suggested that a retrieval or retention problem might be evidenced by a reduction from trial 5 to trial 6 of three or more words. Though the mean for trial 6 is lower than that for trial 5, the difference between them is less than three words. However, it must be noted that 33% of the entire sample and one of the four outliers showed a difference of three or more words.

Werner's (1946) suggestion that including words from a previous list when recalling a new list is interesting in considering the RAVL words given to the wrong list. These are words of List 1 recalled as being from List 2, or vice versa. Three of four outliers made this error as did 51.61% of the older group and 30.00% of the younger group. Werner believed such errors more common among brain damaged populations, and this possibly hints at some difference between the outliers and the rest of the sample. Quality of performance appears to decrease as age increases.

Examination of repeats per trial indicates they are slightly more frequent among the whole sample than among the outliers. Possibly repeating recalled words aids in the recall of other list words, and as such is frequent in better performances; rather than being an indication of perseverative tendency.

The data regarding intrusions are not informative.

Possibly qualitative errors are due to the poor utilization of strategies intended to enhance performance. Mnemonic devices investigated to aid amnesic patients sometimes shows that the devices may be effective but are equally likely to result in the recall of the wrong part of an association. Such a mechanism may account for some intrusion errors such as "teacher", or possibly for some wrong list errors as well.

HOOPER VISUAL ORGANIZATION TEST

The mean HVOT score of the younger group (24.05) falls well within the range of mild impairment which Hooper considers attributable to possible emotional disturbance or mild organic defect. The older group's mean (20.34) is barely within the same range. Pearson r with age is -.48, with education .10, and with MDRS .40. The HVOT's sensitivity to effects of normal aging suggests it might be a poor indicator of dementia. Both groups have subjects with deficient scores. Of the outliers, two have scores in the range of mild impairment and two in the moderate impairment range. Norms are presented in Table 16.

Isolate responses were made by 68% of the younger group, 77% of the older group, and two of the outliers. Frequency of isolate responses is presented in Table 17. The mean scores of subjects making isolate responses are neither lower than their respective group means nor of subjects not making isolate responses. Hooper considered isolate responses to indicate an inability to abstract beyond the concrete appearance of the pieces, and noted them to be frequent in the protocols of organic patients. Other error types, such as bizarre responses, neologisms or perseverations, were not seen.

BENTON VISUAL RETENTION TEST

Examinations of mean scores shows that though the younger group has higher scores, the distributions overlap greatly. On the immediate choice form, the mean score for the younger group was 11.14, compared to 10.58 for the older group. On the delayed choice form, the mean score of the younger group was 13.66, compared to 12.32 for the older group. Norms are presented in Tables 18 and 19.

Correlations between age and delayed choice score was -.42, and between age and immediate choice was .19. Correlations between the MDRS total score and immediate choice form was .44, and between MDRS total score and delay choice form .58.

Ryan and Butters (1980) report BVRT-M/C performances of ten normal controls (mean age = 55.4) and ten chronic alcoholics (mean age = 53.7). WAIS vocabulary subtest mean scale scores were 12.20 and 12.00 respectively. Their mean

BVRT-M/C scores were for the controls: 11.93 immediate and 14.33 delayed; for the alcoholics: 11.80 immediate and 13.40 delayed. These scores correspond nicely to those of the present sample. In contrast to results of the reproduction form of the BVRT, elderly subjects perform as well as middle age controls when administered the multiple choice form. This suggests that graphomotor or visuoconstructive impairments contribute to reduced performance on the reproduction form, not a visual memory deficit.

Many subjects mentioned specific strategies devised to enhance their performance. The most common strategy was to describe verbally the figures, and then select from the four choices on the basis of match to verbal description. As an example, item 10 on the delayed form has two circles each with two radii joined at the center in a ninety degree angle and a small isosceles triangle in the lower left corner. A verbal strategy to help recall the item was two clocks, set at 9:00 and 9:30, small lower left triangle. Upon presentation of the four choice designs, the verbalized description was repeated and the appropriate design selected. Speers (1980) showed the BVRT to be a readily verbalizable task. He asked one member of a pair of subjects to look at a BVRT figure and describe it to the other member sufficiently well to allow selection from a multiple choice array.

Spontaneous generation of effective stategies may partly explain preserved performances on the multiple choice form of the BVRT. Arenberg (1977) administered the BVRT in the usual reproduction version to males (aged 59-77 years) under two conditions. In one, the standard instructions were followed while in the other, a verbal description of the designs was offered by the examiner while presenting the item. Performance on the second condition was better than on the first. He claimed subjects did not spontaneously describe the figures to themselves, but were able to benefit from offered descriptions. His subjects were not as well educated or as verbally facile as the present sample.

Subjects typically performed worse on the immediate form than on the delayed. This result may seem contrary to expectations. However, the delayed form allows a ten second exposure and the immediate, a five second. The additional exposure time may quite adequately counteract effects of delayed choice. It's possbile that additional exposure time allows better encoding and hence better recall on recognition.

HOW CAN OVERALL PERFORMANCE ON A TEST BATTERY BE ASSESSED?

The above sections have discussed the performance of the sample on each test measure. The following section outlines two means of assessing overall performance of individual subjects on the battery.

First, a score representing each individual's performance on all neuropsychological measures was determined. This score is the sum of z scores on each test, exluding the MDRS. Z scores indicate the distance from the mean in terms of standard deviation units. All raw scores were directly converted except the RAVL, for which a cumulative score for all trials was first determined and that score converted to a z score. Summed z scores for each subject are presented in Table 20.

The summed z scores have a mean of 0.0 of course and a standard deviation of 5.08. Five percent, or four subjects of the total 85, have deficient summed z scores. Two of these subjects are outliers, and have summed z scores close to three standard deviations (S. D.) below the mean. The other two subjects have summed z scores close to two S. D. below the mean, but their MDRS total scores are 134 and 137. The two remaining outliers have summmed z scores within one S. D. below the mean.

Such a result suggests that the two outliers having deficient summed z scores are truly showing changes in excess of that attributable to normal aging and are likely tc be suffering a dementia or depressicn. The other four subjects who show a large discrepancy between MDRS standing and summed z score are harder tc explain. Either the MDBS errs in classifying these four subjects, which would still be a gccd performance for any test; or the MDRS and other neuropscyhological measures, while sharing a large amount of variance, could be differentially sensitive tc types of cognitive decline. However, for mcst of the sample, MDRS and summed z score show a considerable degree of agreement.

A second method for examining cverall performance was also employed. Since individuals vary in their ability to do different types of tasks, each individual varies in their standing on each cf the various tests in the battery. Some types of tasks are more affected by age than cthers. For example, an individual whose weakest ability (as measured in middle age) is one particularly affected by aging may fail that task relative to peers once advanced age is reached. A clinician would like tc avoid interpreting such failure as necessarily pathological. But what cf the individual who fails a number of tests? The question of when overall performance is so pocr as to indicate pathclogy arises. Cne would not want to point to poor performance on a single measure in the face of other adequate performances as being indicative of pathology. But how many poor performances do indicate pathology?

In an attempt to answer this question, the number of tests below z= -1.5 for each subject was determined. Table 21 indicates the number of subjects performing below z= -1.5 on a particular number of tests. As the table shows, "failing" four or more tests is "pathological" in comparison to the rest of the subjects, since only 3.54 percent perform at that level. Three subjects perform at this level, two of whom are outliers. "Failing" two or more tests places the subject in the bottom ten percent of the sample.

HOW DOES MDRS RATING COMPARE TO TEST BATTERY PERFORMANCE?

The above sections have focussed on either the MDRS ratings of individual subjects or on the assessment of individual subject's overall performance on the remainder of the test measures. Thus, those subjects who perform poorly on one or both indices have been mentioned. The question of the correspondence between these two indices remains. It is possible that subjects exist in the sample whose performance on each of the indices is adequate, but not comparable. An example of such a subject would be one whose MDRS rating was

1 S. D. below the mean while having a high summed z score calculated from test performances which all exceed z= -1.5. The two indices yield discrepant results. Clearly this subject would not have been distinguished in the above sections. Yet if the MDRS is to have clinical utility, such discrepant results should not be frequent.

The following method was used tc indentify any subjects having discrepant standings on the two indices. First, the summed a scores of all subjects were themselves converted to a z score. This composite z score was subtracted from z score on the MDRS. The resulting difference score indicates the amount of discrepancy between the two indices. Pearson correlation between composite and MDRS z scores was r= .67, or 44.98 % of the variance accounted for.

By this method, six of the 85 subjects, or 7.05%, show a difference between composite z score and MDRS z score in excess of z= 2.0. Three of these subjects are outliers, and have MDRS ratings lower than composite z scores. (The fourth outlier shows little difference since both indices indicate equally poor performance.) The other three subjects do poorly on composite z but perform near the sample mean on the MDRS. Two of these subjects were previously mentioned as having deficient summed z scores; the third performs just above the mean on the MDRS, but nearly 2 S. D.

below the mean on summed z score. This last subject has adequate but not comparable performances on both indices. Since only one such subject was found in the total sample of 85, the two indices can be thought to have good correspondence when neither is itself deficient.

Conclusions can be made regarding the comparability of MDRS rating and composite z score. The following conclusions assume as a valid standard the composite z score and are supported by results presented in Table 25.

1. The MDRS makes true errors in classifying two of the 85 subjects, or 2.35% of the sample.

2. The MDRS misses an additional two subjects in that their composite z scores are just below z= -2.00 while the MDRS z scores are in the normal range. These are not true errors since one expects more sensitive tests to detect pathology more readily than less sensitive measures, i. e., you expect a ceiling effect with the MDRS in a normal sample, but finer discrimination by the other test measures.

3. The MDRS misrepresents the standing of a total of 4 subjects (or 4.70%) while correctly classifying 95.30%; clearly an outstanding performance for any test.

4. Another issue must be considered. The sample is not representative of the true elderly population and probably is more fit. Hence, it underestimates the incidence of true pathology in an ostensibly normal elderly population. Recalling the log transformation results, three outliers would have been classified as normal. Such classification would have been correct for two, but in error for one outlier. The classification actually used was the reverse case, i. e., in error for two, and correct for one of these three outliers.

GENERAL DISCUSSION

Though the present sample is not truly representative of the entire elderly population, the obtained information is still quite useful. The sample is more representative of priviledged elderly in that this sample is better educated, of higher socioeconomic status, and probably healthier than most elderly. Priviledged status is believed to have a positive effect on cognitive fuctioning. The normative data presented here may be thought to represent an optimal level of functioning. The true norms of the elderly population are unlikely to be higher than those of the sample presented here.

These norms can be applied clinically in three ways. First, an elderly patient of similar age, education and verbal ability can be directly compared, in percentiles, to his peers. Comparison allows better determination of whether test profiles indicate normal or pathological changes. Second, the presented normative information can be used indirectly for those patients of lower education or verbal ability and are a better standard than norms established on the basis of younger adults performance. The more closely such a patient's profile approximates that of this sample, the less likely deterioration in cognitive ability is in excess of that attributable to normal aging. Third, presented norms could be compared to score distributions of known patient groups. Such comparison would allow better evaluation of a particular test's sensitivity to early dementia of various etiologies.

The MDRS may be a more informative indicator if used in conjunction with the rating's associated percentile. It can differentiate clearly brain-damaged patients from the normal elderly, but its sensitivity to early stages of dementia has not been determined.

An unresolved issue is the etiology of the outliers poor MDRS performances. Several possibilities have been proposed. Only further investigation of these people or follow-up study can really resolve this issue. The performance of one outlier suggests caution in interpreting the low scores of individuals with more advanced age, reduced education, and lower verbal ability.

Deterioration from the performance levels of younger adults is most noticeable in the Boston Naming Test, Rey Auditory Verbal Learning Test, and Hooper Visual Organization Test; and not noticeable in the Benton Visual Retention

Test, and Controlled Word Fluency Test. Tests evidencing less change due to age may have greater power in identifying early pathological change than those tests greatly affected by age. The BVRT could be considered to indicate preserved memory of visual material which can be readily verbalized. One could think that preserved CWA performance indicates ability to search effectively or to retrieve specific items from a lexicon. In such a context, poor RAVL performance could be the result of poor encoding or ineffective storage rather than a retrieval deficit. These results are consonant with the results of past studies which have examined changes in mental ability with age. Memory deficits, anomia and visuoperceptual difficulties are areas typically showing greatest change with age, whereas more strictly verbal tests are less likely to deteriorate as markedly.

As the preceding sections have shown, the elderly sample shows a variety of performances. Some subjects perform as well as younger adults, while others perform noticeably poorer. Comparison of the younger elderly to the older elderly shows that the proportion of poor quality scores tends to increase with age. This may indicate a qualitative change in mental ability with increased life seen along with a quantitative one. Comparison of the proportion of younger adults making qualitative errors is not possible as these scores are not typically tabulated.

The two methods used to assess overall test battery performance allow better judgement as to a particular subject's standing in relation to peers. The distribuiton of failed tests in community elderly groups could be compared to that of clinical populations and may yield information of diagnostic utility. A older person may experience significant cognitive decline and yet still function sufficiently well thru the maintainence of old habits to live in the community. The pattern of failed tests may be revealing as to which individuals need further investigation or care.

The good correspondence between rating on the MDRS and composite battery score indicates clear clinical utility of the MDRS. Were the chosen battery comprised of different tests, the results would differ. A battery of tests more ideally suited to the assessment of age related changes would hopefully reveal a similar or greater degree of correspondence. Alternatively, a system assigning weighted values to either sections of the MDRS itself, or to tests in the battery, might allow better understanding of the importance of particular age-related changes.

Reduced test performances are probably the result of multiple factors. Significant contributors may be the amount of cortical atrophy and neuronal changes (Blessed, Tomlinson and Roth, 1968). It is possible that priviledged subjects as a group demonstrate less change in their central nervous systems than do contemporaries due to better nutrition, access to medical care, and less exposure to harmful chemicals or other substances. Advances in neuroradiographic interpretation may one day allow better definition of the relationship between brain changes and neuropsychological test performances.

The reduced performances observed on the BNT and RAVL may, in combination, produce the phenomenon described by Kral (1962 & 1978) as "benign senescent forgetfulness." Kral believes this type of forgetfulness to be present in many elderly people in the absence of a dementing process. It is characterized by an inability to remember the relatively unimportant bits of data associated with an experience, though the experience itself is recalled. Such data can be recalled on another inquiry. Kral (1978) gives examples of inability to recall a name, date or place associated with an experience and provides as illustration the case of an 80 year old woman who could not recall the name of the city where her son's wedding took place. The person may "try to compensate by circumlocution" (p. 48). The possibility should be considered that some of what Kral describes as forgetfulness is actually an anomia. Data from the BNT clearly demonstrates a significant anomia even among priviledged elderly. Kral has not distinguished such forgetfulness from an anomia. If the information is temporarily unavailable, the person may be unable to say anything else which would identify it, but an attempt at compensation may indicate some self-cueing. For example, the woman trying to identify the city where the wedding was held might have either a temporary memory loss or an anomia. To separate the two possibilities, one might ask the woman if she could say anything about the city. If the answer is essentially no, she may have a temporary memory loss. If she instead mentions well known landmarks or other characteristics of a particular city, she may be anomic.

Many studies have shown an association between cognitive status and mortality in elderly groups. The concept of terminal decline indicates that cognitive scores gradually deteriorate, or decline, sometime prior to death, usually over a period of several months, and that onset of decline may be predictive of death. Terminal drop is a similar concept, with the exception that scores are thought to drop precipitously rather than to decline gradually. Jarvik and Falek (1963) and Lieberman (1965) showed that subjects whose test scores dropped over sequential test dates had a higher mortality rate than those whose scores were more stable. Palmore and Cleveland (1976) used data from the Duke Longitudinal study to examine the concept of terminal decline or drop and found that few measures in a large group declined, while only two actually dropped. They suggested that increasing age itself has a more powerful effect on test scores than terminal decline. Riegel and Riegel (1972) suggested that observed age related changes in cognitive abilities could be a consequence of including an increasing proportion of subjects in terminal decline prior to death. Data from the present study demonstrates reduced performance despite apparent good health in priviledged subjects. Terminal decline could be seen as a partial explanation for reduced performance, not as the sole or greatest contributor. Though the concept of terminal decline or drop has received academic attention, one must agree with Miller (1980), that research could be more humanely and usefully applied in trying to find ways to improve the quality of life, rather than in predicting demise.

This study has provided normative data on neuropscyhological tests administered to a priviledged sample of normal elderly people. These results show a clear need for age appropriate norms in the evaluation of elderly patients. The decline seen on some measures may be a normal part of aging and must be distinguished from early pathological change.

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TABLE 4

AGES OF THE SUBJECT SAMPLE

AGE	FREQUENCY	PERCENTILE
65	6	7
66	3	11
67	1	12
68	5	18
69	5	24
70	7	32
71	8	41
72	4	46
73	6	53
74	5	59
75	4	64
76	4	68
77	4	73
78	5	79
79	3	82
80	1	84
81	3	87
82	2	89
83	1	91
84	2	93
85	3	96
89	3	100

MEAN	74.035	STD ERR	0.657	MEDIAN	73.083
MODE	71.000	STD DEV	6.054	VARIANCE	36.653
KURTOSIS	-0.187	SKEWNESS	0.603	RANGE	24.000
MINIMUM	65.000	MAXIMUM	89.000		

YOUNGER GROUP MEAN 69.88 OLDER GROUP MEAN 79.84

VALID CASES 85 MISSING CASES 0

TABLE 5

EDUCATION OF SUBJECT SAMPLE

YEARS	FREQUENCY	PERCENTILE
4	1	1.2
7	1	2.4
8	7	10.6
9	7	18.8
10	5	24.7
11	6	31.8
12	27	63.5
13	4	68.2
14	4	72.9
15	2	75.3
16	15	92.9
18	6	100.0

MEAN	12.424	STD ERR	0.328	MEDIAN	12.074
MODE	12.000	STD DEV	3.025	VARIANCE	9.152
KURTOSIS	-0.346	SKEWNESS	0.019	RANGE	14.000
MINIMUM	4.000	MAXIMUM	18.000		

YOUNGER GROUP MEAN 13.04 OLDER GROUP MEAN 12.00

VALID CASES 85 MISSING CASES 0

TABLE 6

MATTIS DEMENTIA RATING SCALE TOTAL SCORES

SCORE	FREQUENCY	PERCENTILE
100	1	1
118	2	4
122	1	5
124	1	6
127	2	8
128	1	9
129	1	11
131	2	13
132	2	15
133	3	19
134	1	20
135	3	24
136	5	29
137	9	40
138	3	44
139	6	51
140	11	64
141	10	75
142	7	84
143	9	94
144	5	100

MEAN	137.282	STD ERR	0.753	MEDIAN	139.417
MODE	140.000	STD DEV	6.943	VARIANCE	48.205
KURTOSIS	9.878	SKEWNESS	-2.624	RANGE	44.000
MINIMUM	100.000	MAXIMUM	144.000		

VALID CASES 85 MISSING CASES 0

TABLE 7

SCORES ON THE ATTENTION SUBSECTION OF THE MDRS

SCORE	FREQUENCY	PERCENTILE
31	2	2.4
32	5	8.2
33	4	12.9
34	6	20.0
35	19	42.4
36	21	67.1
37	28	100.0

MEAN	35.471	STD ERR	0.173	MEDIAN	35.810
MODE	37.000	STD DEV	1.593	VARIANCE	2.538
KURTOSIS	0.577	SKEWNESS	-1.103	RANGE	6.000
MINIMUM	31.000	MAXIMUM	37.000		

VALID CASES 85 MISSING CASES 0

TABLE 8

SCORES ON THE INITIATION & PERSEVERATION SUBSECTION OF THE MDRS

SCORE	FREQUENCY	PERCENTILE
23	1	1.2
24	1	2.4
25	1	3.5
27	2	5.9
31	2	8.2
32	5	14.1
34	3	17.6
35	5	23.5
36	16	42.4
37	49	100.0

MEAN	35.459	STD ERR	0.328	MEDIAN	36.633
MODE	37.000	STD DEV	3.022	VARIANCE	9.132
KURTOSIS	6.907	SKEWNESS	-2.653	RANGE	14.000
MINIMUM	23.000	MAXIMUM	37.000		

VALID CASES 85 MISSING CASES 0

TABLE 9

SCORES ON THE CONSTRUCTION SUBSECTION OF THE MDRS

SCORE	FREQUENCY	PERCENTILE
3	2	2.4
4	3	5.9
5	5	11.8
6	75	100.0

MEAN	5.800	STD ERR	0.067	MEDIAN	5.933
MODE	6.000	STD DEV	0.613	VARIANCE	0.376
KURTOSIS	11.038	SKEWNESS	-3.348	RANGE	3.000
MINIMUM	3.000	MAXIMUM	6.000		

VALID CASES 85 MISSING CASES 0

TABLE 10

SCORES ON THE CONCEPTION SUBSECTION OF THE MDRS

SCORE	FREQUENCY	PERCENTILE
23	1	1.2
28	1	2.4
30	1	3.5
33	1	4.7
34	4	9.4
35	6	16.5
36	6	23.5
37	15	41.2
38	15	58.8
39	35	100.0

MEAN	37.247	STD ERR	0.280	MEDIAN	38.000
MODE	39.000	STD DEV	2.577	VARIANCE	6.641
KURTOSIS	12.125	SKEWNESS	-2.965	RANGE	16.000
MINIMUM	23.000	MAXIMUM	39.000		

VALID CASES 85 MISSING CASES 0

TABLE 11

SCORES ON THE MEMORY SUBSECTION OF THE MDRS

SCORE	FREQUENCY	PERCENTILE
14	1	1.2
16	2	3.5
19	1	4.7
20	4	9.4
21	4	14.1
22	7	22.4
23	14	38.8
24	26	69.4
25	26	100.0

MEAN	23.282	STD ERR	0.230	MEDIAN	23.865
MODE	24.000	STD DEV	2.119	VARIANCE	4.491
KURTOSIS	5.899	SKEWNESS	-2.195	RANGE	11.000
MINIMUM	14.000	MAXIMUM	25.000		

VALID CASES 85 MISSING CASES 0

TABLE 12

SCALE SCORES ON THE VOCABULARY SUBTEST OF THE WAIS

SCORE	FREQUENCY	PERCENTILE
8	1	1.2
9	3	4.7
10	4	9.4
11	12	23.5
12	13	38.8
13	9	49.4
14	19	71.8
15	16	90.6
16	5	96.5
17	2	98.8
18	1	100.0

MEAN	13.153	STD ERR	0.222	MEDIAN	13.526
MODE	14.000	STD DEV	2.050	VARIANCE	4.203
KURTOSIS	-0.368	SKEWNESS	-0.228	RANGE	10.000
MINIMUM	8.000	MAXIMUM	18.000		
YOUNGER GROUP MEAN	13.44	OLDER GROUP MEAN	13.10		

VALID CASES 85 MISSING CASES 0

TABLE 13

AGE CORRECTED SCORES ON THE VOCABULARY SUBTEST OF THE WAIS

SCORE	FREQUENCY	PERCENTILE
10	2	2.4
11	6	9.4
12	6	16.5
13	9	27.1
14	18	48.2
15	33	87.1
16	6	94.1
17	5	100.0

MEAN	14.153	STD ERR	0.175	MEDIAN	14.545
MODE	15.000	STD DEV	1.615	VARIANCE	2.607
KURTOSIS	0.178	SKEWNESS	-0.671	RANGE	7.000
MINIMUM	10.000	MAXIMUM	17.000		

YOUNGER GROUP MEAN 14.30 OLDER GROUP MEAN 14.26

VALID CASES 85 MISSING CASES 0

TABLE 14

FREQUENCY OF EACH TOTAL SCORE ON THE BOSTON NAMING TEST

SCORE	FREQUENCY	PERCENTILE
30	1	1
37	1	2
45	1	4
46	1	5
47	1	6
48	1	7
54	3	11
57	1	12
59	2	14
60	2	16
61	2	19
62	1	20
63	2	22
64	2	25
65	3	28
66	3	32
67	2	34
68	1	35
69	2	38
70	5	44
71	3	47
72	2	49
73	1	51
74	4	55
75	6	62
76	7	71
77	6	78
78	4	82
79	6	89
80	5	95
81	1	96
82	1	98
83	1	99
84	1	100

MEAN	69.612	STD ERR	1.151	MEDIAN	73.000
MODE	76.000	STD DEV	10.615	VARIANCE	112.668
KURTOSIS	2.223	SKEWNESS	-1.427	RANGE	54.000
MINIMUM	30.000	MAXIMUM	84.000		

YOUNGER GROUP MEAN 70.51 OLDER GROUP MEAN 66.71

VALID CASES 85 MISSING CASES 0

TABLE 15

PERFORMANCE ON THE CONTROLLED WORD ASSOCIATION TEST

SCORE	FREQUENCY	PERCENTILE
5	1	1
12	1	2
17	2	5
18	1	6
19	1	7
21	1	8
22	1	9
23	1	11
24	2	13
25	1	14
27	3	18
29	4	22
30	2	25
31	4	29
32	2	32
33	2	34
34	1	35
35	4	40
36	3	44
37	3	47
38	2	49
40	3	58
41	2	60
42	2	62
43	2	65
44	3	68
45	7	76
46	2	79

CONTINUED ON THE NEXT PAGE

PERFORMANCE ON THE CWA TEST, CONTINUED

48	2	81
49	2	84
52	3	87
55	1	88
56	1	89
57	2	92
58	2	94
59	1	95
60	1	96
65	1	98
72	1	99
75	1	100

MEAN	38.776	STD ERR	1.397	MEDIAN	38.625
MODE	45.000	STD DEV	12.876	VARIANCE	165.794
KURTOSIS	0.466	SKEWNESS	0.216	RANGE	70.000
MINIMUM	5.000	MAXIMUM	75.000		
YOUNGER GROUP MEAN	41.12	OLDER GROUP MEAN	36.97		

VALID CASES 85 MISSING CASES 0

TABLE 16

PERFORMANCE ON THE HOOPER VISUAL ORGANIZATION TEST

SCORE	FREQUENCY	PERCENTILE
8.5	1	1
12.0	1	2
12.5	2	5
13.0	1	6
14.5	1	7
15.0	1	8
15.5	2	11
17.0	3	14
18.5	1	15
19.5	2	18
20.0	3	21
20.5	1	22
21.0	3	26
21.5	3	29
22.0	2	32
22.5	6	39
23.0	5	45
23.5	5	51
24.0	11	64
24.5	5	69
25.0	7	78
25.5	2	80
26.0	8	89
26.5	3	93
27.0	2	95
28.0	3	99
29.0	1	100

MEAN	22.518	STD ERR	0.444	MEDIAN	23.700
MODE	24.000	STD DEV	4.089	VARIANCE	16.723
KURTOSIS	1.577	SKEWNESS	-1.319	RANGE	20.500
MINIMUM	8.500	MAXIMUM	29.000		

YOUNGER GROUP MEAN 24.05 OLDER GROUP MEAN 20.34

VALID CASES 85 MISSING CASES 0

TABLE 17

FREQUENCY OF ISOLATE SCORES ON THE HOOPER TEST

SCORE	FREQUENCY	PERCENTILE
0	25	100.0
1	25	98.8
2	18	94.1
3	5	89.4
4	3	85.9
5	4	80.0
6	4	58.8
7	1	29.4

MEAN	1.635	STD ERR	0.189	MEDIAN	1.200
MODE	0.0	STD DEV	1.745	VARIANCE	3.044
KURTOSIS	1.150	SKEWNESS	1.324	RANGE	7.000
MINIMUM	0.0	MAXIMUM	7.000		

VALID CASES 85 MISSING CASES 0

TABLE 18

PERFORMANCE ON THE IMMEDIATE FORM OF THE BENTON TEST

SCORE	FREQUENCY	PERCENTILE
6	2	2.4
7	2	4.7
8	7	12.9
9	10	24.7
10	15	42.4
11	11	55.3
12	23	82.4
13	11	95.3
14	4	100.0

MEAN	10.800	STD ERR	0.205	MEDIAN	11.091
MODE	12.000	STD DEV	1.889	VARIANCE	3.567
KURTOSIS	-0.351	SKEWNESS	-0.475	RANGE	8.000
MINIMUM	6.000	MAXIMUM	14.000		

YOUNGER GROUP MEAN 11.14 OLDER GROUP MEAN 10.58

VALID CASES 85 MISSING CASES 0

TABLE 19

PERFORMANCE ON THE DELAYED FORM OF THE BENTON TEST

SCORE	FREQUENCY	PERCENTILE
7	1	1.2
8	3	4.7
9	3	8.2
10	4	12.9
11	7	21.2
12	7	29.4
13	19	51.8
14	18	72.9
15	23	100.0

MEAN	12.976	STD ERR	0.218	MEDIAN	13.421
MODE	15.000	STD DEV	2.012	VARIANCE	4.047
KURTOSIS	0.558	SKEWNESS	-1.090	RANGE	8.000
MINIMUM	7.000	MAXIMUM	15.000		

YOUNGER GROUP MEAN 13.66 OLDER GROUP MEAN 12.32

VALID CASES 85 MISSING CASES 0

TABLE 20

FREQUENCIES OF SUMS OF Z SCORES

SUM	FREQ	P+	SUM	FREQ	P+	SUM	FREQ	P
*-14.84	1	1	-1.00	1	35	2.82	1	69
*-14.37	1	1	-0.65	1	36	2.87	1	71
-11.51	1	4	-0.60	1	38	2.94	1	72
-10.23	1	5	-0.50	1	39	3.01	1	73
-9.31	1	6	-0.42	1	40	3.02	1	74
-8.95	1	7	-0.35	1	41	3.18	1	75
-8.87	1	8	-0.33	1	42	3.51	1	76
-8.49	1	9	-0.24	1	44	3.73	1	78
-7.73	1	11	0.10	1	45	3.76	1	79
-7.46	1	12	0.63	1	46	3.84	1	80
-7.05	1	13	0.81	1	47	3.88	1	81
-6.93	1	14	1.17	1	48	3.94	1	82
-6.11	1	15	1.30	1	49	3.97	1	84
*-5.59	1	16	1.43	1	51	4.12	1	85
-5.40	1	18	1.71	1	52	4.32	1	86
-4.20	1	19	1.76	1	53	4.36	1	87
-4.18	1	20	1.78	1	54	4.86	1	88
-3.88	1	21	2.04	1	55	5.21	1	89
-3.66	1	22	2.23	1	56	5.54	1	91
*-3.54	1	24	2.25	1	58	6.09	1	92
-1.81	1	25	2.31	1	59	6.33	1	93
-1.77	1	26	2.35	1	60	6.58	1	94
-1.76	1	27	2.38	1	61	6.82	1	95
-1.65	1	28	2.41	1	62	6.96	1	96
-1.32	1	29	2.49	1	64	7.28	1	98
-1.24	1	31	2.57	1	65	7.44	1	99
-1.20	1	32	2.64	1	66	9.00	1	100
-1.11	1	33	2.73	1	67			
-1.04	1	34	2.82	1	68			

* These are the four outliers.
P+ = percentile

MEAN	0.000	STD ERR	0.552	MEDIAN	1.427
MODE	-14.837	STD DEV	5.086	VARIANCE	25.867
KURTOSIS	0.490	SKEWNESS	-0.906	RANGE	23.835
MINIMUM	-14.837	MAXIMUM	8.998		

- 2 S. D. = -10.17
NUMBER OF DEFICIENT SCORES = 4
VALID CASES 85 MISSING CASES 0

TABLE 21

DISTRIBUTION OF POOR PERFORMANCES CN NEUROPSYCHOLOGICAL MEASURES

NUMBER OF TESTS BELOW -1.5 S.D.	NUMBER OF SUBJECTS	PERCENT	CUMULATIVE PERCENT
0	64	75.29	100.00
1	9	10.59	24.71
2	7	8.23	14.12
3	2	2.35	5.89
4	2	2.35	3.54
5	0	0.00	1.19
6	1	1.19	1.19

TABLE 22

INTERCORRELATIONS OF VARIABLES

	AGE	EDUC	MDRSTOT	SUM
AGE	1.0000	-0.3668	-0.3460	-0.4280
	P=0.0	P=0.000	P=0.001	P=0.000
EDUC	-0.3668	1.0000	0.3627	0.3247
	P=0.0000	P=0.0	P=0.000	P=0.001
MDRS	-0.3460	0.3627	1.0000	0.6707
	P=0.001	P=0.000	P=0.0	P=0.000
SUM	-0.4280	0.3247	0.6707	1.0000
	P=0.000	P=0.001	P=0.000	P=0.0
ACS	-0.0968	0.3716	0.4984	0.7259
	P=0.189	P=0.000	P=0.000	P=0.000
FAS	-0.2229	0.3010	0.4230	0.6687
	P=0.020	P=0.003	P=0.000	P=0.000
HOOPER	-0.4826	0.1024	0.3984	0.6916
	P=0.000	P=0.176	P=0.000	P=0.000
IMM	-0.1899	0.1504	0.4365	0.6872
	P=0.041	P=0.085	P=0.000	P=0.000
DEL	-0.4212	0.3283	0.5801	0.7884
	P=0.000	P=0.001	P=0.000	P=0.000
BNT	-0.4340	0.1820	0.6249	0.8249
	P=0.000	P=0.048	P=0.000	P=0.000
REY	-0.3297	0.2155	0.4503	0.6997
	P=0.001	P=0.024	P=0.000	P=0.000

TABLE 23

INTERCORRELATIONS OF VARIABLES, CONTINUED

	PS	FAS	HOOPER	IMM
SUM	0.7259 P=0.000	0.6687 P=0.000	0.6916 P=0.000	0.6872 P=0.000
PS	1.0000 P=0.0	0.5296 P=0.000	0.3232 P=0.001	0.4708 P=0.000
FAS	0.5296 P=0.000	1.0000 P=0.0	0.3217 P=0.001	0.3301 P=0.001
HOOPER	0.3232 P=0.001	0.3217 P=0.001	1.0000 P=0.0	0.3488 P=0.001
IMM	0.4708 P=0.000	0.3301 P=0.001	0.3488 P=0.001	1.0000 P=0.0
DEL	0.4959 P=0.000	0.4415 P=0.000	0.4667 P=0.000	0.4218 P=0.000
BNT	0.5564 P=0.000	0.3842 P=0.000	0.6290 P=0.000	0.4926 P=0.000
REY	0.3163 P=0.002	0.3941 P=0.000	0.4283 P=0.000	0.4314 P=0.000

TABLE 24

INTERCORRELATIONS OF VARIABLES, CONTINUED

	DEL	BNT	REY
SUM	0.7884 P=0.000	0.8249 P=0.000	0.6997 P=0.000
PS	0.4959 P=0.000	0.5564 P=0.000	0.3163 P=0.002
FAS	0.4415 P=0.000	0.3842 P=0.000	0.3941 P=0.000
HOOPER	0.4667 P=0.000	0.6290 P=0.000	0.4283 P=0.000
IMM	0.4218 P=0.000	0.4926 P=0.000	0.4314 P=0.000
DEL	1.0000 P=0.0	0.6647 P=0.000	0.5196 P=0.000
BNT	0.6647 P=0.000	1.0000 P=0.0	0.4690 P=0.000
REY	0.5196 P=0.000	0.4690 P=0.000	1.0000 P=0.0

TABLE 25

COMPARISON OF MDRS AND COMPOSITE Z SCORES

ZMDRS	ZCOMPOSITE	DIFFERENCE SCORE	CLASSIFICATION
-2.78*	-1.10	-1.68*	ERROR
-2.20*	-2.92*	0.72	CORRECT
-2.78*	-0.70	-2.08*	ERROR
-5.37*	-2.83*	-2.54*	CORRECT
-0.47	-2.26*	1.79*	MISSED
-0.04	-2.01*	1.97*	MISSED
0.25	-1.76	2.01*	CORRECT

* indicates position outside of the normal range

APPENDIX

Variables are listed in columns in the following order: Subject number, age, education, sex, test site, MDRS total, attention, initiation and perseveration, construction, conception, memory, raw WAIS vocabulary score, scaled score, age corrected score Subject number, RAVL 1 to RAVL 5, RAVL sl, RAVL 6, repeats on RAVL 1-5, Subject number, CWA total, repeats on CWA, wrong words on CWA, HVOT total score, isolates on HVOT, BVRT Immediate, BVRT Delayed, BNT spontaneously correct, number correct with semantic cue, number of semantic cues given, number correct with phonemic cue, number of phonemic cues given, misperceptions, total on BNT. Subject number, sl, 6; list 2 given to list 1, list 1 given to list 2, intrusions on RAVL 1-5, sl, 6.

001	84	12	1	1	144	37	37	6	39	25	67	15	15
001	06	11	11	13	13	04	15	00	00	06	03	09	
002	76	12	1	1	143	37	37	6	38	25	67	15	15
002	08	09	14	15	14	05	13	03	01	00	00	07	
003	75	12	1	1	136	36	31	6	39	24	62	13	15
003	05	11	13	11	12	03	13	00	01	00	00	00	
004	78	08	2	3	137	36	36	6	34	25	49	11	12
004	05	05	09	07	06	05	06	01	00	00	00	00	
005	77	16	1	3	141	37	37	6	37	24	66	14	15
005	04	10	12	13	11	08	12	00	00	02	00	06	
006	73	16	1	1	142	36	36	6	38	25	64	14	15
006	07	10	11	12	13	04	12	00	01	00	00	00	
007	81	16	1	1	144	37	37	6	39	25	69	15	15
007	06	05	06	09	10	05	06	00	00	04	02	00	
008	71	11	1	2	144	37	37	6	39	25	61	13	15
008	04	07	10	11	10	06	09	00	00	03	00	00	
009	89	12	1	1	143	37	37	6	38	25	65	14	15
009	05	03	05	02	08	04	02	01	00	02	00	01	
010	67	16	1	1	144	37	37	6	39	25	57	12	13
010	06	07	10	10	10	07	08	03	01	04	09	07	
011	85	11	1	1	143	37	37	6	38	25	52	11	13
011	05	10	10	12	11	06	06	01	01	02	05	02	
012	71	12	1	1	143	37	37	6	39	24	52	11	13
012	08	10	09	11	12	07	10	00	00	01	01	00	
013	72	14	1	2	137	36	37	6	38	20	68	15	15
013	04	07	13	13	12	03	13	00	01	01	02	06	
015	65	09	1	1	140	35	37	6	37	25	47	11	11
015	06	11	12	13	14	04	10	04	00	00	09	01	
014	72	16	2	1	137	37	36	6	39	19	74	17	17
014	05	05	06	08	09	03	06	00	00	01	00	02	
016	76	13	2	1	140	36	36	6	39	23	68	15	15
016	07	05	04	08	11	05	08	02	00	00	00	00	
017	71	16	1	1	139	36	35	6	37	25	57	12	14
017	03	06	08	10	09	03	10	00	01	00	02	02	
018	78	09	2	1	143	37	37	6	39	24	67	15	15
018	05	06	07	09	10	05	08	00	00	00	00	01	
019	75	11	1	1	141	37	37	6	36	25	58	12	14
019	05	07	10	13	13	04	11	00	00	00	01	00	
020	69	16	1	1	140	35	37	6	39	23	76	18	17
020	07	10	10	13	14	08	10	00	00	00	08	03	
021	79	12	1	1	141	37	37	6	37	24	68	15	15
021	04	06	07	12	10	01	11	00	00	00	00	03	
022	78	18	1	1	134	35	32	4	39	24	52	11	13
022	05	07	08	07	07	04	05	00	02	06	08	02	
023	74	10	1	1	138	36	37	6	39	20	44	10	12
023	04	06	09	08	09	04	07	00	01	00	00	02	
024	73	12	1	1	129	33	27	6	39	24	56	12	14
024	05	08	08	13	13	03	11	00	00	05	10	12	
025	69	15	1	2	140	36	37	6	38	23	65	14	15
025	07	10	12	12	13	06	10	01	11	07	15	06	
026	77	18	1	2	137	32	37	6	38	24	64	14	15

026	05	05	07	08	10	04	06	00	00	00	05	00	
027	83	07	2	2	143	36	37	6	39	25	64	14	15
027	03	04	07	07	09	03	08	00	00	00	00	01	
028	77	12	1	2	118	36	32	6	28	16	50	11	13
028	02	07	05	09	10	04	09	00	00	01	00	00	
029	79	08	1	1	139	35	36	6	39	23	70	15	16
029	06	09	10	14	13	05	12	00	00	01	02	02	
030	85	13	1	1	131	35	31	6	34	25	58	12	14
030	05	07	07	03	11	04	09	00	02	00	00	00	
031	71	12	1	1	141	35	37	6	39	24	57	12	14
031	06	08	09	10	08	05	11	00	00	01	02	00	
032	70	09	2	2	139	35	36	6	37	25	60	13	15
032	06	07	08	07	10	04	04	00	00	01	01	01	
033	75	16	1	2	137	35	36	6	38	22	70	15	16
033	06	06	08	12	13	05	08	00	00	00	02	00	
039	70	12	1	2	136	35	34	4	39	24	58	13	14
039	04	08	10	12	12	01	10	00	01	00	00	04	
038	68	11	1	2	140	36	37	6	38	23	62	13	14
038	05	06	08	10	12	03	12	01	00	00	01	00	
036	69	18	1	1	143	37	37	6	39	24	71	16	16
036	05	06	09	11	14	05	12	00	00	01	00	00	
037	71	16	2	1	141	37	37	6	37	24	66	14	15
037	07	11	13	14	12	07	12	00	00	00	00	00	
034	85	09	1	1	137	35	37	6	36	23	57	12	14
034	02	05	08	08	11	04	09	00	00	00	00	00	
035	76	16	1	1	133	35	36	3	37	22	54	12	14
035	03	04	05	08	08	01	06	00	03	00	03	00	
040	70	12	1	2	142	37	37	6	37	25	69	15	15
040	04	08	11	11	13	04	14	00	00	03	01	00	
041	74	10	2	2	140	37	36	6	36	25	73	16	17
041	05	07	08	09	12	04	10	00	00	03	00	00	
042	77	15	1	2	142	36	37	6	39	24	59	13	14
042	02	06	08	09	10	05	09	00	00	00	01	02	
043	89	08	1	1	139	36	36	6	39	22	65	14	15
043	03	06	06	07	08	02	04	01	01	01	00	01	
044	65	16	1	1	144	37	37	6	39	25	61	13	13
044	07	11	11	11	11	06	07	01	00	00	00	01	
045	75	12	1	2	142	37	37	6	38	24	65	14	15
045	04	05	07	09	12	06	07	00	03	00	02	00	
046	70	16	1	2	140	33	37	6	39	25	66	14	15
046	05	07	08	10	11	05	11	01	02	04	00	04	
048	82	13	1	1	127	35	35	6	35	16	52	11	13
048	04	07	05	07	06	03	03	00	00	00	00	00	
047	76	08	1	1	122	36	25	6	35	20	31	08	10
047	02	02	04	05	03	02	02	00	00	01	02	01	
049	73	14	1	1	128	32	37	6	30	23	51	11	13
049	05	07	08	10	11	02	09	00	00	03	05	08	
050	84	12	1	1	132	31	35	5	39	22	48	11	12
050	05	07	09	09	12	03	06	00	00	00	00	00	
051	78	12	1	1	137	36	37	6	37	21	57	12	14
051	03	06	07	10	09	03	07	00	01	01	00	00	

052	65	10	2	2	136	35	37	6	34	24	39	09	10
052	05	07	08	08	09	05	05	00	00	00	00		
053	71	11	1	2	135	36	36	6	35	22	65	14	15
053	04	09	09	11	11	05	08	00	03	01	01		
054	65	16	1	1	142	36	37	6	39	24	69	15	15
054	05	08	09	09	09	06	09	00	00	00	01		
055	66	12	2	1	136	34	36	6	39	21	65	14	14
055	05	07	11	11	12	04	08	00	00	00	02		
056	89	04	2	1	118	35	23	3	37	20	47	11	12
056	04	06	09	10	08	03	07	00	00	00	01		
057	71	12	1	1	138	37	34	5	38	24	56	12	14
057	05	06	08	10	12	04	07	01	01	00	00		
058	65	12	1	1	140	37	37	4	37	25	61	13	14
058	05	05	09	09	11	03	07	00	02	01	03		
059	70	08	2	1	131	32	32	6	39	22	49	11	12
059	03	06	04	04	05	01	05	00	00	01	00		
060	69	18	1	1	142	37	37	6	39	22	69	15	15
060	06	07	09	11	09	04	07	00	03	02	03		
061	70	09	1	1	140	36	36	6	38	24	67	15	15
061	05	08	11	11	12	05	09	00	00	00	00		
062	68	11	2	3	143	37	37	6	39	24	66	14	15
062	04	07	08	11	08	05	06	00	00	01	01		
063	65	18	2	3	141	37	37	6	38	23	74	17	17
063	06	10	14	14	15	03	12	00	01	00	01		
064	74	10	1	1	135	33	36	6	35	25	37	09	11
064	07	09	11	12	11	05	09	00	01	03	00		
065	79	12	2	1	133	33	34	6	37	23	64	14	15
065	04	07	08	10	11	04	02	00	00	00	00		
066	73	18	2	2	137	34	37	6	36	24	42	10	11
066	03	04	06	03	05	02	02	00	00	00	00		
067	68	12	2	1	141	35	37	6	39	24	70	15	15
067	07	11	12	12	14	07	14	00	01	02	01		
068	73	12	1	1	136	35	35	6	37	23	66	14	15
068	04	06	09	09	09	04	05	00	01	01	00		
069	68	09	2	1	137	35	35	6	37	24	46	10	11
069	05	07	08	09	09	06	07	00	00	01	01		
070	72	12	2	1	132	37	32	6	34	23	66	14	15
070	05	08	08	09	11	05	08	00	01	01	00		
071	81	12	1	1	135	35	36	6	37	21	62	13	15
071	04	07	09	10	10	07	10	00	01	01	04		
072	80	09	1	1	127	31	27	5	39	25	49	11	12
072	04	06	09	10	06	03	06	00	00	00	00		
073	72	12	1	1	141	34	37	6	39	25	73	16	17
073	05	08	10	10	11	06	08	01	00	00	00		
074	66	16	2	3	143	36	37	6	39	25	71	16	16
074	03	05	08	10	09	03	08	01	00	00	00		
075	66	16	2	3	139	35	37	6	38	23	65	14	14
075	04	05	09	09	10	03	07	00	01	00	02		
076	68	14	1	1	141	34	37	6	39	25	66	14	14
076	07	07	11	13	12	05	10	00	00	00	00		
077	70	12	2	1	139	36	37	6	35	25	71	16	16

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077 01 02 04 02 04 04 00 00 00 00 00 00
078 81 08 2 4 124 32 32 6 33 21 36 09 11
078 05 06 08 09 07 05 05 00 00 00 00 02
079 78 10 1 1 133 32 37 5 36 23 63 14 15
079 03 05 06 06 08 04 07 00 00 00 00 00
080 82 08 1 1 100 34 24 5 23 14 43 10 11
080 02 04 05 05 06 01 02 00 00 00 00 01
081 73 14 1 1 141 37 36 6 39 23 70 15 16
081 05 06 08 10 08 07 04 01 01 01 02 02
082 74 12 1 4 138 36 37 6 35 24 55 12 14
082 04 08 07 10 10 04 06 00 00 02 02 09
083 69 13 2 2 142 37 37 6 38 24 65 12 13
083 06 08 08 10 10 05 08 00 00 00 03 01
084 71 12 1 1 140 37 37 6 36 24 54 12 14
084 05 09 10 12 11 05 10 02 00 01 01 00
085 74 12 2 1 140 34 37 6 39 24 68 15 15
085 05 08 08 08 11 05 08 01 00 01 00 01
001   42 00 07 215 1 12 11 63 0104 0511 02 69
001 03 10 1 0 0 1 1 0 0 0 3
002   43 01 03 270 1 13 13 76 0103 0304 02 80
002 02 00 0 0 0 0 1
003   29 01 00 225 0 12 15 63 0104 0715 01 71
003 00 01
004   17 01 00 170 2 10 10 59 0204 0408 02 65
004 00 00 0 0 0 0 0 1 1 0 0
005   24 03 01 230 0 12 14 72 0103 0001 02 74
005 01 03 0 0 1 0 0 0 0 1 0
006   30 07 00 235 1 13 14 72 0202 0307 00 77
006 00 01 0 0 0 0 0 0 0 0 0
007   36 03 00 200 0 12 15 79 0104 0404 03 84
007 00 00 0 1 0 0 0 0 0 0 0
008   37 03 02 220 0 12 15 68 0404 0505 00 77
008 00 02 0 0 0 0 0 0 0 0 0
009   29 07 00 260 2 11 13 73 0101 0103 01 75
009 00 00 1 1 1 1 1 0 1 0 0
010   27 03 00 250 1 09 13 70 0000 0206 01 72
010 04 03 2 1 0 0 0 0 0 2 0
011   33 04 01 200 2 13 14 43 0307 0817 02 54
011 01 02 1 0 0 0 1 0 0 0 1
012   48 01 00 270 2 08 14 59 0205 0205 00 63
012 01 00 0 0 0 0 0 0 0 0 0
013   46 01 00 280 1 13 12 74 0101 0305 01 78
013 00 03 1 0 0 0 0 0 0 1 0
015   27 02 06 255 2 11 11 70 0101 0305 00 74
015 02 00 0 0 0 0 0 0 0 1 0
014   29 00 00 230 0 11 15 75 0000 0505 00 80
014 01 00 0 1 0 0 0 0 0 0 0
016   44 01 00 210 1 12 15 75 0404 0101 00 80
016 00 00 0 0 0 0 0 0 0 1 0
017   39 03 01 250 1 12 14 68 0101 0103 00 70
017 00 00 1 0 0 0 0 0 0 0 0
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018	37	00	01	230	1	12	15	74	0101	0202	00	77	
018	00	00	0	0	0	0	0	0	0	0	0		
019	30	01	01	260	1	10	15	79	0000	0000	00	79	
019	00	00	0	0	0	0	0	0	0	0	0		
020	58	06	00	255	0	13	13	71	0202	0303	02	76	
020	01	04	0	0	0	0	0	0	0	0	0		
021	35	02	00	260	0	12	13	77	0101	0101	00	79	
021	00	02	0	0	0	0	0	0	0	0	0		
022	24	06	04	085	6	10	09	35	0105	0102	08	37	
022	01	06	1	0	1	0	0	0	1	0	1		
023	31	07	00	245	0	09	11	59	0406	0612	02	69	
023	02	01	0	1	1	0	0	0	0	0	0		
024	36	01	01	225	1	12	12	50	0205	0813	02	60	
024	00	09	1	0	0	1	0	0	0	0	0		
025	44	13	00	220	0	10	14	73	0001	0000	03	73	
025	00	07	0	0	0	0	0	0	0	0	0		
026	43	06	00	200	1	10	13	53	0202	0406	04	59	
026	00	00	1	1	1	0	1	0	1	1	1		
027	45	04	00	215	0	12	11	66	0205	0001	01	68	
027	00	01	0	0	2	2	2	1	1	0	2		
028	17	00	00	250	2	09	09	65	0103	0002	00	66	
028	00	00	0	0	0	0	0	0	0	0	0		
029	56	00	00	245	1	12	13	59	0102	0406	02	64	
029	00	00	0	2	0	0	0	0	0	0	0		
030	38	00	00	225	0	10	13	58	0204	0203	02	62	
030	00	00	0	0	0	0	0	0	0	0	0		
031	72	00	00	240	1	09	14	61	0003	0406	02	65	
031	01	01	1	0	0	0	0	0	0	0	0		
032	31	07	01	235	0	12	13	79	0000	0001	00	79	
032	00	00	0	0	0	1	1	0	0	0	1		
033	59	16	00	250	1	10	15	77	0000	0202	00	79	
033	00	00	1	1	0	0	0	0	0	0	0		
039	35	01	00	245	2	14	15	68	0002	0202	02	70	
039	00	00	0	0	0	1	0	1	0	0	0		
038	33	01	00	240	1	12	15	71	0002	0404	00	75	
038	00	00	1	0	0	0	1	0	0	0	0		
036	57	00	02	260	0	13	15	70	0202	0303	00	75	
036	00	00	0	0	1	0	0	0	0	0	0		
037	58	07	00	245	1	11	15	78	0101	0000	01	79	
037	00	00	0	0	0	0	0	0	0	0	0		
034	38	04	00	155	2	11	13	51	0004	0308	03	54	
034	00	01	1	0	0	0	0	0	0	1	1		
035	41	07	02	125	2	07	11	43	0203	0204	02	47	
035	00	03	1	0	1	1	1	2	1	1	1		
040	34	00	00	245	0	12	15	71	0103	0505	00	77	
040	00	01	0	0	0	0	0	0	0	0	0		
041	31	08	00	240	1	12	15	72	0002	0203	00	74	
041	01	00	0	0	0	0	0	0	0	0	0		
042	52	03	00	250	1	10	14	57	0506	0205	03	64	
042	00	02	2	0	0	0	0	0	1	0	1		
043	27	04	01	150	6	08	08	46	0310	0509	05	54	

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044 00 00 0 0 0 0 0 0 0 0 0
045  60 03 00 195 2 11 13 76 0001 0101 00 77
045 00 00 0 0 0 0 0 0 0 0 0
046  48 02 00 240 0 12 14 74 0102 0303 01 78
046 00 06 0 0 1 0 0 0 0 0 0
048  45 05 04 240 3 08 07 40 0204 0607 06 48
048 00 00 2 0 0 0 0 0 0 0 1
047  05 03 00 235 0 06 08 36 0215 0713 01 45
047 00 00 1 0 0 0 1 0 0 1 0
049  22 01 01 130 5 08 13 54 0101 0205 05 57
049 02 03 0 0 1 1 1 1 1 0 1
050  39 07 02 125 6 10 11 54 0304 0405 04 61
050 00 00 1 1 0 1 0 0 0 0 0
051  46 03 00 210 0 11 13 68 0000 0202 00 70
051 00 00 0 0 0 1 0 0 1 0 0
052  32 05 03 210 1 09 15 62 0204 0203 01 66
052 00 00 1 0 1 0 1 0 0 0 1
053  35 03 01 240 0 09 15 72 0000 0606 00 78
053 00 00 1 0 0 0 0 0 0 0 1
054  45 02 01 265 0 09 15 74 0101 0102 00 76
054 00 00 0 0 0 0 0 0 0 1 0
055  40 04 00 240 5 14 14 67 0002 0304 02 70
055 00 00 1 0 1 0 0 1 1 0 1
056  49 03 02 155 3 10 13 64 0101 0001 03 65
056 00 02 0 1 0 0 0 0 0 1 0
057  45 04 01 225 2 07 14 70 0001 0102 01 71
057 02 03 0 0 1 1 0 0 0 1 0
058  39 07 00 215 2 10 12 64 0205 0104 04 67
058 00 00 0 0 1 1 0 0 0 0 0
059  19 02 02 230 7 11 12 58 0101 0709 01 66
059 00 00 1 0 1 1 1 1 1 2 1
060  39 03 00 265 1 13 15 75 0000 0102 00 76
060 00 00 0 0 0 0 0 0 0 0 0
061  49 01 00 260 3 14 14 74 0000 0001 00 75
061 00 00 0 0 0 0 0 0 0 0 0
062  41 06 00 290 0 12 14 73 0002 0405 01 77
062 00 01 0 1 0 0 0 0 0 0 0
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065  37 00 00 225 2 12 13 75 0103 0202 00 78
065 00 00 2 0 0 0 0 0 0 0 0
066  32 03 00 145 6 10 11 41 0102 0408 08 46
066 00 00 0 0 0 1 0 0 0 0 0
067  52 02 01 265 1 12 15 77 0101 0101 01 79
067 00 00 0 0 0 0 0 0 0 0 0
068  45 00 00 260 1 11 15 72 0002 0206 00 74
068 00 00 0 0 0 0 0 0 0 1 0
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069  35 01 01 280 0 12 10 69 0102 0202 00 72
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070 00 02 0 0 0 0 0 0 0 0 0
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071 00 00 0 0 0 0 0 0 0 1 1
072  18 02 00 185 2 06 10 69 0203 0002 02 71
072 00 00 0 0 0 0 0 0 0 1 0
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073 00 00 0 0 0 0 0 0 0 0 0
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074 00 00 0 0 0 0 0 0 0 0 0
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075 00 00 0 0 0 0 0 1 0 1 0
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076 00 01 0 0 0 0 0 0 0 0 0
077  42 11 00 230 2 10 12 79 0000 0202 00 81
077 00 00 0 0 0 0 0 0 0 0 0
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078 01 00 0 0 1 0 0 0 1 0 0
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079 00 00 1 1 2 0 0 0 0 0 0
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084 01 00 0 0 0 0 0 0 0 0 1
085  52 07 04 260 2 13 13 73 0000 0202 01 75
085 00 00 0 0 0 0 0 0 0 0 0
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Publications:

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A NORMATIVE STUDY OF NEUROPSYCHOLOGICAL TEST PERFORMANCE OF A NORMAL ELDERLY SAMPLE

[redacted]

Kathleen May Montgomery

Date