Psychological assessment of the elderly.

Hamilton, Susan Bruce

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PSYCHOLOGICAL ASSESSMENT

OF THE ELDERLY

Susan E. Hamilton
Institute of Psychiatry
University of London

Thesis submitted for the degree of Ph.D. in the University of London.

7326 45144
ABSTRACT

The performance of elderly normal, depressed and dementing subjects was examined on tests of psychomotor function, verbal fluency, paired-associate learning, serial learning, and the Eysenck Personality Questionnaire. It was predicted that the performance of the controls would be superior to that of the depressives who would perform better than the dementeds, and depressives would have higher N-scores than controls. Univariate analysis of variance and t tests showed the tests differentiated between the groups: controls performed significantly better than depressives who performed significantly better than the dementeds. Personality measures showed the depressives scored significantly higher than the controls on the neuroticism scale. Following remission of clinical symptoms of depression the depressives showed significant gains on the Digit Copying Test. Canonical correlation analysis indicated the verbal fluency task (animal words), the PALT Hard, and the PALT Mediate were the best discriminating tests. Having discussed the physiological and structural mechanisms of dementia in relation to the results it is suggested that some of the psychomotor slowing is due to frontal lobe damage. As for the reasons why the depressives perform so poorly, the results of the serial learning task indicated difficulties of acquisition largely due to impaired linguistic strategies.
ACKNOWLEDGEMENTS

Among the many people who have helped and encouraged me I am especially grateful to Dr. Felix Post and Dr. Raymond Levy who introduced me to the study of ageing, and to Dr. M. Shapiro for his kind and timely advice.

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Finally, I thank my family, my husband, Robert, and my children, Paul, David and Wendy, for their enthusiasm and their tolerance.
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CHAPTER 1

PSYCHOLOGICAL ASSESSMENT WITHIN PSYCHIATRIC DIAGNOSIS

Broadly-defined psychological assessment involves the acquiring of information about a person, which in turn is interpreted and recorded. More precisely, previously validated and reliable instruments are used to more accurately quantify and qualify intellectual and cognitive abilities, personality, physiological and psychiatric states. These measurements classify people. They can be an aid in prognosis, assessment for and evaluation of treatment, prediction of behavior, neurological investigation, research, and psychiatric diagnosis. It is with this final category, psychiatric diagnosis, that this discussion is mainly concerned.

In a general examination of the diagnostic process Post (1971) quoting Card (1969) notes that if disease is defined as a cluster of symptomatic data separable from other clusters, then "diagnosis becomes the problem of allocating a set of data . . . geometrically a point . . . into a disease cluster." In other words, diagnosis is "the allocation of a set of characteristics to the most probable class." Rarely though is all ascertainable data obtained from a patient before a psychiatric diagnosis is made. The process usually consists of eliminating less probable alternatives.
Considerable criticism has been directed toward psychiatric diagnostic labeling (Ash, 1949; Eysenck, 1952, 1960, 1960a; Mehlman, 1952; Pasamanick et al., 1959; Payne, 1958; Scott, 1958). Psychiatrists differ widely in their assignment of categories to patients, even when viewing the same patients. The difference is more extreme when specific rather than major diagnostic categories are involved. The highest degree of concordance occurs in the assignment to an organic category (Sandifer et al., 1964; Schmidt & Fonda, 1956). Within general psychiatric populations the stability of diagnosis over time has been reported infrequently (Barbigan et al., 1965; Cooper, 1967; Masserman & Carmichael, 1938), while in more homogeneous groups a higher reliability has been indicated (Clark & Mallet, 1963; Guze & Perley, 1963; Walton, 1958; Winokur & Pitts, 1964). Bannister, Salmon and Lieberman (1964) examined the treatment given to a large hospital group and found a significant but low correlation between diagnosis and treatment. Between diagnostic category and response to treatment in specific groups a higher correlation has been reported (Mendals, 1965; Rose, 1963; Roth, 1959).

In order to avoid the problem of allocating a patient to an identified disease category, Card (1969) suggested using a rule whereby a given treatment would be prescribed according to a set of data presented by the patient, thus making the traditional diagnostic process unnecessary. However, no formal system to make use of this method has been developed, and the practical
demand for immediate patient management decisions and specific therapeutic procedures continues to necessitate traditional psychiatric diagnosis.

The usefulness of psychological diagnostic testing to psychiatric diagnosis has also been seriously questioned (Meyer, 1957; Payne, 1958; Phares, 1967). After examining the unreliability of diagnosis and by association, its implication for diagnostic testing, Payne (1958) concluded that test scores could only be used to validly predict the diagnostic label assigned by the psychiatrist to the patient, and not to predict any of the consequences of the label. Moreover, the objection has been made that in some circumstances more errors will result from tests being used than not being used, and more accurate classification can be obtained from the use of base rates, that is, the incidence of a given diagnosis in the population, than with tests (Dawes, 1962; Ley, 1974; Maxwell, 1961; Meehl & Rosen, 1955).

In 1960 McFie reported that in the investigation of brain damage few neurologists considered psychological tests capable of providing data of diagnostic value. Among psychologists at that time the disagreement over which tests were valuable and how to present effectively the data reflected two divergent theoretical viewpoints regarding intellectual activity. The first considered the brain as an homogeneous organ; therefore a lesion in any part of the cerebrum would result in the same kind of
impairment. This view was demonstrated by the work of Goldstein (1948) and his followers, and by psychologists influenced by Lashley's early work (1929) in which he showed that the degree of impairment of maze-learning in rats was related to the extent of cortical surface ablated, rather than to the locus of the damage. The second viewpoint considered cerebral function as capable of sub-division, and experimental workers supporting this view investigated the effect of lesions in different areas (Milner, 1954; Rylander, 1939; Weisenburg & McBride, 1955; Zangwill, 1943). Even this second school was ambivalent about the value of psychological tests. Meyer (1957) contended that obstacles to their aiding diagnosis were due to the fact that cases were generally selected to emphasize the disability being studied, and often there was no comparison made with a control group and no way of contrasting the "relationship of the disability to the site of the lesion with functions related to other intact areas" or with the patients' pre-injury capacity. Moreover, besides overlooking neurological evidence for the localization of cerebral function, a large amount of the experimental work was based on arbitrary tests or ratios between test scores, without any hypothesis as to their possible relation to cerebral function.

Responding to the situation, Eysenck (1957) described three categories of tests: notational tests which lack demonstrated validity; empirical tests which have demonstrated validity but have no theoretical rationale; and rational tests which have
demonstrated validity and are based on theoretical rationale. While discussing the need for rational tests, Ley (1974) emphasized the practical implications in his statement that some "sorts of theoretical rationale are more important than others." His primary concern lay in the area of prognosis and remedial treatment. If the diagnostic process is not merely a classification system, but a method whereby appropriate treatment programmes are instituted and reliable predictions of outcome are made, then psychological tests must not only have demonstrated validity in and of themselves, they must have incremental validity, that is, their use must improve on the accuracy of prediction obtained without their use. As prediction in some areas may be made more accurately without their use, their usefulness will also depend on the base rates of the populations in which they are used (Ley, 1974).

Despite and possibly because of extensive criticism directed toward psychological testing and its relevance to psychiatric diagnosis, the refinement of tests has continued. Even without satisfactory theoretical explanation "certain tests and procedures have undoubted value in clinical diagnosis" (Warrington, 1974). This view is particularly relevant when psychological assessment and psychiatric diagnosis impacts on the geriatric population, those members of the general population over the age of sixty.
It has been established that the probability of developing a psychiatric disorder increases considerably after middle age (Slater & Roth, 1977). Among the elderly there is a high prevalence of both functional and organic psychiatric disorders (see Table 1). Whilst undertaking a study of people under state care, Kay, Beamish and Roth (1962) found that almost 40 per cent of the patients in geriatric wards were exhibiting psychiatric symptoms as severe as those in older patients in mental hospitals. Mental disorders in the elderly have been described as falling into distinct categories: affective disorder, late paraphrenia, acute or subacute delirious state, senile dementia and arteriosclerotic dementia (Kay, Morris & Post, 1956; Roth, 1955; Roth & Morrissey, 1952). A difference in outcome and mortality between the groups showing predominantly functional and predominantly psychiatric symptoms was indicated by Post (1951) and Robertson and Brown (1953), and has been observed in as short a time as six months after hospital admission (Roth, 1955; Roth & Morrissey, 1952). Accurate initial diagnosis of the elderly person is therefore of primary importance, both to alleviate unnecessary suffering and to optimise treatment possibilities.

Roth (1955) reported that patients with late paraphrenia had a normal life expectancy, those with affective disorders had three quarters normal life expectancy, while patients with either senile or arteriosclerotic dementia had only twenty-five per cent their normal life expectancy. When Roth (1971) reexamined this
### TABLE 1

**ESTIMATED TOTAL PREVALENCE RATES FOR THE MAIN PSYCHIATRIC DISORDERS PER 1,000 POPULATION AGED 65 YEARS OR OVER**

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Institutional cases, per 1,000</th>
<th>Cases living at home, per 1,000</th>
<th>Total prevalence per 1,000 with standard errors</th>
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<tr>
<td>Senile &amp; arteriosclerotic dementia</td>
<td>6.8</td>
<td>38.8</td>
<td>45.6±11.0</td>
</tr>
<tr>
<td>Other severe brain syndromes</td>
<td>0.8</td>
<td>9.7</td>
<td>10.5±5.0</td>
</tr>
<tr>
<td>Manic-depressive disorder</td>
<td>0.7</td>
<td>12.9</td>
<td>13.6±6.4</td>
</tr>
<tr>
<td>Schizophrenia, chronic</td>
<td>(0.2)*</td>
<td>9.7</td>
<td></td>
</tr>
<tr>
<td>Paraphrenia, late onset</td>
<td>0.9</td>
<td>0.0</td>
<td>10.8±5.6*</td>
</tr>
<tr>
<td>Psychoses, all forms</td>
<td>9.4</td>
<td>71.1</td>
<td>80.5±14.7*</td>
</tr>
<tr>
<td>Organic syndromes, mild forms</td>
<td>5.3</td>
<td>51.8</td>
<td>57.1±12.6</td>
</tr>
<tr>
<td>Neuroses and allied disorders (moderate/severe forms)</td>
<td>1.9</td>
<td>87.4</td>
<td>89.3±16.1</td>
</tr>
<tr>
<td>Character disorders, including paranoid states</td>
<td>0.5</td>
<td>35.6</td>
<td>36.1±10.5</td>
</tr>
<tr>
<td>All disorders</td>
<td>17.1</td>
<td>245.9</td>
<td>263.0±24.5</td>
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* Long-stay mental hospital schizophrenics not included.

(Slater and Roth, 1977)
study he found the cause of death was clear cut for patients with affective disorders. For patients in the organic psychosis group the cause of death had "a more indefinite character". Roth concluded the descriptions were more "like confessions of ignorance than diagnoses."

Warrington, a specialist in the development of psychological tests measuring neurological deficits, has maintained that the assessment of dementia is possibly the "most important differential diagnosis . . . psychologists must be equipped to undertake" (Warrington, 1974). Although she was including in her definition the pre-senile dementias which become manifest before the age of approximately 60, her view remains pertinent when considering solely the elderly, for pseudodementia occurs in both age groups.

Pseudodementia refers to the occurrence of symptoms defined as dementia but whose origin lies in another psychiatric disease (e.g., depressive illness, schizophrenias). As pseudodementia is treatable the clear differentiation from true dementia is especially important. There is a high proportion of mis-diagnosis in this area. Lishman (1978) has emphasised the value of inpatient rather than out-patient evaluation, and cites the results of a survey by Marsden & Harrison (1972) of 106 patients admitted to the National Hospital, Queen Square, with a presumptive diagnosis of senile or pre-senile dementia. These
patients had come directly to the hospital from outside psychiatric referral, or had been diagnosed in the out-patient clinic. Fifteen patients were judged not to be demented after comprehensive psychiatric and psychometric evaluation, eight diagnosed as suffering from depression, and the presenting symptom in six of these was a disturbance of memory. A recent study at Duke University Medical School indicated that only one third of patients diagnosed as "senile" that is, dementing, had in fact organic brain syndrome (Davis, 1978).

It is with the psychological differentiation of dementia from depression within an elderly hospital population, and a comparative study of a normal elderly population, that the experimental portion of this dissertation is concerned. In order to place the debilitating aspects of both the organic (dementia) and functional (depression) illnesses within the context of normal ageing, normal ageing processes will be examined in the following chapter.
CHAPTER 11

NORMAL AGEING

"Old people remember what interests then ... Besides, I never heard of an old man forgetting where he buried his money." (Cicero)

PHYSIOLOGICAL AGEING

The physiological efficiency of the human organism declines with increasing age. The health of older people is not as good as that of younger people. The sensory systems tend to function less efficiently; muscular strength decreases and movements become slower; visual and auditory acuity become impaired. A neurological examination of an elderly person may routinely reveal rigidity, diminished reflexes, doubtful planter responses, nystagmus, minor irregularities of the pupils and an impaired vibration sense (Slater & Roth, 1977).

Pertinent to the period of senescence and related psychiatric disorders are the changes within the structure and biochemical composition of the brain. The average weight of the brain peaks between the age of 20 and 30 years, and thereafter declines. At 70 years of age the decline becomes very steep (Slater & Roth, 1977). The actual volume of the brain similarly decreases. As a consequence of this shrinking an exaggerated pattern of cerebral cortical convolutions is seen: the gyri are narrower and the sulci deeper and wider than normal. There is an increase in volume
of cerebrospinal fluid (Domino, Dren & Giardina, 1978).

From middle age the various chemical constituents of the brain decline. These include protein, lipids, nitrogen and phosphorus (Slater & Roth, 1977); tyrosine hydroxylase, DOPA decarboxylase, and glutamic decarboxylase (McGeer & McGeer, 1976). A consistent trend toward higher monoamine oxidase (MAO) activity in the brain, platelets and plasma has been found in the ageing brain by both Mies, Robinson, Davis and Ravaris (1973) and Robinson (1975). Robinson (1975) also found that the norepinephrine (NE) concentration in the hind brain progressively decreased with age and negatively correlated with the increase of MAO activity. Such neurochemical changes can directly influence the effect of medication prescribed to the elderly. Unfortunately few psychological studies have been undertaken to elaborate on the behavioural changes that occur concurrent with chemical changes. An exception being that the mean counts of senile plaques show a sharp increase after the age of 70 and correlate with measures of psychological functioning (Blessed et al., 1968; Roth et al., 1967).

The precise mechanisms controlling the rate of the ageing process remain unclear. Storrie and Misdorfer (1978) organized the major relevant theories presently used in psychophysiological studies of ageing (see Table 2), and emphasized that the issue is not whether one or the other of the concepts explains the process,
<table>
<thead>
<tr>
<th>Major Theories Used in Psychophysiological Studies of Ageing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary neuronal loss</td>
</tr>
<tr>
<td>Metabolic (enzymatic) deficit</td>
</tr>
<tr>
<td>Differential organ system ageing, including selective</td>
</tr>
<tr>
<td>hyper- or hypo-sensitivity of end-organ receptor sites</td>
</tr>
<tr>
<td>ANS-CNS congruence or incongruence</td>
</tr>
<tr>
<td>Immune system</td>
</tr>
<tr>
<td>Genetic preprogramming with early or late onset of display</td>
</tr>
</tbody>
</table>

(Storrie and Eis dorfer, 1978)
but rather how each contributes to the change of a particular factor in a specific group under investigation.

**PSYCHOLOGICAL ASPECTS OF AGEING**

Miller (1977) has drawn attention to the distinction between "chronological age", the period of time lived, and "functional age", the age of performance level, either physical (e.g., basal metabolic rate) or psychological (e.g., reaction time). Different functions age at different rates so that various functional ages may exist in the same individual. Differentiating between abilities is especially important when the functional level of an ageing adult is considered, for many variables besides age will directly and indirectly alter the level of performance. Similarly the rate of decline of any particular function may be related to variables other than the individual's chronological age. It is in this context then that the overall functioning of an individual must be considered.

**Intelligence**

In general, speed, sensory efficiency, flexibility and the ability to assimilate new skills decrease with age. Skills which involve the reorganization of perceptual data, described by Cattell (1963) as fluid intelligence, decline first and most rapidly. Those using previously learned intellectual skills, described as crystallized intelligence, decline at a slower rate. Horn and Cattell (1966) indicated that fluid intelligence begins
to decline in the twenties, whereas crystallized intelligence improves until approximately the age of sixty. Supportive data has been provided by Cunningham, Clayton and Overton (1975), who used Ravens Progressive Matrices and the Wechsler Vocabulary Scale as measures of fluid and crystallized intelligence. Their results confirmed a prediction that correlations between measures of the two types of intelligence would be higher in young adults than in a sample of elderly adults.

Normative data on the Wechsler Adult Intelligence Scale (WAIS) indicated that some of the subtests were more susceptible than others to an age-related decline in performance (Wechsler, 1958) (see Figure 1 and Figure 2). Wechsler used this differential decline to devise a "deterioration index" for the measurement of intellectual decline in individual subjects, in which scores on four "hold" tests (Vocabulary, Object Assembly, Information and Picture Completion) are compared with four "don't hold" tests (Digit Span, Similarities, Digit Symbol and Block Design). Longitudinal studies of the WAIS suggest there may in fact be no change, and even a slight increase in performance on cognitive tasks for individuals up to the eighth decade (Jarvic, Eisdorfer & Blum, 1974). Stability in scores in non-institutionalized groups has been reported by Granick and Birren (1969) and Eisdorfer (1963). Cognitive decline, especially when it occurs precipitously and evidenced on tests with no speed component may be indicative of disease.
FIGURE 1

RELATIVE AGE-DIFFERENCES ON THE WECHSLER-BELLEVUE SUBTESTS (Adapted from Bromley, 1966).
AGE DIFFERENCES IN WECHSLER-BELLEVUE FUNCTIONS (Adapted from Bromley, 1966).

**FIGURE 2**

Intelligence quotient (IQ, constant by definition)

'Versal' intelligence (unspeeded)

'Non-verbal' intelligence (speeded)

Intellectual efficiency (E.Q. based on verbal and non-verbal tests)

Digit span (forwards)

Digit span (backwards)

Chronological age
**Speed of Performance**

A number of authorities have concluded that one of the main differentiating factors between older and younger adults is their speed of performance (Birren, 1968, 1970; Bromley, 1971; Cattell, 1943). Birren (1970) emphasized, "slowness ... sets limits for the older person in such processes as memory, perception and problem solving". Tests which have a strong speed component show a marked deterioration with age (Rajalaskshuri & Jeeves, 1963; Rabbitt, 1964; Schaie & Strother, 1968b; Talland, 1964). Speed of behaviour has been discussed in a number of studies and research has been undertaken to clarify the mechanisms involved (Birren, 1965; Botwinick, 1965; Brinley, 1965; Riegel, 1965; Siminson, 1965; Welford, 1959, 1970).

Welford (1970) examined studies which compared the same individuals' performance on several tasks, and found that although the age changes in different performances correlated, unless the tasks were closely related the correlations were usually small. He suggested that discrete rather than unitary factors must be of substantial importance in explaining the mechanisms. Welford described three distinct patterns of slowing with age. In the first, the extra time taken by older people can be represented by the addition of a constant to the time taken by younger people, while in the second, the time rises in reasonably strict proportion. A disproportionately longer time is taken by older people for more difficult tasks in the third pattern. The latter
pattern emerged in two types of tasks, one in which a relatively complex sequence of actions was required, and the other in which accurate identification of material was required within a stipulated period of time.

Also of interest is a study by Dixon (1970) who enquired into the relation between the speed of learning and the rate of forgetting in the elderly. Dixon used a paired-associates learning, recall and relearning task to test whether or not faster elderly learners are slower forgetters when all groups learn to the same criterion. The results indicated that the slower learners showed poorer retention over a 15-minute interval, as measured by recall and relearning.

Reaction Time

Many studies have demonstrated that reaction time increases throughout adult life (Birren, 1964; Birren & Botwinick, 1955; Botwinick, 1971; Botwinick et al., 1957; Singleton, 1954). Visual reaction time is slightly longer than auditory reaction time (Birren, 1964). The consensus has been that the results indicate a slowing in central processes rather than any peripheral phenomenon (Botwinick & Thompson, 1966; Hugin, Norris & Shock, 1960; Miller, 1977; Weiss, 1965).

Botwinick and Thompson (1968) however, have provided data which indicates an environmental influence on reaction time. They
compared the reaction times of older adults with athletic and non-athletic young adults. The older group was slower than either of the two younger groups, but the difference was smaller with the non-athletic group.

Memory and Learning

A failing memory and impaired learning ability are two of the more obvious features of ageing. Minor defects of memory, retention and disorientation for time and place are noted in healthy old people. The ability to recall recent and remote memories has been shown to decline from the age of forty (Warrington & Sanders, 1971; Warrington & Silberstein, 1970).

Various hypotheses and models have been offered to explain the decline of both memory and learning ability (Arenberg, 1967; Crovitz, 1966). After investigating them Crovitz (1966) isolated four relevant factors: cerebral alteration, interference, disuse and motivation. To explain the deterioration of recently acquired new material a reduction in the efficiency of the short term memory (STM) has been suggested, which may occur at registration, due to an inability to encode a trace (receptor dysfunction), or to an interference effect (Inglis et al., 1968; Kinsbourne, 1973; McGhie et al., 1965; Taub, 1975). Loss of STM capacity may be in part an artifact, e.g., deficits in attention, perception or iconic memory (Clark & Knowles, 1973).
Learning performance declines more quickly when material is presented in a visual modality than in an auditory modality (Arenberg, 1967; McGhie, 1965). Williams (1968) reported that when the immediate reproduction of visual material or the learning of spatial relationships is affected by age, then decrements similar to those due to brain damage appear. Among other investigated variables which influence learning are pacing, learning strategies, cautiousness and arousal.

Pacing

Both Kinsbourne (1973) and Taub (1967) concluded that recall ability was a function of the rate of presentation as well as of age. After reviewing studies which compared paired-associate learning in adults as related to age and presentation rate, Witte (1975) decided that the age-related deficit in performance reflected both the effects of performance factors and of a learning disability. The question is whether pacing is more relevant to the acquisition of material or to the ability to recall it. Support for the former position has come from Cannistreri (1963), Eisdorfer, Axelrod and Wilkie (1965) and Eisdorfer (1968), all of whom examined the types of errors produced in tasks in which the pace was varied.

Hulicka and Wheeler (1976) investigated the recall scores of old and young people as a function of registration intervals. The results of their study suggested that the elderly require more time for information processing, and specifically for the
registration of an association, and/or its transfer from primary to secondary memory. The significant improvement of the older persons from the paced-study-interval condition to the self-paced-study-and-registration-intervals condition supported the contention that modification of conditions under which the older person is expected to perform can result in substantial performance increments.

No age X pacing effect was found in studies by Arenberg (1965), Hulicka, Sterns and Grossman (1967), Kinsbourne and Berryhill (1972), and Winn (1975, 1977). Treat and Reese (1976) indicated similarly that presentation interval had no significant effect on performance, however, when the older persons were instructed to use imagery their performance improved. Treat and Reese inferred that the old require a longer retrieval time. Eis dorfer and Service (1967) also found no pacing effect when they compared the performance of elderly people of superior intelligence with younger people of average intelligence.

**Learning Strategies**

The use of mediators on association learning tasks has been found useful to older people who do not appear to use them as spontaneously as younger people (Hulicka & Grossman, 1967; Rowe & Schnore, 1971). Lawrence (1967) suggested that if impairment in storage or retrieval comes from a number of sources, and if appropriate cues enhance performance, then the
difficulty must lie at some point in the retrieval process. A study by Nebes and Andrew-Kulis (1976) lends support to this hypothesis. They hypothesised that older persons tend not to use verbal mediators in paired-associate learning because it takes them too long to form an appropriate mediator. Although their speed at forming sentences was equivalent to younger adults, the older persons showed much poorer recall.

Cautiousness

Cautiousness has generally been considered a common trait in the elderly. In learning tasks omission errors have been interpreted as a measure of cautiousness. In a recent study (Okun, Wiegler & George, 1978) investigating the extent to which cautiousness accounts for the age difference in both omission errors and performance in a serial learning task, the results indicated that cautiousness measures accounted for age differences in omission errors but not in performance. In a vocabulary task involving degrees of risk under neutral, supportive and challenging instructions, older men aged 60 to 76 years, were more cautious than men aged 18 to 30 years (Okun & DiVesta, 1976). Relative to the younger group the older men selected tasks in which they would have higher probabilities of success, and following success, they were less likely to raise their level of aspiration. Okun and DiVesta proposed that older adults choose relatively easy tasks as a means of protecting themselves from self evaluation related to important abilities. However, when a payoff structure
was introduced in a vocabulary task involving varying degrees of risk, with the payoff varying either directly or inversely with the risk, the older adults were no more cautious than the younger group (Okun & Elias, 1977). From these two studies it would appear that an "external" positive reinforcement, i.e., a payoff, lessens cautiousness, while an "intrinsic" positive reinforcement, i.e., success in performance itself, does not lessen cautiousness.

Botwinick (1969) examined cautiousness in the context of varying degrees of risk taking. He presented elderly and young adults with questionnaires involving two contexts. One required commitment to risky courses of action in order to improve upon a poor situation; the other was identical except for an option not to choose the risky course regardless of its likelihood of succeeding. The elderly people choose the second option whereas the younger adults did not. When the option was unavailable both elderly and young responded similarly. Botwinick interpreted the behaviour as a tendency to avoid decisions of risk rather than a cautiousness in solving problems. One other study by Birkhill and Schaie (1975) showed that the performance of elderly people improved significantly on cognitive tasks in a low risk condition, when they were presented with the option of responding or not responding to individual task items.
Arousal

It remains undetermined and a controversial issue as to whether the elderly person is over- or under-aroused. Support for the theory of under-arousal comes from classical conditioning studies indicating the elderly are more difficult to condition, and from electroencephalographic data suggesting lowered cortical excitability (Jarvic & Cohen, 1973). It has also been proposed that different regions of the body may be more or less activated by a central nervous system (CNS) and autonomic nervous system (ANS) interaction, i.e., the individual may be centrally under-aroused and autonomically over-aroused. Evidence indicates there are marked differences in ANS responsivity in stressful situations in the elderly as compared with younger persons. This is not so with CNS activity. While cortical measures may reveal older persons attending and aroused, their behavioural performance is poor, indicating they are less reactive at the autonomic level (Thompson & Marsh, 1973).

Arousal level is related to performance. A number of studies have demonstrated that maximum performance occurs with moderate arousal and deteriorating performance occurs with either under- or over-arousal (Eisdorfer, 1968; Hulicka & Weiss, 1965; Troyer, Eisdorfer, Bogdonoff & Wilkie, 1967). Powell, Eisdorfer and Bogdonoff (1964) and Troyer, Eisdorfer, Wilkie and Bogdonoff (1966) investigated the arousal level in the elderly during learning and vigilance studies, and suggested that the elderly
are more highly aroused than younger people in experimental settings involving the assessment of cognitive skills. Elaborating on this, Eisdorfer (1968) hypothesised that contrary to general impressions, older people may generally be in a high state of arousal. A later study (Eisdorfer, Nowlin & Wilkie, 1970) supported the hypothesis and also indicated that the introduction of a pharmacological agent, in this case, propranolol, to modify the ANS, improved learning.

**SUMMARY**

It is apparent that the decline in physiological efficiency and structural and biochemical changes in the brain, greatly affect the functioning of the ageing person. Most obvious is the reduction in speed and sensory efficiency. There also appears to be an age related decline in performance in learning and memory, which relates to both the effects of performance factors and a true learning disability. How these changes are reflected and relate to clinical populations will be examined in the following chapter.
CHAPTER 111

ABNORMAL AGEING

"A good old man, sir; he will be talking; as they say, When the age is in, the wit is out. God help us! it is a world to see."

(Much Ado About Nothing)

SENILE DEMENTIA

Slaby and Wyatt (1974) have listed six definitions of dementia ranging from a colourful description written by Dr. Benjamin Rush in 1812 to the succinct and qualified definition of Slater and Roth in 1969 (see Table 3). Dementia is often labeled a chronic brain syndrome (see Table 4). The diseases associated with dementia can be divided into two main groups: those which occur before the age of approximately 60 years, comprising a pre-senile group, and arteriosclerotic and 'true' senile dementia making up the second group named senile dementia. The prevalence of senile dementia, the dementia mainly referred to in this discussion, increases with age (Kay, 1970) (see Table 5). Of the two types, arteriosclerotic dementia with its insidious onset, is more common in men, while senile dementia occurs more often in women.

Dementia is characterized by personality changes which are often an exaggeration of earlier traits, mood alterations (usually depression or euphoria changing to apathy), memory impairment (dysnesia), initially for the recall of recent events and finally a global failure of all memory, disorientation, impairment of
TABLE 3

DEFINITION OF DEMENTIA

Slater and Roth, 1969

"... a global deterioration of mental functioning in its intellectual, emotional, and cognitive aspects. Intellectual decline is the central feature, but affective and personality changes are nearly always closely associated and in the early stages of some dementing processes ... the deterioration may be confined to those emotional aspects. However, dementia should not be used to describe personality changes unless intellectual deterioration can be confidently predicted at a later stage. Some structural alteration in the brain is probably always present ... but this is not necessarily irreversible." (p. 490)

Slaby and Wyatt, 1974
TABLE 4

DEFINITION OF ORGANIC BRAIN SYNDROME

<table>
<thead>
<tr>
<th>Diagnostic and Statistical Manual of Mental Disorders (DSM-II) 1968</th>
<th>Organic Brain Syndromes (Disorders caused by or associated with impairment of brain tissue function).</th>
</tr>
</thead>
<tbody>
<tr>
<td>These disorders are manifested by the following symptoms:</td>
<td></td>
</tr>
<tr>
<td>a) Impairment of orientation,</td>
<td></td>
</tr>
<tr>
<td>b) Impairment of memory,</td>
<td></td>
</tr>
<tr>
<td>c) Impairment of all intellectual functions such as comprehension,</td>
<td></td>
</tr>
<tr>
<td>calculation, knowledge, learning, etc.,</td>
<td></td>
</tr>
<tr>
<td>d) Impairment of judgement,</td>
<td></td>
</tr>
<tr>
<td>e) Lability and shallowness of affect.</td>
<td></td>
</tr>
<tr>
<td>The organic brain syndrome is a basic mental condition characteristically resulting from diffuse impairment of brain tissue function from whatever cause. (p.22)</td>
<td></td>
</tr>
</tbody>
</table>

Slaby and Wyatt, 1974
<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>65-69</td>
<td>2.3</td>
</tr>
<tr>
<td>70-74</td>
<td>2.8</td>
</tr>
<tr>
<td>75-79</td>
<td>5.5</td>
</tr>
<tr>
<td>80 and over</td>
<td>22.0</td>
</tr>
</tbody>
</table>

(Miller, 1977)
judgement and a deterioration of other intellectual functioning. Dementia follows a progressively worsening course. For people with dementia there is a very much reduced life expectancy, and one authority, Katzman (1979) has called it one of the leading causes of death in the United States.

The brain of the demented person is distinguished from the normal ageing brain by the extent of the atrophy. The frequency of senile plaques, known to correlate with intellectual deterioration (Roth, et al., 1967) is especially prevalent in the dementing brain. Electroencephalographic changes observed in the normal ageing brain are accentuated (bilateral synchronous slow-wave patterns) in the demented patient (Levy, 1969; Müller & Kral, 1967), and the slowing of motor-nerve conduction correlates with the severity of the dementia (Levy, Isaacs & Hawks, 1970). Recent research has shown that the brains of demented patients have a large deficit in choline acetyltransferase, an enzyme necessary for the manufacture of acetylcholine, one of the main substances used by the brain to transmit nerve signals (Davies, 1979).  

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1. It has been suggested that acetylcholine deficiency may underlie the memory impairment in senile dementia. Deanol (2-dimethylaminoethanol), assumed to increase brain acetylcholine, was given to 14 out-patients in order to determine the safety of the drug and whether it reduces cognitive impairment. No cognitive improvements were reported but positive behavioural changes occurred in some patients (Ferres et al., 1977).
Psychological Functioning

By definition, in dementia a deterioration of intellectual functioning may be expected to be manifest in studies evaluating intellectual performance. Lower than average I.Q.s are reported for dementing subjects, and studies utilizing the WAIS demonstrate different patterns of subtest performance scores for demented and non-demented old people (Botwinick & Birren, 1951b; Dorken & Greenbloom, 1953; Overall & Gorham, 1972). When WAIS verbal and performance scores of demented persons are compared the performance scores are lower (see Table 6). Similar results emerge from studies using the Mill Hill Vocabulary Scale and Ravens Progressive Matrices (Kendrick et al., 1963; Kendrick & Post, 1967; Newcombe & Steinberg, 1964; Orme, 1957). In a longitudinal study of four groups, affective, schizophrenic, organic and normal, Hall (1972) investigated intellect and survival in the aged using the shortened WAIS and the Walton and Black Modified Word Learning Test. The results indicated that a deficit in WAIS performance abilities was significantly related to death in the elderly, particularly in schizophrenic and organic persons. A verbal learning impairment was found only in the organic persons. Alexander (1973) compared 14 psychiatric patients suffering from senile dementia with 40 elderly normal persons and 20 non-brain-damaged psychiatric patients on an abbreviated WAIS, Ravens Colored Progressive Matrices, Inglis Paired Associate Learning Test (PALT) and a nonsense learning test. Of the WAIS subtests only Block Design differentiated brain-damaged patients from
### COMPARISON OF WAIS VERBAL AND PERFORMANCE SCORES

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>VERBAL</th>
<th>PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolton, et al. (1966)</td>
<td>47</td>
<td>83.6</td>
<td>77.1</td>
</tr>
<tr>
<td>Kendrick, et al. (1965)</td>
<td>20</td>
<td>93.1</td>
<td>79.2</td>
</tr>
<tr>
<td>Kendrick &amp; Post, (1967)</td>
<td>10</td>
<td>96.0</td>
<td>79.5</td>
</tr>
</tbody>
</table>
controls. The demented also performed poorly on Raven's Coloured Progressive Matrices, which Alexander interpreted as a decline in the ability to manipulate visuospatial material. The dementing group was able to deal with the vocabulary and verbal comprehension tasks comparably with the controls. The PALT did not differentiate among the groups.

A factor analysis of learning impairment and intellectual deterioration in the elderly by Savage and Bolton (1968) indicated that the learning impairment was distinct from the intellectual deterioration. Boyd (1936) had similarly noted the marked degree of memory impairment compared with a milder decline in general intellectual functioning of a 54 year old man with Alzheimer's disease.

It is necessary when considering the learning impairment in demented people to determine at what stage in the learning process a deficit is occurring, that is, whether it occurs during acquisition, registration, retention or retrieval. Further, it is important to enquire how the deficit relates to other functioning, and to learning models. Unfortunately, all too frequently in clinical practice, by the time a demented person presents for examination, the dementing process is considerably advanced and specific discrimination extremely difficult.
Miller (1977) in a review of early experimental work related to the memory disorder in demented people was unable to find more than a few studies, and these mostly used inadequate experimental techniques. It was not until Inglis (1957) began his examination of the memory impairment in the elderly that continuous systematic investigations took place. Inglis used paired-associate learning tasks in which the person was required to learn three associate pairs of words which had no obvious relationship (e.g. pen - cabbage). The word pairs were presented either auditorily or visually. The method of acquisition was varied by having the subject either recall the word or recognize it from a set of alternatives. The memory disordered group took more trials to learn to criterion than a normal control group on all forms of the test, and in comparison with the control group the experimental group showed similar degrees of impairment for both recognition and recall. Inglis suggested that the deficit lay in the acquisition of new material rather than in storage or recall. Inglis (1959a) replicated the experiment using only auditorily presented paired associates and confirmed the presence of an acquisition deficit. Later, using Broadbent's (1954) 'dichotic listening' technique with elderly subjects Inglis found the memory-disordered subjects showed a deficit in recall ability (Inglis & Sanderson, 1961; Caird & Inglis, 1961).

Jonszon, Malhammar and Waldton (1976) investigated
orienting responses in 48 women patients with a diagnosis of senile dementia. Twenty of these were compared with twenty healthy old people. Whereas the control group habituated in their orienting response, the demented group failed to habituate significantly. This defective habituation was explained in terms of a memory disturbance and a low capacity to interpret sensory data.

Dementing persons demonstrate a language impairment. They have greater difficulty in naming objects (Barker & Lawson, 1968; Lawson & Barker, 1968), and exhibit agnosia (Rochford, 1971). Perseveration of speech is readily apparent in demented people, especially of the type described by Luria (1965) as 'impairment of switching' (Freeman & Gathercole, 1966).

Psychomotor performance is also reduced (Birren & Botwinick, 1951; Ajuriaguerra et al., 1966). Birren and Botwinick (1951) suggested that the retardation in writing speed may be due to an aphasic difficulty rather than a reduction in motor speed.

DEPRESSION

The symptoms of depression have been annotated by a number of clinicians (Beck, 1970; Cassidy, 1957; Post, 1976). The central disturbance is one of depressed mood with the person feeling sad, unhappy and unable to enjoy life. Anxiety frequently accompanies the depressed mood. Other symptoms include
disturbances of thinking, psychomotor changes, change in sleep patterns, sexual function, menstruation, and digestive functioning. The boundary between normal and pathological depression is indistinct (Katz, 1970). In pathological depression the mood change is unduely persistent and pervasive in nature, and inappropriate to circumstances. It may be incidental to another disturbance. Clinical depression refers to a cluster of symptoms and functional disturbances which have a common mechanism, but a variety of causes. The disease model of depression implies a specific cause, follows a predictable course and requires a specific treatment. Depression is more common in women than in men, and its incidence rises in the elderly (Post, 1976). Post (1976) considers this rise in incidence as reactive or due to an illness related to the ageing process itself.

Mendels, Stern and Frazer (1976) reviewed current biological concepts involved in depression. Few studies presented unequivocal evidence. Included in the established findings are those which associate clinical depression with a retention of sodium, increased adrenocortical activity, and the influence of hormonal factors. Of special importance is the biogenic amine hypothesis which suggests that depression is associated with a functional deficiency of norepinephrine or serotonin at significant receptor sites in the brain. The compounds which

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ii. Although outside the scope of this dissertation it is interesting to speculate on the possible relationship of the biogenic amine hypothesis in depression, and the recent reports of large deficits of choline acetycholine in the brains of demented individuals.
serve as transmitter substances in the CNS, acetylcholine, norepinephrine, dopamine, serotonin, are linked with various complex functions including eating, drinking, sleep and reward systems. The biogenic amine hypothesis was derived from the discovery that most antidepressant drugs have pharmacological actions which tend to increase the activity of amines at post-synaptic receptors in the brain. Wendels, Stern and Frazer (1976) warn against assuming that depression is due to amine deficiency just because of the effects of the antidepressant drugs, and "suggest the importance of other systems which may interact with changes in amine function to perhaps cause clinical depression".

After finding evidence of impaired performance on serial and free recall verbal learning tasks during depression and mania, Henry, Weingartner and Murphy (1973) investigated the influence of various psychoactive drugs on performance level. They found that treatment with L dopa and L tryptophan significantly improved performance, while imipramine, lithium carbonate, and alphamethyl para tyrosine treatments had no effect. These results could be relevant when psychotherapeutic approaches designed to teach new response patterns to patients with affective disorders are used.

**Psychological Functioning**

Because of the paucity of studies which investigate the
functioning of depressed elderly people, the following review will not be limited to studies of the elderly, but will include studies relevant to depression in general.

A number of studies report slowing of psychomotor performance in depressed persons (Friedman, 1964; Martin & Rees, 1966; Shapiro & Nelson, 1955). Friedman (1964) also found that depressed patients grossly underestimated their level of performance, a finding supported by other experimental work (Seligman, 1975), and which has been extensively described by Beck (1967) as a negative cognitive pattern. Kahn, Zarit, Hilbert and Niederehe (1975) have reported that complaint of poor memory related to the level of depression regardless of performance. They considered the exaggerated memory complaint as a manifestation of a general pattern of discrepant reporting of symptoms by depressed persons, and related to an underlying personality factor. Depressed persons have been shown to have lowered response initiation measured by social verbal responses and gestures (Ekman & Friesen, 1974; Lewinsohn, 1974).

During the period of depression the IQs of hospitalized depressed patients drops and their ability to learn definitions of new words deteriorates (Payne, 1961; Walton et al., 1959). Depressed people frequently report having difficulty with their memories, as do some normal elderly people. When this is severe and accompanied by other symptoms such as disorientation, the
question arises as to whether the person is dementing or suffering from pseudodementia. Considerable work has been undertaken to elucidate the degree of memory impairment and learning disorder in depressives in order to prevent misdiagnosis. Miller and Lewis (1977) offered an hypothesis to explain the similarly poor performance by dementes and depressives on tests of memory. They theorized that depressives do not have impaired memory, but adopt a very conservative response strategy. Miller and Lewis used signal detection analysis of a simple recognition task which they administered to 20 depressives, 20 dementes and 20 normal controls over the age of 65 years. Their results were consistent with their hypothesis. This could be interpreted as an exaggeration of the cautiousness exhibited by the elderly in other experimental situations.

Hilbert, Niederehe and Kahn (1976) explored accuracy and speed of memory in depressed and organic persons aged 50 years and over. The depressed group performed less accurately and less quickly than a control group on a Sternberg recognition-memory test. The authors concluded however that the performance differences were a result of the additive effects of depression and educational background, rather than by any variable alone.

In order to examine more systematically the discrepant findings of studies using specific tests to compare learning and memory performance in elderly depressed and demented persons,
the tests used for this purpose will be reviewed individually in later chapters. Preceding these will be the following chapter which will describe and examine theories of learning and memory.
CHAPTER IV

LEARNING AND MEMORY

CLINICAL DEFINITION

Memory may be divided into three clinically distinguishable kinds; two involving short-term memory (STM), and the other, long-term memory (LTM). Registration is regarded as a selecting and recoding process whereby perceptions enter the memory system (Atkinson & Shiffrin, 1968; Lewinsohn et al., 1972). If information within the registration process is not transferred to STM it decays rapidly. Registration and the rate of decay may be measured in milliseconds (Atkinson & Shiffrin, 1968). Iconic memory is defined as storage at a level prior to the contact between incoming stimulus information and linguistic categories in memory, and persists for approximately .25 second (Crowder, 1976). Neither iconic memory nor echoic memory, the auditory precategorical store, will be discussed here.

Immediate memory lasts from 30 seconds to several minutes unless it is sustained by rehearsal, a repetitive process that serves to lengthen the duration of a memory trace. Evidence suggests that information in the immediate memory is maintained in reverberating neural circuits (Rosenzweig & Leiman, 1968; Thompson et al., 1972). The electrochemical activities constituting the immediate memory trace will spontaneously
dissipate unless converted into a more stable biochemical organization for longer lasting storage. Another type of STM lasts from about an hour to one or two days, but is not permanently fixed as learned material in long-term storage.

Long-term memory implies an ability to store information. The process begins as early as one-half second after information enters short-term storage, and continues as long as that information remains there (Atkinson & Shiffrin, 1968). The consolidation period is a lengthy process, evidenced by the fact that more recently learned behaviour or material is more vulnerable to disruption than older memories (McGaugh, 1966; Weiskrantz, 1966). It has been suggested that LTM storage is a biochemical process involving the transformation of protein configurations in cortical nerve cells (Hyden, 1970; Nagoun, 1966). Memories seem to involve neuronal contributions from many cortical and subcortical centres (Penfield, 1968; Thompson et al., 1972).

Memory system efficiency depends on how readily and completely information can be retrieved, either through recall, when an association precipitates awareness of stored information, or by recognition, when a specific stimulus precipitates the awareness. Recent and remote memories refer respectively to memories stored within the last few hours, days, weeks, or months, and to older memories dating from early childhood (Brierly, 1966).
ANALYSIS OF LEARNING AND MEMORY

Crowder (1976) describes three abstract principles which govern the analysis of learning and memory: stage analysis, coding analysis and task analysis. Stage analysis separates sequentially the processes involved into (i) acquisition, the placing of information into memory storage, (ii) retention, the persistence of memory over time, and (iii) retrieval, the extraction of the information from the memory storage. When there is a failure to retrieve the information there are three ways whereby this may have happened; either the information has been adequately acquired and retained, but for some reason is unaccessible at the time of attempted retrieval, or it has been acquired adequately but then lost during the time elapsing between acquisition and retrieval, or finally, the information could have been inadequately acquired so there is nothing to retain or retrieve. It is useful therefore to assess 'forgetting', that is, to assess the amount of information which does not persist between acquisition and retrieval. The preferred experimental design to examine whether a given variable affects retention when it is known that it affects acquisition, is to have separate groups tested at the beginning and end of the retention interval, a pair of such groups used for each level of the variable in question (Underwood, 1964). To distinguish between retention and retrieval impairment it is necessary to include within the experimental design both cued-recall and free-recall of information.
Coding analysis is concerned with what aspects of items to be learned are recorded in memory, in other words, which codes are important in which situation. Some of the findings in this area of research have been especially illuminating. Conrad's (1964) work demonstrated that in immediate memory, coding in the visual memory task occurs in terms of the item's sounds. When substitution errors were examined a high proportion were found to have been letters of a sound similar to the 'forgotten' correct response. This points to a strong involvement of the hearing-speech system in immediate memory.

Not all codes are equal in their usefulness; the type of code employed can be related to the efficiency of performance (Craik & Lockhart, 1972). It appears that codes involving semantic properties of words are better than codes involving the structural properties of words (Hyde & Jenkins, 1969). When subjects are not given instructions to learn they will usually try to establish a coding strategy based on meaning, and their performance will be almost equally as good as subjects instructed to learn using a particular code. Other forms of coding include a selective coding which is especially appropriate when the material presented contains more information than is necessary, and elaborative coding, when the coding process entails the addition or elaboration of the original stimulus (Bower, 1972a; Lindley, 1963).
Task analysis refers to the process of separating complex skills into simpler constituent skills on the premise that sub-skills may be more related to theory than global skills. An underlying assumption in task analysis is that experimental variables can have different, even opposite effects on components of the overall task. An example of task analysis is McGuire's (1961) examination of paired-associate learning and subsequent isolation of three levels of difficulty within the task.

THEORETICAL MODELS OF MEMORY

A perennial question raised throughout the research investigating memory is whether there are distinct memory systems which correspond to short- and long-term tasks. Until the late 1950s the process was generally considered one of dualism, with different rules controlling short-term memory and long-term memory. Brown (1958) and Broadbent (1958) both introduced a theory that information will decay over time unless maintained by an active rehearsal process which will delay decay, thereby allowing the buildup of a permanent storage. Hebb (1961) proposed a transient reverberatory process to maintain short-term retention, and suggested that long-term memory depended on structural changes in the brain. After experimental investigation, Hebb concluded though that even for transient memory tasks, such as immediate recall, a long-term trace is laid down. Melton (1963a) examined experimental reports and data from various sources and described a unitary process in which the same
experimental variables operate similarly on both short- and long-
term memory. He favoured viewing short- and long-term memory
tasks as different points on a task continuum.

Waugh and Norman (1965) proposed a dualistic model with an
interactive system combining primary memory and secondary
memory (see Figure 3). They suggested that primary memory is
a stable form of storage affected only by the number of inter-
vening variables, and can be measured in short-term memory tasks.
In order to directly measure primary memory they devised a number
of experimental tasks in which rehearsal was discouraged and
transfer to secondary memory thereby blocked. They suggested
there were varying contributions of secondary memory to short-
term memory tasks. For example, using free recall in serial
learning, there is a recency effect attributed to primary
memory, and also a flat region of the serial-position function in
the centre of the list, where little if any of the items are
remembered, called the "asymptote" which is assumed to reflect
a constant contribution of secondary memory to performance at all
serial positions.

Evidence indicating that some independent variables affect
only primary memory tasks, and that some variables affect
primary and secondary memory in different directions, would lend
further support to a model of dualism. Two studies have presented
findings which indicate primary memory is phonologically coded and
FIGURE 3

A DUALISTIC MODEL OF MEMORY

After Waugh and Norman, 1965.
secondary memory is semantically coded (Baddeley & Dale, 1966; Baddeley, 1966). Baddeley and Dale (1966) used a short 2 - 3 item paired associate list presented once and then tested a few seconds later by presenting the stimulus term alone. Their results indicated that similarity on a semantic dimension had a large effect on secondary memory, and little or none on primary memory. In a comparative study of ten item lists with either phonological or semantic similarity, semantic similarity affected performance on the secondary memory task, and phonological similarity had a strong harmful effect on the primary memory task (Baddeley, 1966).

Atkinson and Shiffrin (1968) more explicitly examined the process of transfer in their general model of memory constructed along two dimensions. The first dimension is made up of structural features including the physical system and built in processes that are unvarying and fixed, and of control processes which are selected, constructed and used at the option of the individual. Even if superficially the task may appear similar they may vary from one task to another. Use of a particular control process will depend on the nature of the instructions, the meaningfulness of the materials, and the individual's history. The second dimension divides memory into three structural components: a sensory register, a short-term store, and a long-term store (see Figure 4). Rehearsal, occurring voluntarily in the short-term store, serves to maintain information for immediate use, and also
FIGURE 4

STRUCTURE OF THE MEMORY SYSTEM ACCORDING TO ATKINSON & SHIFFRIN

EXTERNAL INPUT

SENSORY REGISTER

Visual  Auditory

Lost from sensory register

SENSORY REGISTER has properties of iconic and echoic stores.

SHORT-TERM STORE

Auditory  Verbal  Linguistic (A.V.L.)

Lost from short-term store

Voluntary process is rehearsal

LONG-TERM STORE

A.V.L.  Visual etc.  Temporal

Main control process is retrieval via a search procedure

[Decay, Interference and loss of strength in long-term store.]

(after Atkinson & Shiffrin, 1965)
to maintain information in a state of access pending coding operations for transfer to the long-term store. There is voluntary control over the form of transfer. Recoding results in a more permanent representation in the long-term store than rote repetition. Beyond their general model of memory Atkinson and Shiffrin also proposed a specialized buffer model for certain short-term memory tasks (see Figure 5.). The rehearsal buffer contains a fixed number of slots of information. Each slot holds one complete item at a time, about the size of a verbal unit. During the time the item is in the buffer its strength as an item in long-term storage increases.

It appears unlikely that the process of rehearsal is the sole means of transfer from primary to secondary memory (Smith et al., 1971; Craik & Watkins, 1973). Maintenance rehearsal serves to keep information available whilst not increasing its accessibility to free recall from secondary memory (Craik & Watkins, 1973; Woodward, Bjork & Jongeward, 1973). Although the amount of rehearsal does not affect final recall probability it does affect performance when measured by recognition (Woodward, Bjork & Jongeward, 1973).

Craik and Lockhart (1972) perceive memory as a by-product of a perceptual information process occurring at different levels of complexity, eg. sensory, phonological, semantic; encoding at these levels with reference to semantic content can be either shallow or deep (see Figure 6). They contend that rehearsal
THE REHEARSAL BUFFER AND ITS RELATION TO THE MEMORY SYSTEM

Lost from sensory register

Lost from short-term store

Long-term store
(Decay, Interference, loss of strength, etc.)

(after Atkinson & Shiffrin, 1968)
The Craik & Lockhart Proposal of Memory as a Product of Perceptual Information Processing

Perceptual information processing

Different Levels of Complexity

- Phonological
- Sensory
- Semantic

Deep Encoding

Elaborative Processing → More persistent memory trace

Maintenance Rehearsal

Primary Memory

Secondary Memory
can occur at any level; it being easiest at the phonological level where it serves to maintain an item's accessibility in primary memory without leading to a more permanent memory trace. At a deeper level called elaborative processing, the processing is more persistent and results in a memory trace in the secondary memory storage. Maintenance rehearsal serves to prevent decay and keep the item available while a more elaborative code is being sought. Furthermore it can facilitate long-term recognition without facilitating long-term recall (Woodward et al., 1973). It is important to note that Craik and Lockhart have proposed that the two levels of processing are not exclusive, but are in fact reciprocal, for information can be recirculated within one level of processing, whilst also advancing toward deeper levels.
Basically there are three ways whereby a list of verbal items can be presented to a subject for learning: free recall, serial recall and paired associates. Free recall consists of items being presented consecutively with the subject being required to recall them without regard to their order of presentation. Serial recall requires the subject to recall the items from the list in their correct order of presentation. With paired associates double items are presented in such a way that the subject, given the stimulus item will provide the response item of the pair. Multiple trial presentations are conventionally called free-recall learning, serial learning, and paired-associate learning.

Paired-associate learning has been analysed into three task components, and McGuire (1961) has shown that these separable aspects of difficulty have significant and largely independent effects on overall performance. Firstly, the stimulus term has to be recognised for its membership in the list. Secondly, the response term must be learned or integrated to make it a single unit that can enter an association, and thirdly, during the associate or hook-up phase, the integrated
response must be attached to the proper stimulus.

**AGEING STUDIES**

Unlike serial learning, paired-associate learning has been widely used in studies examining the performance of elderly subjects. Using the Associate Learning Task of the Wechsler Memory Scale, which consists of ten word pairs, six of which are easy pairs and four are hard pairs, Hulicka (1966) showed that scores tend to fall steadily from the age of 40. As the summed scores drop the difference between older (60 years and above) and younger (30-39 years) groups becomes significant ($p < .01$) as shown in Table 7. In comparative studies with other learning tasks, paired-associate learning shows greater impairment in the elderly than digit span (Gilbert, 1941), nonsense syllables (Taub, 1967), and serial learning (Eisdorfer, Axelrod & Wilkie, 1963). More recent studies have concentrated on how task variables contribute to overall impairment.

**Pacing**

Studies which have investigated the effect of pacing have presented conflicting conclusions; some indicating that performance improves as the rate of pacing decreases (Hulicka & Wheeler, 1976; Monge & Hultsch, 1971; Taub, 1967; Witte, 1975), and others indicating that there is no pacing effect on learning (Kinsbourne & Barryhill, 1972; Leech & Witte, 1971). Taub (1967) examined two presentation rates in a group of young men with a mean age
<table>
<thead>
<tr>
<th>AGE</th>
<th>SUMMED SCORES</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-39</td>
<td>15.48</td>
<td>3.48</td>
</tr>
<tr>
<td>60-69</td>
<td>11.49</td>
<td>4.53</td>
</tr>
<tr>
<td>70-79</td>
<td>10.98</td>
<td>4.78</td>
</tr>
<tr>
<td>80-89</td>
<td>9.98</td>
<td>3.28</td>
</tr>
</tbody>
</table>

(Hulicka, 1966)
of 26.1 years, and an older group of men with a mean age of 69.7 years. As the rate of pacing decreased the performance of the older men approached that of the younger group.

Hulicka and Wheeler (1976) administered a single learning trial on paired associate lists under four temporal conditions to two groups, one consisting of 24 persons from a senior citizens' centre (mean age 69 years), and the other consisting of 24 college freshmen and high schoolers (mean age 19 years). In the older group a significant improvement was noted from a paced-study-interval condition to a self-paced-study-and registration-intervals condition. Monge and Hultsch's study (1971) revealed a generally better performance by younger men aged 20 to 39 years, and by those working at longer intervals, than by older men aged 40 to 66 years, and by those working at shorter intervals. Their study also confirmed earlier work showing a significant age X anticipation interval interaction.

Two studies have shown pacing variables as not being significant (Kinsbourne & Berryhill, 1972; Leech & Witte, 1971). Kinsbourne and Berryhill (1972) examined the effect of pacing by holding constant the anticipation interval and the total time available for learning while varying the amount of learning time on a given trial. Their results showed no pacing effect on learning within the 2.4 and 2.6 presentation rates used. It is possible that had a wider range of presentation rates
been examined the pacing effect may have emerged.

A detailed review of studies comparing paired-associate learning in young and elderly adults as related to age and presentation rate was made by Witte (1975). After a careful examination of many studies he concluded that the acquisition of young adults is superior to that of the elderly, and that the faster the rate of presentation the greater the age difference in acquisition. Witte added two important qualifiers regarding the Rate X Age interaction, which were based on the then currently existing data: a) that only the time allotted for the response (the anticipation interval) differentially affected performance, and b) the interaction is reflected in overall response measures such as total errors, trials to criterion, correct responses, and also in omission errors, but not in commission errors. By including self-paced anticipation intervals in studies with the elderly it is evident that neither the hypothesis of Canestrari (1963), which suggests the performance deficit is due to insufficient time for responding nor Arenberg's (1965) hypothesis that the elderly require a longer time to search among the possible alternative responses in order to respond, are sufficient to explain the deficit in the performance of the elderly.

The speed of learning and the rate of forgetting were compared in a study by Dixon (1970) involving 45 members
(aged 60 to 80 years) of nursing and retirement homes. He found that the slower elderly learners showed poorer retention over a 15-minute interval, as measured by recall and relearning.

**Interference Associations**

Boyarsky and Eisdorfer (1972) investigated the pattern of forgetting due to interfering associations in one hundred 60 to 83 year old bright persons. Under list recall test conditions they found that the pattern of forgetting was directly related to the theoretical number of sources of interfering associations. The pattern of forgetting was complicated under modified free recall test conditions by the greater apparent contribution of contextual associations to forgetting. The authors suggested that their subjects were sensitive to the learning of contextual associations and therefore subject to increased forgetting from this source. Lair, Moon and Kausler (1969) investigated the role of associative interference in paired-associate learning of middle-aged and old patients. They found an Age X Interference interaction in the performance of the elderly who made significantly more errors than the middle-aged.

**Cautiousness, Anxiety and Rigidity**

Cautiousness, anxiety and rigidity may all adversely affect the performance of elderly people in paired-associate learning. Taub (1967) undertook an investigation to determine whether instructions affected performance of elderly subjects (61-83 years). The results indicated instructions had no affect, and
because the rate of omission errors remained high, Taub suggested that it probably reflected a marked tendency of the elderly subjects not to respond unless there were a high probability of their being correct.

Leech and Witte (1971) conducted an experiment to test the hypothesis that the high number of omission errors appearing in research on verbal learning in the elderly may be due to over-anxiousness. They employed a token system so that all subjects received three tokens for correct responses and none for omissions. Half of the subjects also received one token for commission errors. Reinforcing the subjects for commission errors significantly reduced the omission errors, and number of trials required to reach the criterion (p<.05). However, the two incentive groups did not differ significantly in commission or total errors. Witte (1975) has suggested that the results indicate that some of the omission errors which normally occur for the elderly may reflect a performance factor (e.g., a reluctance to respond unless highly confident) rather than a learning disability. Monge (1968) found no initial difference in anxiety between young and elderly subjects, but an old fast-paced group showed decreased paired-associate learning and a reliable increase in anxiety.

The age-related rigidity hypothesis states that a) negative transfer is increased in old age, and b) it is
increased to the degree that there is a similarity between the first and second tasks. Traxler (1972) tested the hypothesis and his experimental results were generally supportive.

**Meaningfulness of Items**

The question has been raised as to whether the meaningfulness of stimulus items can affect the age-related performance deficits. Wittels (1972) was unable to confirm a hypothesis that these deficits are minimized or nonexistent when the stimuli are equally meaningful for all age groups. Of related interest is a study by Drietomszky (1975) who used word pairs in order to elaborate on the changes in mechanical and logical memory with age. The word pairs were either aninomous (conflicting), class-conceptual, synonymous, mixed (e.g. part to whole), or heteronymous (without logical relation). Drietomszky found that the 420 subjects aged 55 to 90 years retained twenty per cent fewer word pairs than the middle-aged subjects. Performance was closely related to educational level. Retaining heteronymous word associations showed the greatest impairment and antinomous associations the least. In his conclusion Drietomszky dismissed the notion that the relation between word meaning was a simple associative character, and supported Vygotsky's suggestion that the principle of association should give place to one of structure.

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1. Vygotsky, a brilliant Russian psychologist, who died at the early age of 38, in 1934, emphasised man's capacity to create higher order structures to replace earlier thought structures. See Thought And Language, Vygotsky, L.S. M.I.T. Press, 1970.
Both item concreteness and the reported strategies used in learning as a function of age were investigated by Rowe and Schnore (1971). Their subjects were three groups of women, young (mean age 18.4 years), middle-aged (mean age 50.4 years), and elderly (mean age 72.8 years), all of whom learned a paired-associate list consisting of six concrete and six abstract word pairs under self-paced conditions. For all three groups the concrete pairs were easier to recall than the abstract pairs. Higher recall scores were recorded for the younger women than for the middle-aged women, who performed better than the elderly women. After completing the task the women were asked about their use during learning of three types of learning strategies: repetition, verbal mediation, and imagery. The young and middle-aged groups reported a greater overall use of the three strategies than the old. Age interacted with pair type, with strategies being reported more frequently for concrete pairs by the elderly women, while the younger women reported using them more frequently for abstract pairs. All groups reported using verbal mediators more often for abstract pairs, while imagery was reported more frequently for concrete pairs.

Nebes and Andrew-Kulis (1976) tested the hypothesis that older persons tend not to use verbal mediators in paired-associate learning because it takes them too long to form
an appropriate mediator. Their results were inconclusive.

From the previously mentioned studies it is apparent that there is an age related performance deficit in paired-associate learning in both men and women, which reflects both the effects of performance factors and those of a learning disability. It remains undetermined whether the age related learning deficit is due to disuse and therefore reversible, or due to physiological changes and therefore irreversible. Also, it is unclear at which stage in the learning process that the deficit occurs, though it seems likely that the process of retrieval is involved for when it was possible for subjects to make responses via a multiple-choice method of paired-associate learning presentation, the performance of elderly subjects, as well as that of younger subjects, was superior to that of comparable subjects tested with the anticipation method (Freund & Witte, 1975).

CLINICAL STUDIES

Paired-associate learning has been used in a variety of clinical groups and for various purposes. These include the investigation and assessment of brain damage (Benton, 1968; Newcombe, 1969; Robertson, 1957), the examination of the amnesic and the therapeutic effects of bilateral and unilateral ECT in depressives (Costello, Belton, Abra & Dunn, 1970). It has been used in investigating the learning impairment in depressives (Irving et al, 1970; Whitehead, 1973), the
learning and memory impairments in young and old alcholics (Ryan & Butters, 1980), and the effects of ageing, brain damage and associative strength on learning (Zareysky & Halberstam, 1968). Isaacs (1962) used paired-associate tasks for purposes of prognosis and rehabilitation of hospitalized old people, and with Walkey (Isaacs & Walkey, 1964), to characterize groups of elderly hospital patients. Inglis developed it as a tool in the analysis of the memory defect in elderly patients presenting with memory disorder (1957, 1959a, 1960), and it was later used for differentiating between functional and organic geriatric patients (Kendrick & Post, 1967; Kendrick, Parboosingh & Post, 1965).

The studies investigating brain damage have been largely concerned with differentiating right and left hemisphere damage. Benton (1968), using eight easily associated word pairs over six trials, found that correct association scores for right frontal lobe damaged patients averaged 40.6 (SD 10.1), and for left frontal lobe damaged patients 35.5 (SD 10.1), and for bilaterally damaged patients 18.7 (SD 14.1). He later discontinued using the test as it failed to discriminate between right and left hemisphere diseases (Lezak, 1977). Newcombe (1969) examined 40 normal control subjects along with a brain damaged group. With the exception of the frontal lobe group, left hemisphere patients performed more poorly than right hemisphere patients. There was a significant overall difference between
the two hemispheres \((p < .05)\). Lansdell (1973) developed a word association test to measure remote verbal memory for use with two groups of male patients who had left hemisphere neuro-surgery. The patients performed significantly worse following surgery. Neither males with right hemisphere lesions nor females regardless of hemisphere showed a performance decrement with this test. Milner (1971) reported that patients with left temporal lobectomies are impaired in verbal paired-associate learning. A study with depressives (Costello et al., 1970) revealed that the dominant hemisphere is more closely associated with recall and relearning, while recognition is associated with both hemispheres.

The effects of ageing, brain damage, and associative strength on paired-associate learning was studied by Zaretsky and Halberstam (1968). Their subjects were 102 brain damaged and non-brain damaged, elderly and young hospital patients who learned lists of high, medium, and low association word pairs. Although no significant differences were obtained pertinent to the brain damaged or non-brain damaged status of the subjects, the results indicated an age related deficit and a differential effect of associative strength on the learning, which points to the usefulness of the paired-associate method in assessment for diagnostic and/or prognostic purposes.

Ryan and Butters (1980) compared the performance of younger
(34-49 years) with older (50-59 years) alcoholics and non-alcoholic control subjects, and a group of elderly (60-65 years) non-alcoholic subjects, on a number of cognitive tests. Included in the battery of tests was a paired-associate learning test which consisted of ten pairs of unrelated nouns (e.g., silk-pine; beauty-horn). Four study-test trials were administered at the beginning of the testing session, followed three hours later by four additional trials. Performance on the study-test trials indicated that the alcoholics performed more poorly than the non-alcoholics, and the older subjects more poorly than the younger subjects. Over successive trials the performance of all the subjects improved. With both the early and late trials no difference in performance was demonstrated between the younger alcoholics and the older controls, nor between the older alcoholics and the elderly controls. Ryan and Butters discussed their findings in relation to the premature-ageing hypothesis, according to which, the progressive decline in performance associated with normal ageing should also appear in alcoholic subjects, but several years earlier.

The development and application of Inglis' Paired-Associate Learning Test (PALT) has been extensively described by Inglis (1957, 1959a, 1959b), and others (e.g., Miller, 1977). It consists of three groups of three pairs of words, the groups being described as easy, medium, and hard. The procedure for administering the test may be found in Appendix A. The test was
designed to measure, and has been shown to be sensitive to, memory impairment. Largely independent of intellectual functioning, it has been used in a number of studies investigating elderly psychiatric patients presenting with a memory disorder (Caird, Sanderson & Inglis, 1962; Isaacs & Walkey, 1964; Whitehead, 1971). Patients with organic disorders perform more poorly on the test than functional patients (Irving, Robinson & McAdam, 1970; Kendrick, Parboosingh & Post, 1965; Newcombe & Steinberg, 1964; Riddell, 1962b). A study by Kendrick and Post (1967) showed a highly significant difference between the performance of dementing patients, non-impaired depressives, and normals matched for age and Mill Hill Synonyms I.Q.

The hard version of the PALT was included in a cross-national study investigating differences in diagnostic frequencies among patients over the age of 65 years in the United States and the United Kingdom (Cowan et al., 1974). The clinical group was made up of 50 patients in the U.S.A., and 75 in the U.K., and included organic, affective, schizophrenic and others. In the U.K. there were 20 dementics out of 29 organics, and 29 affectives all of whom were depressives, while in the U.S.A. there were 15 dementics out of 23 organics, and 16 affectives all of whom were depressives. Between these diagnostic groups the PALT discriminated at a high level of confidence both in the U.K. and in the U.S.A. However, the demented groups were significantly older than the affectives, and performed significantly worse on
the vocabulary measure, indicating they were either duller or more severely deteriorated as a group.

Alexander (1973) conducted a validation study of some psychological tests purported to measure intelligence and learning in elderly psychiatric patients. Among them was included Inglis' PALT. In a comparison of 14 dementing patients, 40 elderly normal controls and 20 non-brain damaged psychiatric controls, the PALT did not differentiate among the groups.

A variation of the more common paired-associate tests is the Synonym Learning Test (SLT), an adaptation by Kendrick, Parboosingh and Post (1965) of the Walton Black Modified Word Learning Test (Walton & Black, 1957). The SLT together with the Digit Copying Test (DCT) forms the Kendrick Battery (Kendrick, 1964a), designated as such by Brown (1970), and usually administered pre- and post-treatment. Both the SLT and the DCT were designed to measure cognitive areas of functioning known to deteriorate with age, psychomotor slowing and increased memory disorder, in order to screen for diffuse brain pathology characteristic of senile dementia, and to measure for change in function (Post, 1965). Neither were intended to be used singly as diagnostic instruments (Kendrick, 1972).

The SLT was developed because some deficiencies had emerged when the Walton Black Test was used with geriatric patients. In
redesigning the test Kendrick et al., (1965) recognised three hypotheses to explain the deficiencies. These were 1) there was a high probability that regardless of diagnosis, patients of previous low intelligence would function as brain damaged patients. This view was supported by previous experience and by reported misclassification by Walton (Walton et al., 1957, 1959). 2) Dysphasic problems are common in old people, and 3) a recognition vocabulary scale, rather than verbal definition, would more appropriately contend with the misclassification due to varying administration of the tests by examiners.

Results of the first validation study with 97 psychiatric patients, 29 brain damaged and 64 depressives, and eleven normal elderly subjects, showed that no brain damaged subjects scored above 56, so a cut-off score of 57 was adopted. Using this cut-off score the SLT correctly classified the normal and psychiatric patients 89.81 per cent of the time. The misclassification occurred with the depressed patients, of whom 63.53 per cent had WAIS Verbal Scale I.Q.s of 95 and below, thus supporting the hypothesis that misclassification is more frequently associated with low intelligence. Post (1966) has described this group as depressive "pseudo-dementia" subjects, who are characterized by low initial intelligence, delusional systems, complaints of perplexity, and poor knowledge of recent general events.
The PALT was also included in the battery of tests administered, and there was a significant correlation between that and the SLT. A centroid analysis was calculated for all the measures obtained, and both the SLT and the PALT were associated with a factor of short-term memory. There was also a high correlation with psychiatric diagnosis. Both the SLT and the PALT showed an absence of practice effects when the tests were administered three times over a three-month period at six weekly intervals (Kendrick & Post, 1967).

**SUMMARY**

Experimental evidence strongly supports both an age related performance deficit, and an Age X Anticipation interval interaction in paired-associate learning. Cautiousness affects the probability of responding by the elderly subject, and experimental conditions (e.g. fast pacing) may increase the level of anxiety in the elderly person, thereby lowering performance level. Meaningfulness of items employed in tasks also affects performance. The clinical use of paired-associate learning tasks is extensive, and they have been shown to reliably discriminate between diagnostic groups. Misclassification occurs more frequently among persons of lower intelligence.
The concept of seriality in thought was first examined by Aristotle, who identified three laws of association, that is, three laws of learning --- similarity, contrast, and contiguity. It was not until the eighteenth and nineteenth centuries that the groundwork was laid for the experimental investigation of learning in the work of the British empiricists, James Mill and his son, John Stuart Mill. Ebbinghaus was the first to undertake the systematic investigation of memory and learning, and experimented with learning lists and checking for associations between items. Since Ebbinghaus' work, which was published in 1885 (1964), the subject of serial learning has been extensively investigated. The literature is exhaustive. In comparison, as a tool in psychiatric diagnosis, or as it relates to the subject of the ageing individual, serial learning has been largely neglected, and the literature, therefore, sparse.

This chapter is concerned with the process of learning and performance factors involved in serial learning. It will include an overview of current theory, and a summary of the research which relates to psychiatric diagnosis and ageing.
METHODOLOGY

The conventional method of examining serial learning is by serial anticipation, which consists of items singly in series of repeated trials. On succeeding trials the subjects are required to correctly reproduce an item before it appears in its proper position within the temporal series. The distribution of resulting errors is generally known as the serial-position curve.

Jensen (1962) described four methods of plotting the curve which are reported in the literature. These were a) Mean number of errors at each position. b) Percentage of errors at each position. c) Mean percentage of errors at each position. d) Mean logarithm of errors at each position. Jensen criticized each of these as confounding at least two or more of the essential components analysed in serial learning data. The components are:

1. The difficulty of the learning task, represented by the number of trials or stimulus presentations required to learn to a particular criterion.

2. The efficiency of learning, represented by the percentage of correct responses (or the percentage of errors) during the course of learning to a particular criterion.

3. The relative difficulty of learning the various positions. This actually is the serial-position curve.

Jensen proposed a method whereby the serial-position would be represented unconfounded by the difficulty of the task or the efficiency of learning. He suggested this 'Index of Relative Difficulty' be used when serial curves are to be
compared by analysis of variance.

The two main features of the curve are the piling of errors near the middle, and the asymmetry of the distribution (Harcum & Coppage, 1965b). Thomas (1968) proposed that the bowing is due to some kind of interference or inhibition. There appears to be greater bowing for less meaningful items (Horton & Turnage, 1970). Other variables influencing the shape of the curve include distribution of practice, inter-item interval, degree of familiarity with the items, and individual differences in learning ability (Jensen, 1962). When the curve is plotted in terms of the mean number of errors occurring at each serial position then the aforementioned variables do affect the serial-position curve. However, McCrary and Hunter (1953) plotted the curve in terms of the percentage of total errors that occurred at each position, and found none of the above variables had any effect on the shape of the curve.

Martin and Noreen (1974) developed a method whereby scoring sequences in serial learning could be identified (see Figure 7). They chose and recommend examining individual performance rather than group norms. From their study of individual serio grams they have found that there is a clear subjective subsequence in serial learning and that the
ILLUSTRATIVE SERIAL FOR A SINGLE SUBJECT

LEARNING A SINGLE 32-ITEM LIST (After Martin & Noreen, 1974)

SL(F) FR

1 BIRD
2 DESK
3 PORT
4 FIRE
5 TASK
6 WARD
7 KNEE
8 SALT
9 CARE
10 MODE
11 HORN
12 ARCH
13 YEAR
14 LOAF
15 ZONE
16 GLUE
17 SHOP
18 CAVE
19 PAGE
20 BATH
21 WOOL
22 DUKE
23 NAIL
24 TIME
25 LUCK
26 VIEW
27 HOOD
28 ROSE
29 GOAL
30 JACK
31 FIST
32 YCON

(SL(F) is forward serial learning; FR is free recall)
subsequences are largely idiosyncratic, easily identifiable, and relate to other phenomena such as anticipation errors during acquisition and clustering in later free recall. Furthermore, certain errors are integrated members of the subsequences they proceed. Martin and Noreen reject the associative-chaining theory on the grounds that it cannot explain the distinctive subsequencing observed in individual seriograms. They also reject the serial-position theory, and instead support an organizational model, the nesting hierarchy theory.

Martin and Noreen are not alone in emphasising the necessity for examining individual performance. Bolles (1959), Montague (1972), Rehula (1960), and Reitman (1970), are among others who have drawn attention to the need to consider individual performance. Rehula (1960) reminding those working in the area of serial learning stated:

Perhaps the line of attack in most studies is misplaced in that emphasis has been on the lists rather than the learner. Lists do not produce the curve; the curve represents the way people learn the lists. The only thing that remains constant over the various experiments is that people are used as the subjects (pp.16).

THEORETICAL APPROACHES

Crowder (1976) has indicated that the current state of theory concerning serial learning centres around the basic problem of what gets learned, and the interpretation of the
serial position. The importance of organization in learning is acknowledged generally. In serial learning, whether this occurs solely by a process of association among items and position, or by inclusion of cognitive codes and controls, has been the subject of sharp debate. The present trend among researchers is toward a more inclusive model which seeks to relate learning to central processes (Gregg, 1972; Melton & Martin, 1972; Harcum, 1975).

The two general theories that endeavour to explain the process of serial learning are based on different views about the effective stimulus for serial learning. The associative-chaining hypothesis and the serial-position hypothesis are both derived from the paired-associate learning task in which each list item is the response term of some pair.

**Associative Chaining**

The associative-chaining hypothesis, also called the sequence or specificity hypothesis, explains the serial phenomena in terms of a link between pairs or groups of items. Thus, when an item or group of items is presented, there will be a tendency of the stimulus to elicit a response of other items. This theory, which was part of the original work of Ebbinghaus (1964) was considered self-evidently true until 1959 when R.K. Young and others reopened the question.
Serial Position

The serial-position theory maintains that during learning a link is established between an item and its position within the series, so the stimulus for an item is its ordinal position in the series. Among the studies which lend support to this theory are those of Melton and Irwin (1940), Schulz (1955), Fuchs and Melton (1974) and most importantly, Ebenholtz (1963, 1972).

Crowder (1976) suggests that the serial-position hypothesis is best considered as a class of propositions with something in common. The first proposition is that serial learning is a form of paired-associate learning, where the stimulus term for each item is the number representing its position in the list. The second is that associations occur between items and some sort of relative positional cue, and depends on the concept of anchor points in serial learning. Ordinarily the first and last items are the most prominent anchor points, but an unusually conspicuous item in the interior of the list can also serve as an additional anchor. A third proposition is based on a transformation between time and space.

Harcum (1975) described a hypothesis called Field Organization, which is similar to the second proposition suggested by Crowder, in that it specifies that certain items are learned first because of their position of dominance within the framework of the stimulus configuration, usually the first and last items in the
series. Harcum maintains that in order for learning to take place there must be organization or structure established for the series.

**Alternative Theories**

According to Crowder (1976) the other theoretical positions fall into two groups, the nonassociative recoding position forming one, and the multilevel-associate position forming the other, the two sharing a major assumption, and differing in functional laws within the structure. The shared assumption is that of a nested hierarchy in relation to memory structure (see Figure 8). The difference is how the organization of the nested hierarchy comes about and how it is used. The nonassociative recoding position relies on information processing machinery (Bower & Springston, 1970; Johnson, 1970, 1972). The multilevel-associate position held by Hebb (1949), Sheffield (1961), and Estes (1972), accepts the associationistic assumption and rejects the terminal meta-postulate that only the ultimate response units can enter into associations.

**The Nonassociative Recoding Position**

Jensen (Jensen & Rohwere, 1965), Bower, and Johnson, are the main proponents of the nonassociative recoding position. Each agrees that according to the nested hierarchy theory during learning the terminal elements become fused into chunks. Johnson's (1970, 1972) model indicates how the grouping process
FIGURE 8

A NESTED HIERARCHICAL MEMORY STRUCTURE

(After Crowder, 1976)
is established and used during recall. He distinguishes a higher-level unit called the code, that stands for chunked elements. The code represents the 'nested' subordinate information, but it is not the sum of the information. Codes themselves therefore can be treated as constituent elements of still higher-level codes. Johnson offers a telephone number as an example of a three-level nesting relation (see Figure 9). The order in which the codes are decoded into their constituents is to start at a node, the highest code in the system first, and then to retrieve all codes immediately subordinate to it. While the most important part is selected and decoded, the other parts are stored in short-term memory.

Harcum's (1975) field associationistic hypothesis can be included in the group of theories supporting the nonassociative recoding position. Harcum's hypothesis combines associative linking and a 'field' effect; field in this instance meaning that the "stimulus may be some emergent property of a total stimulus complex". He argues that serial learning involves the selective use of multiple cues, and that the functional stimulus is a configuration of several stimuli which change as the subject makes progress in acquiring the series. This implies that the best-cued, most discriminable, easiest item within the configuration is learned first, then another item becomes the most discriminable item.
FIGURE 9

EXAMPLE OF A THREE-LEVEL NESTING RELATION

617 566 1757

617
566
1757

Entire phone number is 617 566 1757. The prefix (area code) is 617, the individual number is 566 1757.

[ ] = A terminal element

(As described by Johnson, 1970)
The Multilevel-Associative View

The three theorists connected with this view are Hebb, Sheffield and Estes. Hebb's (1949) contribution is defined at a neural level. Sheffield's (1961), although conceptually of critical value, deals with serial behaviour in general, and does not address verbal serial learning or the serial-position effect. Their contribution is therefore of less direct value to this discussion than the short-term coding model proposed by Estes (1972).

Estes' model consists of a nested hierarchical structure for memory traces with higher-order control elements governing subordinate constituents. It includes Estes' conceptualization of primary (short term) memory, a system of reverberatory loops connecting each element to its superordinate control element, and the preservation of order information through cyclic reactivation of the reverberatory loops. Estes supports the view that it is through rehearsal that information moves from primary memory to secondary (long term) memory. His interpretation of rehearsal is that it produces specific inhibitory connections among each of the elements grouped under a particular control element (see Figure 10).

What is presently lacking is empirical data to support the multilevel-associative view. Martin and Moreen (1974) analysis of subjective subsequencing is an exception, as it does focus on
Solid lines are excitatory and dashed lines are inhibitory. Retrieval starts with the highest node and works down, choosing the least inhibited lower node; following its selection, a node becomes temporary refractory.

(After Estes, 1972)
the organizational structure in learning, and takes into account the nested hierarchical model of memory.

AGEING STUDIES

Studies using serial learning tasks in elderly populations have demonstrated performance differences between older and younger persons, and have attempted to elucidate the factors influencing these differences.

Korchin and Basowitz (1957) claimed that learning in older people is determined by three factors: increased cautiousness, which inhibits correct responding and produces more omission errors; increased length of time required to integrate factors leading to a response; and that older people learn by making discrete S-R combinations, rather than through conceptualizing that response items belong "somewhere in the series" of stimuli.

The first two factors postulated by Korchin and Basowitz were substantiated by data from a study by Eis dorfer, Axelrod and Wilkie (1963) designed to examine the effect of increasing exposure time in a serial rote learning situation. Their subjects were a group of young men aged 20-49 years (mean age 37.3 years) and a group of older men aged 60-80 years (mean age 66.5 years). Three exposure intervals of four, six, and eight seconds per word were tested as the subjects learned to a criterion of two consecutive errorless trials, or until 15
trials had been run. Intelligence level, measured by the vocabulary subtest of the WAIS (Wechsler, 1955) was found unrelated to performance level in both groups at any of the three time variables. The results confirmed the hypothesis that the older group would make more errors than the younger group, and that increasing the stimulus time from four to eight seconds would facilitate learning in the older group to a greater extent than in the younger group. No significant difference was found for the serial position curve for the two groups.

Basing his views on previous studies (Eisdorfer, Axelrod, & Wilkie, 1963; Eisdorfer, 1965), Eisdorfer (1967) concluded that performance difficulty rather than a true learning decrement was partly responsible for the age-related decrement in rote learning. Heightened task anxiety has been suggested as the basis of the response inhibition at faster speeds (Eisdorfer, 1965; Troyer, Eisdorfer, Wilkie & Bogdonoff, 1967). Eisdorfer and Service (1967) examined performance in elderly people of superior intelligence, expecting that the ability and experience of this group would enable them to be less anxious in a learning situation. The results which compared average and high I.Q. persons of both old and young groups, confirmed the hypothesis that the high I.Q. older men would perform similarly to the average I.Q. young men, and the performance decrement usually seen in the normal aged person to response inhibition at rapid pacing would not be observed. An unexpected finding
was that the high I.Q. older men made more errors than their average I.Q. peers, although the difference was not significant. Eisdorfer suggested that this may indicate a propensity for heightened verbal responsivity in persons of high I.Q., so by selecting persons of high I.Q. the persons most likely to give a verbal response were being selected.

Okun, Siegler and George (1975) investigated the extent to which age differences in omission errors and performance could be accounted for by cautiousness. Their results indicated that whereas cautiousness measures accounted for age differences in omission errors, they did not do so for performance.

Sex differences in serial learning performance of the elderly have been examined by Okun, Siegler and George (1977), and by Wilkie and Eisdorfer (1977). When the performance of men and women aged 60-79 years, and of average ability, was compared, the men performed more poorly than the women at a fast pacing speed (four seconds). The performance of the women was similar to that of men and women of high verbal ability. No sex difference was found when a slower presentation speed (ten seconds) was used (Wilkie & Eisdorfer, 1977). Okun, Siegler and George (1977) found no difference in performance when they compared men and women of high verbal ability.
CLINICAL STUDIES

Whitehead (1971, 1973, 1974) used a serial learning task as part of a battery of psychological tests in a comparative study of the performance of elderly depressed and dementing patients, both to determine the extent of a verbal learning impairment in elderly depressives, and in order to estimate the importance of two non-specific task attributes, familiarity of words, and pacing. The serial learning task was an adaptation of that used by Eisdorfer and his co-workers (1963, 1967). Intelligence was measured by the WAIS vocabulary subtest (Wechsler, 1955).

The aim of the comparative study (1973) was to determine if the deficit in verbal learning of depressed patients is different in kind from that of dementing patients. Error type was expected to be different in the two groups; omissions and false negatives occurring more frequently in the depressed group, and random errors and false positives occurring more frequently in the demented group. The results showed a deficit in performance of the ill depressed group, but they tended to be less impaired than the dementing group. The remitted depressives made more transposition errors than the ill depressives, who made more than the dments. The dments also evidenced more false positives, random errors and omissions (see Table 8). Non-specific task attributes were not found important to the degree of impairment in ill depressives.
TABLE 8

MEANS AND STANDARD DEVIATIONS OF SCORES FOR

ILL DEPRESSIVES AND DEMENTS

<table>
<thead>
<tr>
<th></th>
<th>Ill depressives 4 men, 22 women</th>
<th>Dements 3 men, 17 women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>p</td>
<td>Mean</td>
</tr>
<tr>
<td>Age</td>
<td>n.s.</td>
<td>69.9</td>
</tr>
<tr>
<td>WAIS vocabulary</td>
<td>n.s.</td>
<td>10.7</td>
</tr>
<tr>
<td>Serial Learning</td>
<td>.001</td>
<td>14.0</td>
</tr>
</tbody>
</table>

(Adapted from Whitehead, 1973)
Whitehead (1974) compared groups of elderly depressed patients before therapy or following remission of symptoms. Untreated patients made fewer correct responses and transposition errors, and more omission errors than the patients who had remitted. Correct responding was reported to be related to vocabulary knowledge, and negatively to subjective feelings of depression and tension. In contrast to the findings of Eisdorfer, Axelrod and Wilkie (1963) and others (Eisdorfer, 1965; Troyer, Eisdorfer, Wilkie & Bogdonoff, 1967), Whitehead's study reported that pacing had no effect on performance level.

Previous findings (e.g. Sanderson & Inglis, 1961) indicate a learning disorder points toward a poor prognosis in elderly patients. The evidence presented by Whitehead in this regard indicating that there is a reversible depressive deficit in the serial learning performance of elderly people is therefore of importance. Depressed patients, however, did not demonstrate a similar deficit on a paired-association task. In order to explain this discrepancy, Whitehead discussed the results within the context of Atkinson and Shiffrin's model of verbal learning (Atkinson & Shiffrin, 1968; Shiffrin & Atkinson, 1969). She suggested that the rehearsal buffer, through which material must pass if it is to move from the short term store to the long term store, remains intact for both depressed and dementing patients. Short-term memory impairment is responsible for the extreme disability of dementes, while for depressed patients, the
impairment is explained by difficulty experienced in generating necessary retrieval tags, so that items may be retrieved from long-term memory.
CHAPTER VII

PSYCHOMOTOR PERFORMANCE

In earlier chapters studies investigating psychomotor performance in the elderly were summarised. These demonstrated that there is a general slowing in the elderly which is more accentuated in demented persons. Depressed persons also manifest a psychomotor slowing, though subjectively they tend to underestimate their actual performance level. Reaction time increases in length as an individual ages, and this is more evident in a visual modality than in an auditory modality.

Of the various tests used to measure psychomotor performance only the three included in the experimental portion of this thesis will be considered here; they are two copying tests, the Digit Symbol Test (DST), and the Digit Copying Test (DCT), and one free drawing test, the timed drawing of squares. When examining psychomotor function it is useful to consider laterality, and in all these tests it is primarily the right hemisphere which is involved.

THE DIGIT SYMBOL TEST

The DST is a timed performance subtest of the WAIS, and is a symbol substitution task consisting of four rows each containing 25 small blank squares, each paired with a randomly assigned
number from one to nine. Above the rows is a printed key that pairs each number with a different nonsense symbol. The subject is allowed a practice trial on the first ten squares, and is then required to fill in the blank spaces with the symbol that is paired to the number above the blank space as quickly as she is able. After 90 seconds the subject is stopped and the score is the number of squares filled in correctly. The DST shows the most change on the standardised age-related scores of all the WAIS subtests (Birren & Morrison, 1961; Botwinick, 1967), and is the most sensitive to brain damage.

Even when brain damage is minimal the score is likely to be depressed, and when other WAIS subtests show low scores, the DST will be lower (Hirschenfang, 1960b). Murstein and Leipold (1961) reported that the DST is relatively unaffected by intellect, memory or learning. Lezak (1976) has implied that some weak perceptual co-ordination and memory components are evident in the performance of older persons. Salthouse (1978) examined the role of memory in the age decline of DST performance. He concluded that not only do memory factors play only a very small role in contributing to the performance decline, but there is presently no adequate explanation of what the DST measures, or which of the component abilities are responsible for the age related decline. Performance is affected by the ability to sustain attention and the speed of response (Russell, 1972b), motor persistence and visual-motor co-ordination (Lezak, 1976). A practice effect on
DST performance has been reported in studies comparing old and young people using modified digit symbol tests in ten practice sessions (Erber, 1973; Grant, Storandt & Botwinick, 1978). Erber (1973) found the older subjects' improvement comparable to the younger group, leaving the two age groups apart in their performance. As the DST tends to be affected regardless of the locus of a lesion it is of little use for predicting the laterality of a brain lesion (Lezak, 1976).

Folstein and Luria (1973) administered the DST with a number of other scales (Zung self-rating depression scale, Clyde mood Scale, Taylor Manifest Anxiety Scale) including a visual analogue mood scale (VAMS). The DST and the VAMS identified a mood-performance correlation which distinguished patients with affective disorders of a manic or depressed type, from other psychiatric patients.

THE DIGIT-COPYING TEST

The DCT consists of 100 digits randomly distributed in a 10 x 10 matrix, with each of the ten digits, numbered zero to nine, occurring randomly ten times. The time limit for the test is 120 seconds, and the score is the average time taken by the subject to copy a single digit, regardless of whether the digit is correct or incorrect. The test was devised by Clement (1963) and used by Kendrick (1965) to test for diffuse brain damage in elderly people, and by HemsJ, Whitehead and Post (1968) to measure
cognitive functioning and cerebral arousal in elderly depressives and dementes. Thereafter it was included as part of the Kendrick Battery.

Kendrick maintains that the DCT reflects the level of arousal in the reticular activating system, and scores will be poor in demented persons, but not so in depressed persons. Together with the Synonym Learning Test and in conjunction with the Mill Hill and WAIS Verbal Scale I.Q. discrepancies, when used in a test-retest sequence, the DCT successfully identified demented, pseudo-demented and non-demented patients (Kendrick, 1972). Whitehead (1971) found that the DCT differentiated between organic and ill depressives at a highly significant level, and also that no practice effect was apparent.

TIMED FREE DRAWING

Warrington, James and Kinsbourne (1966) investigated drawing disability in relation to laterality of cerebral lesion, using line drawings of a four-pointed star, a square, and a number of single lines, angles, and corners, together with two copying tests. Although there were clear differences between the drawings of right and left hemisphere damaged subjects, Warrington et al. were unable to sort the drawings systematically on the basis of the locus of the lesion. Persistent differences were noted though, and these included a greater likelihood of left-sided visual attention, and among right hemisphere lesions, an increased
tendency toward detailing, both consequential and inconsequential. Albert (1979) has shown that even normal elderly people exhibit difficulty in drawing, and will make mistakes on the drawing of a clock face.

Whitehead (1971) used the timed free drawing of three squares as a back-up test for those patients exhibiting profound difficulty on the DCT. She found that even this test was too difficult for some organic subjects.
CHAPTER VIII

FLUENCY AND MOOD

FLUENCY

Reduced fluency of either speech, writing or reading commonly accompanies most aphasic disabilities, though of itself it is not indicative of aphasia. Impaired fluency is associated with frontal lobe damage.

Tests of verbal fluency consist of naming words according to a pre-designated letter or class (e.g. animals) within brief time periods. There are a number of tests available (Benton, 1973a; Borkowski, Benton & Spreen, 1967; Isaacs & Kennie, 1973; Talland, 1965). The associative value of each letter was determined in the normative study of Borkowski, Benton and Spreen (1967) (see Table 9). Borkowski et al. also found that control subjects of low ability tended to perform a little less well than brighter brain damaged patients, pointing to the necessity for evaluating premorbid verbal skills when evaluating verbal fluency.

Cauthen (1978) administered a verbal fluency test and the WAIS to two groups: the first consisting of 51 normal volunteers aged 20-59 years, and the second consisting of 64 mostly institutionalized persons aged 60-94 years. There were no
TABLE 9

VERBAL ASSOCIATIVE FREQUENCIES FOR THE 
FOURTEEN EASIEST LETTERS

<table>
<thead>
<tr>
<th>LETTERS</th>
<th>9 - 10</th>
<th>11 - 12</th>
<th>&gt;12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A C D G</td>
<td>B F L M</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>H W</td>
<td>R S T</td>
<td></td>
</tr>
</tbody>
</table>

(From Borkowski et al., 1967)
significant differences in verbal fluency found in the younger group when compared across three I.Q. and four age ranges. In the older group there were no significant differences found across the four decade age ranges, but there were significant differences across the three I.Q. ranges. There was no I.Q. X task difficulty interaction.

Of particular interest is the study of Isaacs and Kennie (1973) using The Set Test to investigate dementia. The Set Test consists of four categories of items, colours, animals, fruits, and towns. The subject is required to name items in the first category until ten have been named or no more can be remembered, then the second category is introduced. Forty items is the highest possible score. Isaacs and Kennie administered the test to 189 persons aged 65 years and older. Healthy old people achieved an average score of 31.2 names, while 95 per cent scored 15 or over. Scores of 15 and below were considered abnormal for this group. As may be seen in Table 10 all of the twenty-two persons in the group who scored 15 and below had other symptoms of brain disease.

Whitehead (1971) included a simple verbal fluency task (the naming of animals) in a battery of tests in order to compare the depressive impairment with that found in dementing patients. Her subjects were 26 depressives and 20 dementing patients. She
### TABLE 10

**THE SET TEST**

**RESULTS OF STUDY BY ISAACS & KENNIE, (1973)**

<table>
<thead>
<tr>
<th>N</th>
<th>Total Possible Score</th>
<th>AGE = 65 and older</th>
<th>Mean (Healthy Ss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>189</td>
<td>40</td>
<td></td>
<td>31.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>N</th>
<th>SCORE</th>
<th>Score Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>146</td>
<td>&gt; 25</td>
<td>(1 confused, 11 anxious or depressed)</td>
</tr>
<tr>
<td>23</td>
<td>15-24</td>
<td>(12 healthy, 3 depressed, 6 demented)</td>
</tr>
<tr>
<td>22</td>
<td>15&lt;</td>
<td>(All had other symptoms of brain disease)</td>
</tr>
</tbody>
</table>
found that it significantly discriminated between ill depressives and organics ($p < .01$), and loaded in the expected direction on the 'verbal learning' component.

**MOOD**

Most people experience mood swings of varying intensity, an occurrence supported experimentally by studies of mood oscillation in normal subjects by Wessman and Ricks (1966). If we view the variability of mood change along a continuum with happiness or euphoria at one end, and sadness or dejection at the other, then the mood of unhappiness most commonly reported by depressives is at the further end of the latter part of the continuum.

One of the first mood scales to be developed was The Mood Adjective Check List (Nowlis & Nowlis, 1956) for use with college students, and from which a number of scales for different populations have since been derived. The Psychiatric Outpatient Mood Scale (POMS) is one of these. It was originally designed to assess change over brief time intervals in a study of the effects of chlorpromazine and meprobamate on outpatient psychotherapy patients (Lorr, McNair, Weinstein, Michaux & Raskin, 1961). The scale consists of adjectives describing mood states which are rated according to a 4-point intensity scale: "not at all", "a little", "quite a bit", and "extremely". The adjectives in the Nowlis Scale, which were assembled for college
students, were thought to be often too difficult for the average individual, so Lorr et al. used the Thorndike-Lorge (1944) word lists to limit their scale to items the average individual would easily understand.

Following a number of revisions a factorial analysis of the scale was undertaken and seven factors extracted. The seven factors together with the most highly correlated items identified with each factor may be seen in Table 11. The population in each of the revision studies was made up of male outpatients of Veteran Administration Mental Hygiene Clinics. Unfortunately in the report by McNair and Lorr et al. there is no indication of the age range of the patients. The mean age of each group and other sample characteristics are shown in Table 12. A comparison of correlations among the seven mood factors and the factor scores for the final study, and a small sample of normals (n = 45), showed lower correlations among scores for the normals. The differences were substantial for some and slight for others. The patients did not discriminate Tension and Fatigue as clearly from other moods. The relations among moods may be different in a nonpatient population, but as the sample was very small it would be premature to conclude this as a fact.

Five of the factor scores were replicated and detected short-term changes over 8-week and 4-week treatment periods in two of the studies. In the third study, after only one week, a
**TABLE 11**

MOOD FACTORS AND SCALE ITEMS OF THE PSYCHIATRIC OUTPATIENT MOOD SCALE

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>SCALE ITEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: ANGER-HOSTILITY</td>
<td>Angry, Furious, Ready to fight</td>
</tr>
<tr>
<td>T: TENSION-ANXIETY</td>
<td>Tense, Nervous, On edge</td>
</tr>
<tr>
<td>D: DEPRESSION-DEJECTION</td>
<td>Worthless, Helpless, Unhappy</td>
</tr>
<tr>
<td>V: VIGOR-ACTIVITY</td>
<td>Lively, Vigorous, Full of pep</td>
</tr>
<tr>
<td>F: FATIGUE-INERTIA</td>
<td>Tired, Fatigued, Worn-out</td>
</tr>
<tr>
<td>Fr: FRIENDLINESS</td>
<td>Friendly, Co-operative, Good-natured</td>
</tr>
<tr>
<td>C: CONFUSION</td>
<td>Forgetful, Able to concentrate, Able to think clearly</td>
</tr>
</tbody>
</table>

(Adapted from McNair & Lorr, 1964)
**TABLE 2**

**CHARACTERISTICS OF SAMPLE IN McNAIR & LORR STUDY**

<table>
<thead>
<tr>
<th></th>
<th>Study I</th>
<th>Study 2</th>
<th>Study 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Median education</strong></td>
<td>High school graduate</td>
<td>High school graduate</td>
<td>High school graduate</td>
</tr>
<tr>
<td><strong>Employed</strong></td>
<td>75%</td>
<td>69%</td>
<td>67%</td>
</tr>
<tr>
<td><strong>Diagnosis</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Neurosis</strong></td>
<td>57%</td>
<td>47%</td>
<td>42%</td>
</tr>
<tr>
<td><strong>Personality or psychophysiological disorder</strong></td>
<td>27%</td>
<td>25%</td>
<td>41%</td>
</tr>
<tr>
<td><strong>Psychosis</strong></td>
<td>16%</td>
<td>28%</td>
<td>17%</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>200</td>
<td>523</td>
<td>150</td>
</tr>
</tbody>
</table>

(After McNair and Lorr, 1964)
significant difference was found between an active drug (chlordiazepoxide) and a placebo on two factors, Factor T and Factor V. The normal group showed no significant changes over an 8-week interval, nor were any shown by a patient group in the third study who received no treatment.

It is worth noting a previously cited study (Folstein & Luria, 1973) which identified a mood-performance correlation that distinguished patients with affective disorders (manic or depressed) from other psychiatric patients.

**SUMMARY**

Verbal fluency appears to be affected by I.Q. in people aged 60 years and older. It discriminates between normal aged and those suffering from brain disease, and between ill depressives and organics.

The mood scale of Lorr et al. detects subjective mood change in outpatients receiving treatment, and a mood-performance correlation has been identified that distinguishes affective disordered patients from other psychiatric patients.
CHAPTER IX

SUMMARY OF LITERATURE REVIEW

Psychological testing has been the focus of considerable criticism in the past. For many years it was viewed largely as an unreliable and superfluous tool in the area of psychiatric and neurological diagnosis, and was vigorously attacked for not relating to hypotheses regarding cerebral functioning. More recently, especially in the field of neuropsychology, psychological tests have undergone extensive refinement, and in many instances their large scale use has demonstrated their reliability and validity. Although still at a rudimentary level, working hypotheses relating behavioural performance to theoretical propositions are now commonly investigated.

Psychological tests have rendered useful information concerning the developmental aspects of disease and prediction of response to treatment. By using tests together with other scientific instruments (e.g., the CAT scan) it has been possible to relate psychomotor and cognitive functioning of the individual to the locus of brain lesion. Their use has been particularly important in the differential diagnosis of dementias, and the psychiatric and neurological examination of the elderly person.
As the human organism ages there are a number of accompanying physiological and biochemical changes that directly affect cognitive and behavioural functioning. Most obvious is the decreased physical efficiency. Less apparent are the reductions of intellectual abilities which become overtly noticeable only when speed of performance and complexity are involved. Available evidence indicates a greater need in the older person for lengthened periods of time in which to process and retrieve information. Like their younger counterparts the elderly enjoy success, but will take fewer risks to attain it, and employ protective manipulations in order to avoid confronting their decreased abilities. It has been observed that there is a sharp drop in mental performance as the individual approaches death.

There is a high prevalence of psychiatric disorders, both functional and organic, in the elderly population. The incidence of depression rises and is diagnosed more frequently in women than in men. On occasion the presenting symptomatology of depression approximates that of the early stages of dementia; prudent diagnosis therefore is a high priority in order to ensure the correct clinical procedure. When a patient presents with a more advanced stage of dementia the problem becomes largely redundant. What is then seen may be described as an extreme exaggeration of normal ageing: intellectual abilities
are grossly impaired, there is marked disorientation, perseveration, and inappropriate responding.

The psychological tests which have been devised to facilitate an unequivocal diagnosis of depression or dementia are mostly concerned with verbal learning and memory. Attempts have been made to ascertain where in the memory system the impairments lie; whether they occur at the level of acquisition, retention, or retrieval. Theoretical discussion has been concerned with whether the structural process is unitary or one of dualism. There are three basic ways in which lists of verbal items can be presented to subjects for learning. They are free recall, serial learning, and paired-associate learning. Paired-associate learning has been widely used in studies of ageing, and scores have been shown to steadily fall from the age of forty, reflecting both the effects of performance factors, and those of an age related learning disability. Clinically its use has included the assessment of ageing and brain damage, the effectiveness of treatment procedures, for prognostic purposes, and to differentiate between diagnostic groups.

Serial learning has been extensively investigated, but unlike paired-associate learning, has been little used in studies of ageing or in psychiatric diagnosis. It has been demonstrated that there are performance differences between
young and old adults due to the increased cautiousness of older persons, and their requiring an increased length of time in which to integrate factors leading to a response. Heightened task anxiety has also been suggested for causing the response inhibition at faster speeds of presentation. Among a psychiatric population performance differences were found between demented and depressives, with the depressives exhibiting a reversible deficit.

Verbal fluency tasks have been shown to discriminate between normal elderly people and those suffering from brain disease, and between ill depressives and organics. In a factor analysis verbal fluency loaded on a 'verbal learning' component.

The other important area of psychological testing relevant to a differential diagnosis is psychomotor functioning. Both dementing and depressed persons perform at a slower rate than normal elderly persons, and the demented significantly slower than the depressives.

The literature review, summarized here, has examined psychological testing within the context of psychiatric diagnosis, and in relation to the process of normal and abnormal ageing. Individual verbal learning tasks, and tests measuring psychomotor functioning, have been more specifically described. It is against this background that the following experimental studies are presented.
INTRODUCTION TO THE EXPERIMENTS

The performance on psychological tests examined here was part of a larger study investigating sedation thresholds, drug effectiveness (Cyclandelate), and the measurement of evoked potentials, of elderly depressives, depressives with incipient brain damage, dments, and normals. The test battery consisted of tests administered in a previous investigation together with three additional tests, the Digit Symbol Subtest of the WAIS (DST), Raven's Coloured Progressive Matrices, and a fluency test. Therefore, although in part this was a replication study aimed at substantiating earlier findings, it was also aimed at acquiring further information by including in the investigation not only additional tests, but also a control group of normal elderly subjects.

In the present study the tests may be divided into four general groups measuring psychomotor functioning, verbal learning and memory, general intelligence, and a group measuring general orientation and subjective mood factors. Two tests, the Digit Copying Test (DCT) and the Synonym Learning Test (SLT), together form a separate specialized group, the Kendrick Battery, an instrument which has been used to differentiate between organics and ill depressives.
Many studies indicate a gradual decline and deterioration of physical and mental efficiency in the ageing person. Psychological investigations have shown that reaction time increases, and speed of performance which is greatly reduced is most marked in elderly dementing patients, and greater in depressed persons than normal elderly persons. Poor memory and an impaired learning ability are routinely regarded as an anticipated aspect of the ageing process. Among the factors cited as contributing to the impaired learning are increased cautiousness, performance difficulty in the form of heightened task anxiety, and poorer learning strategies. The elderly appear to benefit from low risk conditions.

There are few studies that have systematically investigated the learning impairment of depressed and dementing elderly people. Complaints of poor memory within a general depressed population do not correlate with performance measures but with the level of depression. It has been proposed that the deficit exhibited in the verbal learning of depressed patients is different from that of dementing patients. There appears to be a reversible learning deficit in elderly depressed persons when a serial learning task is used, though not when a paired-associate learning task is used. To explain this discrepancy, Whitehead (1971) suggested that while a short-term memory impairment is responsible for the disability of dement, in depressed patients the impairment is due to difficulty in generating necessary retrieval tags in order for the items to be retrieved from long
term storage. It has also been hypothesised that depressives do not in fact have an impaired memory, but rather adopt a very conservative response strategy, which could be interpreted as an exaggeration of the cautiousness exhibited by the elderly in experimental situations.

Whether the elderly are over- or under-aroused remains undetermined. Eis dorfer's (1968) hypothesis that contrary to general opinion, older people may generally be in a high state of arousal has received experimental support. A one-factor theory of arousal has been supplanted by a two-factor theory involving an arousal system related to the reticular system, and another related to the limbic system, both of which are reciprocally inhibiting.

In the following experiments it is planned firstly to compare the performance of elderly normal subjects and elderly psychiatric patients on tests measuring psychomotor function. Secondly, performance on one of these tests, the DCT, together with performance on a verbal learning test, the SLT, will be examined. In this experiment performance on the Gresham Ward Questionnaire will also be investigated. The third experiment will consist of an investigation of performance on two verbal learning tasks, one of paired-associate learning and the other of serial learning. A final experiment will compare the responses of normal elderly and depressed elderly psychiatric patients to a personality inventory (The Eysenck Personality Questionnaire).
CHAPTER XI

PSYCHOMOTOR PERFORMANCE

In this investigation the psychomotor function and intellectual ability of elderly persons is examined in order to substantiate previous findings, and to clarify further the performance differences between normal elderly persons and those diagnosed as depressed or dementing.

It has been well established that there is a slowing of psychomotor speed in the elderly (Birren, 1968; Bromley, 1971). Tests which entail a speed component show a marked deterioration of performance with age (Rajalaskshuri & Jeeves, 1963; Rabbitt, 1964; Schaie & Strother, 1968b; Talland, 1964). Task complexity also affects performance in the elderly. Welford (1970) has described a pattern of slowing with age whereby a disproportionate length of time is taken by older people when either a relatively complex sequence of actions is required, or when accurate identification of material is required within a stipulated period of time. The decrease in psychomotor speed is more accentuated in an elderly dementing population (Ajuriaguerra et al., 1966; Birren & Botwinick, 1951). It has also been demonstrated that in depressed people there is a slowing of psychomotor function (Friedman, 1964; Martin & Rees, 1966; Shapiro & Nelson, 1955).
The two tests of psychomotor function examined here, the Digit Symbol Test (DST), and the Digit Copying Test (DCT), were chosen because of their previous use in studies of the elderly. The DST is a timed task of some complexity. On the standardized age-related scores of the WAIS subtests it shows the most performance change (Birren & Morrison, 1961; Botwinick, 1967), and is the most sensitive to brain damage. It is reported to be relatively unaffected by intellect, memory or learning (Murstein & Leopold, 1961; Salthouse, 1978). Performance can be affected by ability to sustain attention, speed of response, motor persistence and visual-motor co-ordination (Lezak, 1976). A vocabulary test and the DST were included in a study designed to clarify the relationship between performance and depression (Beck, Feshbach & Legg, 1962). With the variables of age and intelligence controlled, DST scores decreased with increasing age, and similarly decreased with decreasing vocabulary scores. The authors concluded that there was no relationship between performance on the DST and depression. The DST was used in the initial validation of the Kendrick Battery (Kendrick, 1965), but dropped during the test-retest portion in favour of the Synonym Learning Test. However, it has been shown to differentiate between depressed and brain damaged elderly psychiatric patients (Kendrick, Parboosingh & Post, 1965).

Together with the Synonym Learning Test, the DCT forms the Kendrick Battery, and is said to tap a "function of perceptuo
motor speed" (Brown, 1970). Originally devised by Clément (1963), it was used by Kendrick (1965) in order to test for diffuse brain damage in elderly people, and by Héms, Whitehead and Post (1968) to measure cognitive function and cerebral arousal in elderly depressed and dementing patients. Two studies have shown that the DCT differentiates between organics and ill depressives at a highly significant level (Cowan et al., 1974; Whitehead, 1971). Kendrick (1972) maintains that the DCT reflects the arousal level of the reticular activating system, and found no difference in the performance of either normal, depressed, or pseudo-dementing elderly people, all of whom scored significantly higher than a group of dementing persons.

As a back-up test for the DCT Whitehead (1971) used the timed Free Drawing of Squares. Although it did not significantly differentiate between diagnostic groups (in fact, depressed patients performed even slower on remission) it was decided to include it with the DCT and DST in this experiment as another measure of psychomotor function.

In the area of general intellectual ability the available evidence supports Cattell's (1963) theory that skills involving the reorganization of perceptual data decline first and most rapidly, whereas previously learned intellectual skills decline at a slower rate (Cunningham, Clayton & Overton, 1975; Horn & Cattell, 1966). Within clinical populations the IQs of hospitalized depressed patients drop during the period of
depression (Payne, 1961), and lower than average IQs are reported for dementing patients (Botwinick & Birren, 1951b; Dorken & Greenbloom, 1953; Overall & Gorham, 1972). In this latter group, when WAIS verbal and performance IQs are compared, performance IQs are always lower (Bolton et al., 1966; Kendrick, Parboosingh & Post, 1965; Kendrick & Post, 1967), but it must be noted that the performance scale involves a speed factor. However, when data from the Mill Hill Vocabulary Scale and Raven's Progressive Matrices are compared, neither of which are timed tests, there is a similar finding, and the scores are below those of the general population (Kendrick & Post, 1967; Newcombe & Steinberg, 1964; Orme, 1957). The Progressive Matrices has been shown to differentiate brain damaged subjects from others (Evans & Marmorison, 1964; Kendrick & Post, 1967).

The principles underlying the use of vocabulary as an index of premorbid intelligence were reviewed by Yates (1956). The main assumption is that vocabulary scales correlate highly with overall measures of general intelligence. Alexander (1973) found that a dementing group was able to deal with vocabulary and verbal tasks comparably with a control group. Miller (1977) has pointed out though that there is an appreciable margin of error in estimating IQ on the basis of vocabulary alone. The question remains open whether vocabulary remains stable during pathological changes in the brain.

Hypotheses

1. Both the DST and the DCT will differentiate between organisms,
ill depressives, and normal elderly subjects.

2. The performance of the intermediates will fall between that of the organics and the ill depressives.

3. With remission of symptoms the performance of the depressives will improve and be equal to that of the normal elderly subjects.

4. The Free Drawing of Squares will not differentiate between the groups.

5. Performance on the tests of psychomotor speed will not correlate with IQ scores.

6. Performance IQ scores will be lower than Verbal IQ scores in all groups.

Method

Subjects

These were 73 patients (62 females, 11 males) over the age of 60 years consecutively admitted to Gresham Ward, a short-stay psychogeriatric unit of the Bethlem Royal Hospital, and who were clinically diagnosed as suffering from either a primary depressive illness of sufficient severity to warrant specific treatment, or from a dementing condition. Of these, 27 patients (22 females, 5 males) were judged to be suffering from irreversible brain damage (mainly senile dementia and/or arteriosclerotic brain damage) and will be referred to as organics. Among this group two patients (1 male, 1 female) with severely impaired hearing, three patients (females) with impaired eye sight, and five patients (females) so severely deteriorated, were all unable to complete the total battery of tests administered. Thirty-eight patients were
diagnosed as having an affective disorder (depressions of various kinds), and on clinical examination displayed no evidence of organic impairment at that time, nor at a further six months follow-up examination. These will be referred to as functionals. Among this group one male refused to complete all the tests during the second assessment, while another discharged himself before the second assessment. Two subjects (females) with severe sight problems, died before the second assessment. During the course of the follow-up period, the presence of cerebral pathology was confirmed in eight patients who had been initially diagnosed as depressed, and who had received anti-depressant treatment. These will be referred to as intermediates. One patient (male) from this group, with severe sight problems, died before the second assessment could be administered.

Acutely confused patients, manics, schizophrenics, alcoholics, and patients with psycho-social problems were excluded, and also those patients who required immediate treatment, or who were physically or mentally too ill or too handicapped for testing. The patients were required to be able to give valid and informed consent to the investigations. The patients had been withdrawn from all psychotropic drugs at least one week before the time of assessment and testing, and none had received ECT during the previous three months. Some were receiving minor tranquilizers during the day and/or night sedation (nitrazepam). Treatment for the depressives consisted of amitriptyline in a
variable dose schedule rising to a maximum of 150 mg a day, or
ECT: a few patients required both types of treatment in succession.

The patients were further divided into three treatment groups
as part of a double-blind clinical trial to evaluate the effect
of the vasodilator drug cyclandelate (3,3,5-trimethylcyclohexyl
mandelate) which was administered in a dose of 1200 mg daily.
The groups were divided into those receiving cyclandelate plus
amitriptyline; those receiving a placebo plus amitriptyline; and
those to whom neither the placebo nor cyclandelate were given.

A control group of 30 apparently healthy subjects between
the ages of 65 and 90 years was recruited from a day centre.
During the initial screening one subject (female) showed symptoms
of dementia and therefore was not included in the investigation.
Subsequently the dementia was diagnostically confirmed when the
person was hospitalized. One other subject (male) was excluded
as he died soon after taking part in the investigation. The
control group finally consisted of 28 normal, healthy elderly
subjects. Unlike the patients, who were assessed both pre- and
post-treatment, the control subjects were investigated on one
occasion only.

Materials

Full details of the tasks used and their administration
are given in Appendix A. They were:-
a) **Digit Symbol Test** (Wechsler, 1955)
b) **Digit Copying Test** (Kendrick, Parboosingh & Post, 1965): A version was used which had larger numbers than usual. *(See Appendix B)*
c) **Free Drawing of Squares**
d) **The Mill Hill Vocabulary Scale, Form A (Senior)** (Raven, 1958)
e) **Raven's Coloured Progressive Matrices** (Raven, 1966): This was not administered to the control group due to limited time available.

Patients also performed other tests. The experimenter assumed a supportive and encouraging attitude in order to maximise the subjects' performance and elicit their cooperation for the entire testing session. If a subject were totally unwilling to complete a task, it was discontinued and the following task introduced, as willingness to continue overall was deemed more important.

**Procedure**

Patients were assessed during an admission conference. If the patient were diagnosed as depressive an assessment of the severity of the illness was made by the psychiatric consultant (Felix Post or Raymond Levy). The scale used is described in Appendix A; the ratings of severity were from 0 (=symptoms absent) to 5 (= extremely severe). Within two days of the initial assessment and prior to the commencement of treatment, the patients received their initial testing. Appendix A gives the order and instructions for the tests used. The Mill Hill Vocabulary Scale, Raven's Coloured Progressive Matrices, and the Gresham Questionnaire
were administered on most occasions by the Registrar in charge of the case, otherwise they were administered by the experimenter. Patients also performed other tests which were part of other experiments. The session lasted approximately one hour and a half. If a patient grew tired, the session was discontinued for a short rest period, and completed as soon as possible following the rest period. If a patient refused to complete a task it was abandoned and the non-completion treated as a failure. Following a second assessment by the psychiatric consultant, a second testing took place; in the case of the depressives after optimal results appeared to have been obtained with treatment, and in the case of the dementes, after six weeks. A third clinical assessment took place at six months to establish a final diagnosis of the initial illness.

The experimenter administered all the tests performed by the control group in sessions lasting approximately one and a half hours. Due to time limitations, it was not possible to include Raven's Coloured Progressive Matrices.

Results

Table 13 shows the initial mean scores and standard deviations for all groups. A one way analysis of variance indicated significant differences between the four groups in the expected direction; functionals scoring higher than the organics, with the small number of intermediates (depressives with some cerebral organic pathology) falling in between. The
<table>
<thead>
<tr>
<th></th>
<th>Controls</th>
<th>Functionals</th>
<th>Intermediates</th>
<th>Organics</th>
<th>F Ratio</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>74.5(6.63)</td>
<td>70.95(6.27)</td>
<td>80.38(7.85)</td>
<td>76.8(7.01)</td>
<td></td>
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<tr>
<td>Mill Hill</td>
<td>108.94(9.31)</td>
<td>94.90(9.94)</td>
<td>93.00(4.36)</td>
<td>85.80(15.38)</td>
<td>13.183</td>
<td>.0001</td>
</tr>
<tr>
<td>Raven's Matrices</td>
<td>97.34(13.46)</td>
<td>96.67(5.28)</td>
<td>85.00(20.16)</td>
<td>3.281</td>
<td></td>
<td>.05</td>
</tr>
<tr>
<td>DCT</td>
<td>109.25(28.75)</td>
<td>68.37(33.72)</td>
<td>46.57(26.83)</td>
<td>39.24(23.16)</td>
<td>25.518</td>
<td>.0001</td>
</tr>
<tr>
<td>DST</td>
<td>12.89(2.42)</td>
<td>9.35(3.67)</td>
<td>6.67(2.34)</td>
<td>4.21(3.91)</td>
<td>28.035</td>
<td>.0001</td>
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<tr>
<td>Squares</td>
<td>13.78(7.92)</td>
<td>19.71(10.09)</td>
<td>31.29(20.19)</td>
<td>24.86(22.39)</td>
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<td>.03</td>
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</table>
control group scored higher than the depressives without cerebral pathology on all the tests, including the Mill Hill Vocabulary Scale. Table 14 shows the retest mean scores and standard deviations for all groups. The performance of the functionals on the DCT improved to a significant degree on the second testing, however it did not equal that of the control group.

The intercorrelations for the functionals alone pre- and post-treatment are shown in Tables 15 and 16. For the pre-treatment functional group age correlated negatively with the Mill Hill Vocabulary Scale \((p<0.01)\), indicating an age related decline in IQ as measured by the Mill Hill Vocabulary Scale. The Mill-Hill Vocabulary Scale performance correlated positively and significantly with performance on Raven's Coloured Progressive Matrices \((p<0.01)\). Patients with later onsets of first depression were not significantly older at the time of the study than those with depressions going back to an earlier age. The Free Drawing of Squares significantly differentiated between the four groups.

Table 17 shows the pre-treatment intercorrelations for the organics. For this group performance on the Mill Hill Vocabulary Scale correlated significantly with performance on Raven's Coloured Progressive Matrices \((p<0.05)\), the DCT \((p<0.01)\), and the DST \((p<0.01)\). Performance on the Matrices correlated
<table>
<thead>
<tr>
<th></th>
<th>DCT</th>
<th>DST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressives</td>
<td>84.23 ± 27.43</td>
<td>9.36 ± 3.02</td>
</tr>
<tr>
<td>Intermediates</td>
<td>54.43 ± 28.31</td>
<td>7.67 ± 2.07</td>
</tr>
<tr>
<td>Dements</td>
<td>42.26 ± 28.57</td>
<td>4.41 ± 5.53</td>
</tr>
<tr>
<td>F ratio</td>
<td>14.010</td>
<td>8.198</td>
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<td>Significance</td>
<td>p &lt; 0.001</td>
<td>p &lt; 0.001</td>
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### TABLE 15

Correlations for Functionals (pre-treatment)

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<th>4</th>
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<td>Age</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age at 1st depression</td>
<td>0.264</td>
<td></td>
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<tr>
<td>Mill Hill Vocabulary</td>
<td>-0.484**</td>
<td>-0.241</td>
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<td>Progressive Matrices</td>
<td>-0.116</td>
<td>-0.265</td>
<td>0.578**</td>
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<td>Digit Copying Test</td>
<td>-0.162</td>
<td>0.139</td>
<td>0.148</td>
<td>0.293</td>
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<td>Digit Symbol Test</td>
<td>0.150</td>
<td>0.214</td>
<td>0.029</td>
<td>0.179</td>
<td>0.694**</td>
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### TABLE 16

Correlations for Functionals (post-treatment)

<table>
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<tbody>
<tr>
<td>Age</td>
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<tr>
<td>Age at 1st depression</td>
<td>0.264</td>
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<tr>
<td>Digit Copying Test</td>
<td>-0.371</td>
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<tr>
<td>Digit Symbol Test</td>
<td>0.206</td>
<td>0.321</td>
<td>0.565**</td>
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**p<0.01  *p<0.05
<table>
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<tr>
<th>Age</th>
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<th>2</th>
<th>3</th>
<th>4</th>
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<td>Mill Hill</td>
<td>2</td>
<td>0.234</td>
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<td></td>
</tr>
<tr>
<td>Progressive Matrices</td>
<td>3</td>
<td>0.032</td>
<td>0.457*</td>
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<tr>
<td>DCT</td>
<td>4</td>
<td>-0.058</td>
<td>0.657**</td>
<td>0.443*</td>
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<tr>
<td>DST</td>
<td>5</td>
<td>0.173</td>
<td>0.533**</td>
<td>0.782*</td>
</tr>
</tbody>
</table>

*p<0.05  **p<0.01
significantly with the DCT \((p<0.05)\) and the DST \((p<0.05)\). Performance IQ scores were higher than Verbal IQ scores for both the functional and intermediate groups, and approximately the same for the organic group. Performance on the DCT correlated significantly with performance on the DST for both pre-treatment \((p<0.01)\) and post-treatment \((p<0.01)\) functionals, and for organics \((p<0.05)\).

**Discussion**

The results clearly confirm previous findings that the decreased speed of psychomotor functioning in the elderly is most extreme in dementing persons. The mean score of the organics was significantly lower than in any of the other groups on both the DCT and the DST. A comparison of the present results with those of organic groups in earlier studies shows that performance on the DCT in this investigation is lower than in the study of Kendrick, Parboosingh and Post (1965), but approximately the same as in two later studies by Kendrick and Post (1967) and Whitehead (1971) (see Table 18). Three organic patients scored higher than the cut-off score of 64 or less which was used in the initial validation and cross-validation studies to place subjects within an organic category (see Figure 11). At the retest six weeks later they continued to give performance scores which were outside the organic category. Performance of the organics on the two tests correlated significantly \((p<0.05)\). A weighted score of 3 or less on the
<table>
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<th>Study</th>
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<th>Functionals</th>
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<tr>
<td>Kendrick, Parboosingh &amp; Post (1965)</td>
<td>$49.35^{+}16.20$</td>
<td>$81.10^{+}15.25$</td>
</tr>
<tr>
<td>Kendrick &amp; Post (1967)</td>
<td>$38.60^{+}14.76$</td>
<td>$70.23^{+}28.65$</td>
</tr>
<tr>
<td></td>
<td>$38.80^{+}17.20$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$41.90^{+}20.00$</td>
<td></td>
</tr>
<tr>
<td>Whitehead (1971) (post-treatment) (at three months)</td>
<td>$39.65^{+}24.59$</td>
<td>$72.00^{+}23.69$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$80.67^{+}17.46$</td>
</tr>
<tr>
<td>Present Study</td>
<td>$39.24^{+}23.16$</td>
<td>$68.37^{+}33.72$</td>
</tr>
</tbody>
</table>
DST was used to indicate organicity in the initial validation and cross-validation studies. In this investigation the mean score of the organic group is above the proposed cut-off score. An examination of individual scores however shows nine patients have performance scores which fall within the organic category, eight of whom having a score of zero.

Psychomotor function of the elderly depressed patients was slower than of the normal elderly persons. The mean scores of the functionals for the DCT and the DST were significantly lower \((p<0.001)\) than those of the control group for both tests. The performance of the functionals was also significantly different \((p<0.001)\) from that of the organics. This supports earlier studies which have indicated the DCT can correctly classify a psychiatric diagnosis of diffuse brain pathology or depression. According to Kendrick (1972) this classification is correct 87.4 per cent of the time with 4.29 per cent Type 1 errors (i.e. misclassification of demented patients as non-demented). If the scores of the organic group are combined with those of the intermediate group in the present study a misclassification of 1.7 per cent Type 1 errors is found. It should be noted that Kendrick has cautioned against using separately either of the two tests which form the Kendrick Battery. The performance of the functionals is lower than depressives' performance in both the study by Kendrick et al. (1965) and by Whitehead (1971) (see Table 18). The greatest difference lies in the former study, in which the sample of depressives was also
brighter than in the present sample by 6.6 points. The results support the hypothesis that the DCT and the DST will differentiate between organics, ill depressives and normal elderly subjects.

The small group of patients who were originally diagnosed as depressed but in whom the presence of cerebral pathology was later confirmed, performed at a level significantly lower than the patients without cerebral pathology on both the DCT and the DST, but above the performance of the organic patients, thereby supporting the second hypothesis that the performance of the intermediates would fall between that of the organics and the ill depressives. All but one of the intermediates scored below the cut-off point designated by Kendrick to indicate organicity.

Although the functionals' performance on the DCT improved significantly following remission of clinical symptoms, it was not sufficient to equal the performance of the normal elderly subjects. The increase of 20.86 points was considerably larger than the increase of 3.16 points reported in Whitehead's sample at a third retesting three months later. This gain, in fact, followed a drop of 4.80 points which was revealed when the depressives were retested following successful treatment. Post-treatment performance of the functionals on the DST showed negligible improvement. Therefore the evidence does not support
the hypothesis that following remission of symptoms the improved performance of the depressives will equal that of the normal elderly subjects. It is important to note that the depressed patients were retested when they were still hospitalized, and when some were continuing to receive anti-depressant medication. Had they been retested again at a later time, for example at six months, their performance on both the DCT and the DST may have shown greater improvement.

Unexpectedly, and in contrast to the results reported by Whitehead (1971), the timed free drawing of squares significantly differentiated between the four groups (p<0.03). A comparison of the two sets of data may be seen in Table 19. This shows a higher performance level was attained by the present groups than those previously. Organics' performance level lay between the intermediates and the functionals, which were below that of the controls. It is unclear why the intermediates' performance was lower than the organics. The hypothesis that the free drawing of squares will not differentiate between groups is not supported by these results.

There was a significant performance correlation on the DCT and DST for functionals (p<0.01) and organics (p<0.05). The results indicate that psychomotor performance of the functionals did not correlate with either verbal or performance IQ measures, but the organics' performance on the DCT and DST correlated significantly with Verbal IQ (p<0.01) and Performance IQ (p<0.5). Therefore the results only partly support the hypothesis that performance on the tests of psychomotor speed would not correlate with IQ measures.
### TABLE 19

**COMPARISON OF SCORES ON FREE DRAWING OF SQUARES**

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<thead>
<tr>
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<th>Present Study</th>
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<tr>
<td>Functionals</td>
<td>26.27±12.49</td>
<td>19.71±10.09</td>
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<td>34.41±17.02</td>
<td>24.86±22.39</td>
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<tr>
<td>Intermediates</td>
<td>31.29±20.19</td>
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</tr>
<tr>
<td>Controls</td>
<td>13.78± 7.92</td>
<td></td>
</tr>
<tr>
<td>Significance</td>
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<td>p&lt;0.03</td>
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</tbody>
</table>
The final hypothesis, that Performance IQ would be lower than Verbal IQ is not supported by the results. In the three patient groups Performance IQ was higher than Verbal IQ. This is most unusual. One explanation is that the population from which the patient group came was of a low socio-economic status and low educational attainment. The Verbal IQ test employed in this study measures knowledge of word meanings, which are likely to be affected by education, exposure and practice. As the IQs of both depressed and dementing patients are reported to be lower than among the normal population it was not surprising to find the Verbal IQ of the control group higher than any of the other groups. Interpretation is confounded though, as the population from which the controls were drawn was a higher socio-economic and educational level than of the patients.

The frequency of DCT scores obtained by organics is shown in Figure 11, those obtained by ill functionals in Figure 12, and by remitted functionals in Figure 13. Figure 14 shows the frequency of DCT scores for the controls. If a cut-off point of 64 and less is applied, two controls and a number of functionals fall within the organic category. Illustrated in Figure 15 is the effect of two cut-off scores on the categorization of the four groups. Post has maintained (1965) that organic scores in depression tend to be associated with low Verbal IQs. Whilst discussing the Kendrick Battery, of which the DCT is part, he pointed out that depressives scoring within the organic range
Figure 11. Frequency of DCT Scores for Organics

Figure 12. Frequency of DCT Scores for Ill Funtionals
Figure 13. Frequency of DCT Scores for Remitted Functionals

Figure 14. Frequency of DCT Scores for Controls
<table>
<thead>
<tr>
<th></th>
<th>15 F</th>
<th>26 C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 O</td>
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<tr>
<td>17 F</td>
<td>2 C</td>
<td></td>
</tr>
<tr>
<td>24 O</td>
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**Cut-off point of 64 or below**

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<th>26 F</th>
<th>28 C</th>
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<tr>
<td></td>
<td>6 O</td>
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<tr>
<td>8 F</td>
<td>0 C</td>
<td></td>
</tr>
<tr>
<td>22 O</td>
<td></td>
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</tr>
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</table>

**Cut-off point of 64 or below for men, 42 for women**

*C = Controls
F = Functionals
O = Organics*

**Figure 15** Cut-off Points for the DCT
were those who tended to have lower intelligence. Lower intelligence and delusional symptoms are among the factors associated with pseudodementia (Post, 1965). If the performance of the patients in this study on the DCT is examined from this perspective and the amended cut-off points suggested by Kendrick (1967) are used, then eight functionals have scores which fall within the organic range. Their mean score on the test of Verbal IQ is 94. One patient with an extremely low score of 23 died before the second testing was administered. At the second testing of the remaining six patients, four continued to score within the organic range, and their IQ score was 93.6. This implies that Post's assertion holds true even when the DCT is used without the Synonym Learning Test to form the Kendrick Battery. An interesting finding emerges when the earlier cut-off point indicating brain damage of 64 or below for females is used in a test-retest situation. After dividing the ill depressives' scores of 64 or below from the higher scores, the mean IQs of the two groups are approximately the same (87.6 and 89.6 respectively). When the scores of 65 and above are screened from the group of remitted depressives on the second testing, there remains a small group (n=4) who have a much lower mean IQ score of 70.25, even lower than the organic group. This is relevant when a cut-off point is employed for diagnostic and prognostic purposes. More important is its implication for further research into the relationship between IQ, psychomotor function and depression.

One of the problems encountered in this investigation is
that the dementing patients were mostly extremely deteriorated, and their test scores were zero. Furthermore, there were many contributing factors influencing their performance, such as visual difficulties, inability to attend to the task, physical infirmity, so that it is difficult to ascertain wherein the actual performance deficit lies. As the performance of the intermediates was higher than the organics, it seems likely that they were seen at an earlier stage during their dementing illness, hence the initial diagnosis of depression. However, their IQ scores were also higher than the organics, by 7.20 points for the Verbal IQ and 11.67 for the Performance IQ. It is when such perplexing findings emerge that the importance of earlier and repeated testings become paramount.

Information regarding socio-economic status and educational attainment would have been valuable in this study, especially for the comparison between performance of the controls and the functionals. In future studies it would be useful to control for these variables, and also to draw control subjects from approximately the same population as the patient groups.

It is easy to assume a defeatist attitude to the treatment of dementing patients, which in turn can influence the types of measurements chosen for investigation. Practice effects, which are often carefully controlled in experimental work with normals, might be usefully investigated in the elderly dementing. If they are as extremely slow as the evidence suggests, will familiarity with a particular task effect improvement, or will the dementing process itself overtake them? The type of
reinforcements which would be of value to the dementing person, and if by their use performance could be improved, are two other areas worthy of enquiry. Were a drug found which was instrumental in improving cerebral functioning, and thereby psychomotor functioning, then these aspects of performance would have meritorious value in aiding an already highly incapacitated patient group.

The investigation of psychomotor function in elderly normal subjects and psychiatric patients has also heuristic value; cognitive measurements are more usefully investigated alongside discrete measurements in order to be of value in further understanding the processes of both functional and organic illness.

Summary

It is apparent that there are large performance differences among elderly psychiatric patients suffering from functional and organic illness, and normal elderly persons, when tasks of psychomotor function are the measuring instruments. Such tests can be used to differentiate between dementing and depressed elderly persons, though care must be taken to assess pre-morbid levels of intelligence, and to include retesting over various time periods as part of the complete assessment. As the tests investigated here tend to misclassify to some degree, the retesting is of primary importance when a psychiatric diagnosis is in question.
CHAPTER XII

PERFORMANCE ON THE KENDRICK BATTERY

Examine in this chapter is the performance together of the two tests which constitute the Kendrick Battery (Kendrick, 1965) the DCT and the Synonym Learning Test (SLT), by three patient groups, functionals, organics and intermediates, that is those patients originally diagnosed as depressed but in whom cerebral pathology was later confirmed. The performance of a control group of normal elderly people is also examined.

The SLT was adapted by Kendrick, Parboosingh and Post (1965) from the Walton Black Modified Word Learning Test (Walton & Black, 1957) as an aid to the differential diagnosis of diffuse brain disease or depression in elderly psychiatric patients. It is a test of auditory short term memory and has been demonstrated to have a high correlation with psychiatric diagnosis. In the initial study a cut-off score of 57 was chosen, any score below indicating diffuse brain damage, in order to eliminate any Type 1 errors. The test correctly classified normal and psychiatric patients 89.81 per cent of the time. There was a misclassification with depressed patients 16.18 percent obtaining scores in the brain-damaged range. Of the misclassified depressives, 63.63 per cent had a WAIS Verbal Scale IQ of 95 and below. As the base rate of the IQs of the depressed groups below 95 was only 36.67 per cent,
it was shown that misclassification is more frequently associated with low intelligence.

The cross-validation study (Kendrick, 1967) was concerned with whether the tests making up the battery would differentiate between pseudo-dementing patients and dementing patients. The original cut-off points proved inadequate, and after further analysis it was found that differentiation could be effected if cut-off points on the DCT were changed for females, and retest cut-off points on the SLT were changed for both females and males. The amended cut-off points for the SLT were: at the initial testing, a score of 57 and over would be equivalent to a non brain-damaged score; for retesting a score of 41 and above would be equivalent to a non brain-damaged score. It still remained necessary to use a test-retest sequence to obtain a reliable differential diagnosis.

The standardization sample mean scores on the SLT were higher than in any of the subsequent studies (Hemsi, Whitehead & Post, 1968; Irving, Robinson & McAdam, 1970; Kendrick, 1967; Whitehead, 1971). Whitehead (1971), who observed that the samples in other studies were of selected depressives, compared the performance of unselected depressives with the selected depressives of the earlier studies. She found the scores of the unselected depressives were even lower than those found earlier. In Kendrick's original study the mean score on the SLT was 72.85 (±12.95), while in Whitehead's study the mean score was 25.07
That Kendrick's group was brighter (6.25 IQ points on the Mill Hill Vocabulary Scale) may have been a relevant factor contributing to the difference in scores. Whitehead's study revealed no difference in performance of males and females, but the severity of illness was a contributing significant factor and was related to non-completion of the task. A strong relationship was shown between the SLT and the General Events portion of the Gresham Questionnaire, though the tendency for scores on both tests to improve on remission was not significant until three months following remission of clinical symptoms.

Kendrick (1972) has suggested that the poor performance of the depressives on the SLT is due to arousal changes within the limbic system. His hypothesis is based primarily on Routtenberg's (1968) claim that there are two mutually inhibitory arousal systems; Arousal System 1 (AS1), which maintains ongoing behaviour and which is related to the reticular activating system, and Arousal System 2 (AS2), which acts as a function of the hypothalamic-limbic system and "provides control of responses through incentive related stimuli". Thus AS1 maintains incoming stimuli while activation of AS2 will suppress AS1 thereby allowing information to be consolidated in a storage system other than a temporary one. Kendrick has proposed that AS1 is involved with short term memory, while AS2 is involved with "intermediate-term" memory. Furthermore, that in senescence there is a general lowering in
cortical excitation mediated by irreversible changes in the reticular activating system" and "concomitantly, a second source of cortical excitation, mediated by the hypothalamic-limbic system, may be subject to deterioration, irreversible and organic, functional or both" (Kendrick, 1972).

Hypotheses

1. The Kendrick Battery will differentiate between patient groups.
2. The Functionals will score at a level similar to those in the study of Whitehead (1971).
3. The Control group will perform at a higher level than the Functionals.
4. Scores on the Gresham Questionnaire will correlate significantly with scores on the SLT.
5. Severity of illness will relate to poor performance scores.

Method

Subjects

These were the functional, intermediate and organic groups of Experiment 1 investigating psychomotor performance. The control group consisted of 22 subjects from the group of control subjects in Experiment 1, who completed the SLT. There was insufficient time to administer the test to all the control subjects.
Materials

Full details of the tasks used and their administration are given in Appendix A. They were:

a) Digit Copying Test (Kendrick, Parboosingh & Post, 1965).

b) Synonym Learning Test 5 (Kendrick, Parboosingh & Post, 1965). A score for the first five trials was used as this shorter version had been shown by Whitehead (1971) to be as reliable as the longer version.


Previous Measures

a) Age

b) Verbal Intelligence The Mill Hill Vocabulary Scale

c) Performance IQ Raven's Coloured Progressive Matrices

d) Severity of illness Psychiatric rating

Procedure

This was conducted as described in Experiment 1.

Results

The initial mean scores and standard deviations of
the variables for all groups, with estimates of the statistical significance of their differences is shown in Table 20. A one way analysis of variance indicated that the SLT and the DCT significantly differentiated between the three patient groups, (for the SLT \( p < 0.01 \), and for the DCT \( p < 0.001 \)). The score of the functionals on both tests were significantly higher than those of both the intermediates and the organics, and the scores of the intermediates were significantly higher than the organics on both tests. The performance of the controls was significantly higher than any of the patient groups on the DCT, but fell between that of the functionals and the intermediates on the SLT. Table 21 shows the mean scores and standard deviations for the functionals, intermediates and organics at the second assessment. There were no significant gains following treatment except for the performance of the functionals on the DCT. A comparison of scores on the Kendrick Battery of the present study and the study by Whitehead (1971) may be seen in Table 22. The mean score of the functionals on the SLT was 25.86 (± 27.21) which is almost identical to the SLT mean score of unselected depressives reported by Whitehead (25.07 ± 27.56).

Pre-treatment intercorrelations for the functionals are shown in Table 23. There was a significant negative correlation between the SLT and the age of first depression (\( p < 0.05 \)). Performance on Raven's Coloured Matrices correlated significantly (\( p < 0.01 \)) with performance on the SLT. Post-treatment
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<th>CONTROLS</th>
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<th>INTERMEDIATE</th>
<th>ORGANICS</th>
<th>F-RATIO</th>
<th>P</th>
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<td>AGE</td>
<td>74.5(6.63)</td>
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<td>94.90(9.94)</td>
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<td>RAVEN'S MATRICES</td>
<td>97.34(13.46)</td>
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<td>85.00(20.16)</td>
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<td>68.37(33.72)</td>
<td>46.57(26.83)</td>
<td>39.24(23.16)</td>
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<td>SLT</td>
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<td>7</td>
<td>-0.338</td>
<td>-0.417*</td>
<td>0.752**</td>
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*p < 0.05  **p < 0.01
intercorrelations for the functionals are shown in Table 24. Performance on the DCT correlated significantly with performance on the SLT ($p < 0.05$). Pre-treatment intercorrelations for the organics are shown in Table 25. There were significant positive correlations in performance by this group on all the tests, except the SLT and the Raven's Coloured Progressive Matrices.

Table 26 shows the age of onset of previous and present illness for the functionals, with performance scores on the SLT and the DCT as related to clinical improvement. Those functionals whose age at the onset of their present illness was between 60 and 69 years had higher mean scores on both tests, than those whose present illness had begun when they were 70 years and older. When retested, the former group's performance had improved on both tests, whereas it only improved on the DCT for the older group.

**Discussion**

The results show that the SLT significantly differentiated ($p < 0.01$) between functionals, intermediates and organics, as did the DCT ($p < 0.001$). For the organic group the mean score of the SLT was significantly lower than the mean score of the intermediate group, which in turn was significantly lower than the mean score of the functional group. The differences in performance for the DCT were in the same direction. As hypothesised, the Kendrick Battery differentiated between patient
### TABLE 24

**INTERCORRELATIONS FOR FUNCTIONALS (POST-TREATMENT)**

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*P < 0.05
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<td>0.443*</td>
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</table>

* p < 0.05
** p < 0.01
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<thead>
<tr>
<th></th>
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<th>Retest</th>
<th>DCT Initial</th>
<th>Retest</th>
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<tr>
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<td>84.23</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>present illness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>19 28.89</td>
<td>32.50</td>
<td>19 80.32</td>
<td>90.44</td>
</tr>
<tr>
<td>&gt;70</td>
<td>11 18.09</td>
<td>17.73</td>
<td>14 51.93</td>
<td>75.62</td>
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<tr>
<td>Much improved (a)</td>
<td>16 16.81</td>
<td>17.46</td>
<td>18 65.33</td>
<td>79.59</td>
</tr>
<tr>
<td>Moderately improved</td>
<td>8 27.38</td>
<td>27.75</td>
<td>8 65.25</td>
<td>72.63</td>
</tr>
<tr>
<td>(a)</td>
<td>6 43.33</td>
<td>57.75</td>
<td>6 88.66</td>
<td>112.83</td>
</tr>
<tr>
<td>Not improved (a)</td>
<td>13 29.85</td>
<td>29.67</td>
<td>14 66.79</td>
<td>84.69</td>
</tr>
<tr>
<td>Much improved (b)</td>
<td>4 30.75</td>
<td>25.00</td>
<td>4 63.25</td>
<td>74.00</td>
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<td>23.55</td>
<td>14 70.50</td>
<td>79.86</td>
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<tr>
<td>(b)</td>
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</table>

(a) At six weeks psychiatric assessment
(b) At six months psychiatric assessment
groups, and these results support the findings in previous studies which have shown the Kendrick Battery to be a useful aid in the differential diagnosis of depression and dementia. Furthermore, the results confirm Whitehead's (1971) report that a five-trial version of the SLT is adequate and can be substituted for the ten-trial version.

By using the 5-trial version a true comparison with the results in the validation and cross-validation studies cannot be made, as the cut-off point used to differentiate brain-damaged subjects from non brain-damaged subjects in the earlier studies by Kendrick et al (1965), and Kendrick (1967), is above the maximum score obtainable in the 5-trial version of the test. However, the present results can be compared with the scores obtained by Whitehead (1971), and these are shown together with the scores for this investigation in Table 22. It is apparent that not only are the scores for the functionals in the two studies similar, as predicted, but the variables of age and Verbal IQ are almost identical. Differences occur in the retest results. A large improvement in performance on the SLT occurred in the earlier study, but this was offset by a drop in performance on the DCT. In the present study the functional's retest performance on the DCT showed a significant improvement.

Figure 16 shows the frequency of SLT scores for ill functionals. As may be seen the range of scores is from zero to fifty. The frequency of SLT scores for functionals following
Figure 16. Frequency of SLT scores for Functionals (pre-treatment)

Figure 17. Frequency of SLT scores for Functionals (post-treatment)
remission of clinical symptoms of depression is shown in Figure 17. Again the range is from zero to fifty, with an increase in the number of patients scoring at either end of the scale, that is with lower or higher scores. One patient who scored zero in the initial testing subsequently raised her score to 27 in the second testing, while the scores of two other women dropped to zero. Both had low IQ scores: Patient W had a Verbal IQ of 85 and a Performance IQ of 70, Patient L had a Verbal IQ of 87 and a Performance IQ of 88. The majority of the organics had SLT scores of zero. Among the normal elderly control group seven subjects had performance scores on the SLT which fell within the zero to five range (see Figure 18). The mean score of this group was lower than the mean score of the functionals, which was especially surprising for as a group their Verbal IQ level was higher than the functionals by 14.04 points. The results do not therefore support the prediction than the control group would perform at a higher level than the functionals.

The results indicate that no significant correlation was found between performance on the SLT and the Gresham Questionnaire for pre-treatment functionals or following successful treatment, whereas for the organic group there was a significant correlation for the Gresham Questionnaire with both the SLT ($p<0.01$), and the DCT ($p<0.01$). Successful performance on the Gresham Questionnaire, which is concerned with orientation and memory for past and present
Figure 18. Frequency of SLT scores for Controls
events, essentially relies upon an intact memory system. As the diagnostic criteria for dementia includes evidence of a deteriorating memory, it is not surprising that for organics the results indicate a significant correlation between performance on the SLT and response to the Gresham Questionnaire. The prediction that the performance on the SLT would correlate with performance on the Gresham Questionnaire is only partially supported by the present results.

The performance of the organics, who were the most severely ill of the groups examined was significantly poorer than any of the other groups. It is evident from the results that as predicted, performance scores were related to the severity of illness. A closer examination of the functionals' performance measures in relation to clinical improvement shows that clinical improvement was reflected in the performance gains on both the DCT and the SLT, except for those whose illness had begun when they were 70 years or older on their SLT performance.

In this sub-group, performance on the SLT was poorer following treatment. The degree of performance gain was not in proportion to the degree of clinical improvement noted. In both the younger and older groups the greatest gain on the SLT was observed in the performance of those who had been described as not clinically improved. Likewise, the greatest gain for functionals on the DCT was for those who had been described as
<table>
<thead>
<tr>
<th>Age of onset of</th>
<th>SLT</th>
<th>DCT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GAIN</td>
<td>GAIN</td>
</tr>
<tr>
<td>All Patients</td>
<td>-0.71</td>
<td>15.96</td>
</tr>
<tr>
<td>60 - 69</td>
<td>3.61</td>
<td>10.12</td>
</tr>
<tr>
<td>&gt;70</td>
<td>-0.36</td>
<td>23.69</td>
</tr>
<tr>
<td>Much improved</td>
<td>0.65</td>
<td>14.26</td>
</tr>
<tr>
<td>(a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderately improved</td>
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<td>7.38</td>
</tr>
<tr>
<td>(a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not improved</td>
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<td>24.17</td>
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<tr>
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<tr>
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<td>10.75</td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not improved</td>
<td>5.32</td>
<td>9.36</td>
</tr>
</tbody>
</table>

(a) At six weeks psychiatric assessment
(b) At six months psychiatric assessment
not clinically improved (see Table 27). This finding is puzzling, and certainly opens an avenue for further investigation.

This examination of the Kendrick Battery provides evidence which adds to previous work indicating the battery reliably differentiates between diagnostic groups. It also demonstrates that the shorter 5-trial version of the SLT can be substituted for the longer version. The importance of retesting is necessarily emphasised as misclassification can occur unless this procedure is carefully adhered to.

Considering the large performance improvements seen in the functionals' DCT scores following treatment it may be possible to eliminate the SLT from the battery. Certainly, if the Gresham Questionnaire were routinely administered the results from that would also indicate organicity. As the controls' SLT performance was poorer than the functionals, the results lend no support to Kendrick's suggestion that poor SLT performance of depressives is due to arousal changes within the limbic system. Rather, it is likely the performance losses following treatment reflect an age related deficit of auditory short term memory.
CHAPTER XII

PERFORMANCE ON TASKS OF PAIRED-ASSOCIATE LEARNING AND SERIAL LEARNING

Two tests of verbal learning are examined in this chapter. They are the Paired Associate Learning Test (PALT) designed by Inglis and his colleagues (Inglis, 1959b; Shapiro, Post, Lofving & Inglis, 1956), and a serial learning task, originally developed by Eisdorfer (1963; Eisdorfer & Service, 1967), and adapted by Whitehead (1971). Also examined are two tests of verbal fluency, one using a pre-designated letter, and the other a pre-designated class.

It is generally acknowledged that a prominent feature of the ageing process is impaired learning ability. Following an extensive examination of paired-associate learning in adults, Witte (1975) concluded that the age-related deficit in performance reflects both the effects of performance factors and of a learning disability. The elderly appear to require more time for processing information (Hulicka & Wheeler, 1976), and the available evidence points toward a difficulty in the retrieval process (Nebes & Andrew-Kulis, 1976). Clinical studies have indicated that there is a verbal learning impairment in both organically impaired persons (Hall, 1972), and depressed persons (Henry, Weingerther & Murphy, 1973; Whitehead, 1971).

Proceeding the development of the PALT a series of
experiments investigating the memory function in elderly psychiatric patients was undertaken by Inglis and his colleagues. Their aim was to construct a test both sensitive to memory impairment, and as independent as possible of intellectual functioning. The PALT was shown to be a test of the acquisition phase of learning, and of something other than general intellectual ability as measured by the Wechsler Verbal Scale (Inglis, 1959b). Cross-validation studies have confirmed these claims (Caird, Sanderson & Inglis, 1962; Parsons, 1965). The PALT was included in the initial validation study of the Kendrick Battery (Kendrick, 1965), and shown to correlate significantly with performance on the Synonym Learning Test (SLT). A centroid factor analysis of the complete battery of tests identified the PALT and the SLT with a short term memory factor.

The PALT has been used in a variety of clinical studies; for prognostic and rehabilitation purposes (Isaacs, 1962), to characterise groups of elderly hospital patients (Isaacs & Walkey, 1964), and to further investigate the learning impairment of elderly psychiatric patients (Caird, Sanderson & Inglis, 1962; Whitehead, 1971). Performance on the test tends to deteriorate with increasing age (Isaacs & Walkey, 1964). Patients with organic disorders perform more poorly on the test than do functional patients (Irving, Robinson & HsAdam, 1970; Kendrick, Parboosingh & Post, 1965; Newcombe & Steinberg, 1964; Riddell,
A cross-national study investigating diagnostic groups in the United States and the United Kingdom showed the Hard version of the PALT discriminated significantly between groups of organics and functionals (Cowan et al., 1974). It has also been shown to highly differentiate between the performance of dementing patients, non-impaired depressives, and normals, matched for age and Mill-Hill Synonyms I.Q. (Kendrick & Post, 1967). Whitehead (1971) examined the performance of a group of depressives and compared it to the performance of the same group following remission of symptoms. She found the Mediate version showed a slight improvement in performance, and the Hard version a slight drop in performance. A change in the type of error was also noted; there being a substantial decrement in omission errors and a slight raise in transposition errors. Omission errors have been interpreted as a measure of cautiousness.

Botwinick (1969) examined cautiousness in the context of varying degrees of risk-taking, and interprets the behaviour of elderly people as a tendency to avoid decisions of risk rather than cautiousness in solving problems.

The Serial Learning Task adapted by Whitehead (1971, 1973, 1974) was part of a battery of tests used to compare the performance of elderly depressives and dementing patients. Whitehead's concern was the extent of the verbal learning impairment in elderly depressives, and the relative importance of non-specific task attributes. The results of the study
showed a deficit in performance of the ill depressives, which was less extreme than the impairment of the dement. No relationship was established between the level of performance and non-specific task attributes. On examination of error type, Whitehead found that the remitted depressives made more transposition errors than the ill depressives, who made more than the dement. The dement evidenced more false positives, random errors and omission errors. Unlike Eisdorfer and others (Eisdorfer, Axelrod & Wilkie, 1963; Eisdorfer, 1965; Troyer, Eisdorfer, Wilkie & Bogdonoff, 1967), Whitehead reported no effect of pacing on performance level.

Tests of verbal fluency have been used in investigations of dementia, and very low scores found to be indicative of brain disease (Isaacs & Kenne, 1973). In her study of verbal learning in elderly depressives and dement Whitehead (1971) found a verbal fluency task significantly discriminated between the two groups (p<.01), and loaded in the direction of a 'verbal learning' component. Intellectual ability appears to affect the performance of verbal fluency in all age groups (Cauthen, 1978; Borkowski, Benton & Spreen, 1967).

Hypotheses
1. The PALT, the Serial Learning Task and the two verbal fluency tasks will differentiate between the organics, intermediates, functionals, and controls.
2. The performance of the control group will be better than the performance of the functionals, who will perform better than the organics, while the intermediates' performance will fall between that of the organics and the functionals.

3. I.Q. level will not relate to performance on either the PALT or the Serial Learning Task.

4. Following remission of symptoms, the performance of the functionals will improve significantly on all the tests.

5. The remitted functionals will make more transposition errors than pre-treatment functionals, who will make more than the organics.

6. The organics will evidence more random errors and omission errors than the functionals.

Method

Subjects

These were the functional, intermediate, organic and control groups of Experiment 1.

Materials

Full details of the tasks used and their administration are given in Appendix A. They were:

a) Paired-Associate Learning Test (Inglis, 1959b)

b) Serial Learning Task (Whitehead, 1971)
c) **Verbal Fluency Tasks:** One task consisted of the naming of animals, and the other, the naming of words beginning with the letter S.

**Previous Measures**

a) **Age**

b) **Verbal Intelligence** The Mill Hill Vocabulary Scale

c) **Performance IQ** Raven's Coloured Progressive Matrices

d) **Gresham Questionnaire**

e) **Self Rating:** Items from the POMS (McNair & Lorr, 1964) were used for subjective ratings of depression, confusion, tension and friendliness.

**Procedure**

This was conducted as described in Experiment 1.

**Results**

Tables 28 and 29 show the initial mean scores of controls, functionals, intermediates and organics. A one-way analysis of variance showed that there were significant differences on the tests between the four subject groups. These were in the expected direction. The control subjects scored higher than the depressives without cerebral pathology on both the PALT and the Serial Learning Task, and also on the tasks of verbal fluency. However, the Mill Hill Vocabulary Scale was also significantly better in the controls. The post-treatment mean scores for the patient
<table>
<thead>
<tr>
<th></th>
<th>CONTROLS</th>
<th>FUNCTIONALS</th>
<th>INTERMEDIATES</th>
<th>ORGANICS</th>
<th>F RATIO</th>
<th>P</th>
</tr>
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<tbody>
<tr>
<td>AGE</td>
<td>74.5(6.63)</td>
<td>70.95(6.27)</td>
<td>80.38(7.85)</td>
<td>76.8 (7.01)</td>
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<td></td>
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<td>MILL HILL</td>
<td>108.94(9.31)</td>
<td>94.90(9.94)</td>
<td>93.00(4.36)</td>
<td>85.80(15.38)</td>
<td>13.183</td>
<td>.0001</td>
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<td>RAVENT'S MATRICES</td>
<td>97.34(13.46)</td>
<td>96.67(5.28)</td>
<td>85.00(20.16)</td>
<td>3.281</td>
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<td>GRESHAM QUESTIONNAIRE</td>
<td>17.39(2.66)</td>
<td>15.19(3.47)</td>
<td>10.29(4.82)</td>
<td>4.24(4.89)</td>
<td>55.667</td>
<td>.0001</td>
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<td>PALT</td>
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<td>49.00</td>
<td>29.39</td>
<td>34.329</td>
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<td>SERIAL LEARNING</td>
<td>20.79</td>
<td>13.16</td>
<td>3.71</td>
<td>2.00</td>
<td>22.854</td>
<td>.0001</td>
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</table>
TABLE 29
INITIAL MEAN SCORES & STANDARD DEVIATIONS FOR VERBAL FLUENCY TASKS FOR ALL GROUPS

<table>
<thead>
<tr>
<th></th>
<th>Animal Words</th>
<th>S Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controls</td>
<td>16.80±3.48</td>
<td>19.90±7.37</td>
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<tr>
<td>Functionals</td>
<td>11.29±4.49</td>
<td>13.17±7.51</td>
</tr>
<tr>
<td>Intermediates</td>
<td>9.29±3.64</td>
<td>9.71±6.99</td>
</tr>
<tr>
<td>Organics</td>
<td>7.06±3.61</td>
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<tr>
<td>Significance</td>
<td>&lt;0.001</td>
<td>&lt;0.003</td>
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TABLE 30
POST-TREATMENT MEAN SCORES AND STANDARD DEVIATIONS FOR VERBAL FLUENCY TASKS FOR PATIENT GROUPS

<table>
<thead>
<tr>
<th></th>
<th>Animal Words</th>
<th>S Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functionals</td>
<td>11.93±3.58</td>
<td>16.80±11.58</td>
</tr>
<tr>
<td>Intermediates</td>
<td>11.00±2.16</td>
<td>8.57±4.16</td>
</tr>
<tr>
<td>Organics</td>
<td>5.41±2.72</td>
<td>9.28±9.81</td>
</tr>
<tr>
<td>Significance</td>
<td>&lt;0.001</td>
<td>&lt;0.05</td>
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</tbody>
</table>

Intercorrelations for functionals and organics (pre-treatment)
For Hill Hill Vocabulary and Verbal Fluency (animal words)

<table>
<thead>
<tr>
<th></th>
<th>t</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Functionals</td>
<td>.308</td>
<td>1.65</td>
<td>ns</td>
</tr>
<tr>
<td>Organics</td>
<td>.432</td>
<td>1.915</td>
<td>ns</td>
</tr>
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</table>
groups are shown in Table 30 and Table 31. Again a one-way analysis of variance showed that there were significant differences between the groups and in the expected direction.

Intercorrelations for the functionals before treatment are shown in Table 32. Performance on the PALT correlated significantly with performance on the Gresham Questionnaire (p<0.05). This correlation held following treatment (p<0.01) (see Table 33). Intercorrelations for the organic group before treatment are shown in Table 34. For this group performance on the PALT correlated significantly with the Gresham Questionnaire (p<0.01). Performance on the Serial Learning Task correlated significantly with the Mill Hill Vocabulary Scale (p<0.01).

Error scores on the Serial Learning Task for the three patient groups before treatment, and for the control group are shown in Table 35. The functionals made more transposition errors than omission errors both pre- and post-treatment. Following treatment the number of omission and random errors decreased, while transposition errors increased. The organics made more omission errors than transposition or random errors both pre- and post-treatment. The total number of errors and type of error remained substantially the same. A univariate analysis of

Intercorrelations for functionals and organics (pre-treatment) for Mill Hill Vocabulary and Verbal Fluency (animal words) are shown on page 167.
<table>
<thead>
<tr>
<th></th>
<th>Gresham</th>
<th>PALT</th>
<th>Serial Learning</th>
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</thead>
<tbody>
<tr>
<td>Functionals</td>
<td>16.40±2.93</td>
<td>74.16±17.88</td>
<td>14.65±7.21</td>
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<tr>
<td>Intermediates</td>
<td>9.87±6.24</td>
<td>56.14±21.78</td>
<td>9.43±10.60</td>
</tr>
<tr>
<td>Organics</td>
<td>2.55±3.28</td>
<td>33.76±20.15</td>
<td>1.58±2.67</td>
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<td>F-ratios</td>
<td>87.322</td>
<td>27.855</td>
<td>22.980</td>
</tr>
<tr>
<td>Significance</td>
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<td>&lt;0.0001</td>
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### TABLE 32

**Correlations for Functionals (pre-treatment)**

<table>
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<th>4</th>
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<td></td>
</tr>
<tr>
<td>Mill Hill Vocabulary</td>
<td>2</td>
<td>-0.484**</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Progressive Matrices</td>
<td>3</td>
<td>-0.116</td>
<td>0.578**</td>
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<td></td>
</tr>
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<td>Gresham Questionnaire</td>
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<td>0.086</td>
<td>-0.126</td>
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</tr>
<tr>
<td>Paired Associate Learning</td>
<td>5</td>
<td>0.001</td>
<td>0.219</td>
<td>0.013</td>
<td>0.411*</td>
</tr>
<tr>
<td>Serial Learning</td>
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<td>-0.120</td>
<td>0.128</td>
<td>0.226</td>
<td>0.236</td>
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</tbody>
</table>

### TABLE 33

**Correlations for Functionals (post-treatment)**

<table>
<thead>
<tr>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gresham Questionnaire</td>
<td>2</td>
<td>-0.067</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paired Associate Learning</td>
<td>3</td>
<td>-0.117</td>
<td>0.711**</td>
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</tr>
<tr>
<td>Serial Learning</td>
<td>4</td>
<td>-0.074</td>
<td>0.325</td>
<td>0.025</td>
</tr>
</tbody>
</table>

*p < 0.05  **p < 0.01
TABLE 34

Correlations for Organics (pre-treatment)

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mill Hill Vocabulary</td>
<td>2</td>
<td>0.234</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Progressive Matrices</td>
<td>3</td>
<td>0.032</td>
<td>0.457*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gresham Questionnaire</td>
<td>4</td>
<td>-0.261</td>
<td>0.832**</td>
<td>0.800**</td>
<td></td>
</tr>
<tr>
<td>Paired Associate Learning</td>
<td>5</td>
<td>-0.187</td>
<td>0.256</td>
<td>0.640**</td>
<td>0.368</td>
</tr>
<tr>
<td>Serial Learning</td>
<td>6</td>
<td>-0.063</td>
<td>0.611**</td>
<td>0.318</td>
<td>0.311</td>
</tr>
</tbody>
</table>

*p < 0.05  **p < 0.01
### Table 35

**Error Scores for Controls, Functionals and Organics**

<table>
<thead>
<tr>
<th></th>
<th>Transposition</th>
<th>Omission</th>
<th>Random</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controls</td>
<td>8.00 ± 6.39</td>
<td>7.44 ± 7.05</td>
<td>1.72 ± 4.60</td>
<td>15.62 ± 10.48</td>
</tr>
<tr>
<td>Functionals (pre-treatment)</td>
<td>12.88 ± 7.59</td>
<td>12.02 ± 9.21</td>
<td>3.71 ± 6.36</td>
<td>25.6 ± 8.02</td>
</tr>
<tr>
<td>Functionals (post-treatment)</td>
<td>15.82 ± 6.75</td>
<td>8.64 ± 7.47</td>
<td>2.35 ± 6.44</td>
<td>24.94 ± 7.53</td>
</tr>
<tr>
<td>Organics (pre-treatment)</td>
<td>5.1 ± 4.41</td>
<td>30.55 ± 6.86</td>
<td>3.25 ± 4.27</td>
<td>38.9 ± 2.48</td>
</tr>
<tr>
<td>Organics (post-treatment)</td>
<td>5.36 ± 7.55</td>
<td>30.21 ± 8.49</td>
<td>2.52 ± 4.51</td>
<td>38.57 ± 2.41</td>
</tr>
</tbody>
</table>
variance indicated that the type of error differentiated between controls, functionals, and combined intermediates and organics, as shown in Table 36.

The PALT is made up of three separate parts, Easy, Mediate, and Hard, in which word pairs of increasing difficulty are presented. To determine how these parts differentiated between the groups a univariate analysis of variance was undertaken. For this analysis the intermediate and organic groups were combined to form one group. The Hard pairs were the best discriminators for the functionals and controls (p<0.001). There were significant differences between the three parts for the functionals and organics (see Tables 37 and 38).

The tasks of verbal fluency were similarly analysed with the intermediate and organic groups combined. Both S words (p<0.0095) and Animal words (p<0.001) significantly differentiated between the functionals and the controls (see Table 37), while both tasks significantly differentiated between the functionals and the organics (p<0.001) (see Table 38).

Pre- and post-treatment performance scores for functionals for the PALT and the Serial Learning Task are shown in Table 39, in relation to their age at the onset of their depressive illness, and their clinical improvement following treatment. Those patients whose present illness had begun before the age of seventy had higher scores, both pre- and post-treatment, for both the PALT and the Serial Learning Task, than those whose illness had begun when they were seventy or older. In the younger group clinical
<table>
<thead>
<tr>
<th>Error Type</th>
<th>F Ratio</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transposition</td>
<td>4.6358</td>
<td>&lt;.0125</td>
</tr>
<tr>
<td>Random</td>
<td>6.5464</td>
<td>&lt;.0024</td>
</tr>
<tr>
<td>Omission</td>
<td>14.4774</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

**TABLE 36. Significance of Error Type Between Groups**

<table>
<thead>
<tr>
<th>F Ratio</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>PALT - EASY</td>
<td>.0305</td>
</tr>
<tr>
<td>MEDIATE</td>
<td>2.4585</td>
</tr>
<tr>
<td>HARD</td>
<td>19.9933</td>
</tr>
</tbody>
</table>

**TABLE 37. Significance of PALT and VERBAL FLUENCY TASK Scores between Functionals and Controls**

<table>
<thead>
<tr>
<th>F Ratio</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>PALT - EASY</td>
<td>14.9689</td>
</tr>
<tr>
<td>MEDIATE</td>
<td>68.3482</td>
</tr>
<tr>
<td>HARD</td>
<td>65.4296</td>
</tr>
</tbody>
</table>

**TABLE 38. Significance of PALT and VERBAL FLUENCY TASK Scores between Functionals and Organics**

<table>
<thead>
<tr>
<th>F Ratio</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>S WORDS</td>
<td>24.4572</td>
</tr>
<tr>
<td>ANIMAL WORDS</td>
<td>63.8932</td>
</tr>
<tr>
<td></td>
<td>PALT</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td></td>
<td>N</td>
</tr>
<tr>
<td>All Patients</td>
<td>33</td>
</tr>
<tr>
<td>Age of onset of</td>
<td></td>
</tr>
<tr>
<td>present illness</td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>16</td>
</tr>
<tr>
<td>&gt;70</td>
<td>14</td>
</tr>
<tr>
<td>Much improved (a)</td>
<td>18</td>
</tr>
<tr>
<td>Moderately improved</td>
<td>8</td>
</tr>
<tr>
<td>(a)</td>
<td></td>
</tr>
<tr>
<td>Not improved (a)</td>
<td>6</td>
</tr>
<tr>
<td>Much improved (b)</td>
<td>14</td>
</tr>
<tr>
<td>Moderately improved</td>
<td>4</td>
</tr>
<tr>
<td>(b)</td>
<td></td>
</tr>
<tr>
<td>Not improved (b)</td>
<td>14</td>
</tr>
</tbody>
</table>

(a) At six weeks psychiatric assessment  
(b) At six months psychiatric assessment
improvement was reflected in the improved performance scores at the retesting of both the PALT and the Serial Learning Task. In the younger group a sub-group described as not clinically improved also evidenced improved performance scores on both tests. Following treatment all the sub-groups of the older group increased their performance scores on the PALT. Scores on the Serial Learning Task increased at the retesting for the moderately improved and not improved sub-groups, but decreased for the group described as clinically much improved.

The mood scale which was administered to the subjects was analysed to determine if there were any difference between the groups. For this analysis the intermediates were joined with the organics to form one organic group. A univariate analysis of variance indicated significant differences between the groups (p<0.0001) (see Table 49).

Discussion

The results show that the PALT significantly differentiated between normal elderly subjects, ill depressives and dementing patients (p<0.0001), as did the Serial Learning Task (p<0.0001). Likewise the Verbal Fluency Task using animal words significantly differentiated between the subject groups (p<0.001), as did the Verbal Fluency Task using S words (p<0.003). These results support the hypothesis that the PALT, the Serial Learning Task and the two verbal fluency tasks would differentiate between
### Table 40

**Difference Between Groups for the Mood Scale**

<table>
<thead>
<tr>
<th></th>
<th>F Ratio</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression</td>
<td>22.4795</td>
<td>.0001</td>
</tr>
<tr>
<td>Confusion</td>
<td>14.9362</td>
<td>.0001</td>
</tr>
<tr>
<td>Tension</td>
<td>14.0044</td>
<td>.0001</td>
</tr>
<tr>
<td>Friendliness</td>
<td>14.5987</td>
<td>.0001</td>
</tr>
</tbody>
</table>
organics, intermediates, functionals and controls.

The control group attained a significantly higher mean score for the PALT than the functionals who performed significantly better than the intermediates. The mean score for the organics was significantly lower than the intermediates'. Therefore the results support the second hypothesis predicting superior performance by the controls, with functionals performing better than intermediates, and organics showing the poorest performance. Figure 19 describes the pre- and post-treatment scores of the three patient groups and the control group with the cut-off points for each level of difficulty superimposed. Although little evidence of learning by the organics is seen in the Serial Learning Task, they were able to correctly respond to Easy word pairs on the PALT. As these word pairs are highly familiar one may speculate as to whether these were retrieved from older intact memories, and not solely measurements of learning. The functionals and the controls were both able to learn word pairs on the Hard pairs, while the intermediates were unable to learn beyond the Mediate level.

Intercorrelations showed that neither Verbal IQ nor Performance IQ correlated with functionals' performance on the PALT or the Serial Learning Task either pre- or post-treatment. The pre-treatment PALT performance of the functionals correlated significantly with their performance on the Gresham Questionnaire (p<0.05). The organics' performance on the Serial Learning Task
Figure 19 Pre- and Post-Treatment Scores of Three Patient Groups with Cut-Off Points

--- Post-treatment performance level
correlated with their performance on the Mill Hill Vocabulary Scale ($p < 0.01$), while their PALT performance correlated significantly with their performance on Raven's Coloured Progressive Matrices ($p < 0.01$). Performance of the organics on both tests of verbal learning did not correlate. Therefore, the third hypothesis predicting no relationship between IQ level and performance on the PALT or the Serial Learning Task, is supported by the results for the functionals, but not by the results for the organics. This latter point may, in fact, be reflecting the gross deterioration of the organics.

Although following treatment the functionals' performance improved on all the tests, the improvement was not significant, and so the results do not support the prediction that following treatment and remission of symptoms their performance would improve significantly on all the tests. Looking at their PALT performance gains following treatment it is apparent that those whose onset of depressive illness developed at a later age, made a larger improvement than a younger group whose onset of illness occurred before 70 years of age. Despite the great improvement gain of the older group it was not sufficient to equal the performance level of the younger group (see Table 39 and Table 41). Performance on the PALT tends to deteriorate with increasing age. The functionals' improvement gains indicate that not only was the older functionals' performance affected by an ageing factor, but also, and to a greater extent than in the younger functionals, by the depressive illness itself. This aspect of depressive illness in the elderly requires more
TABLE 41

GAINS IN PERFORMANCE SCORES FOR FUNCTIONALS FOLLOWING TREATMENT

<table>
<thead>
<tr>
<th></th>
<th>PALT</th>
<th>SERIAL LEARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>GAIN</td>
</tr>
<tr>
<td>All Patients</td>
<td>33</td>
<td>0.01</td>
</tr>
<tr>
<td>Age of onset of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>present illness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 - 69</td>
<td>16</td>
<td>3.31</td>
</tr>
<tr>
<td>&gt;70</td>
<td>14</td>
<td>15.35</td>
</tr>
<tr>
<td>Much improved (a)</td>
<td>18</td>
<td>9.62</td>
</tr>
<tr>
<td>Moderately improved (a)</td>
<td>8</td>
<td>5.25</td>
</tr>
<tr>
<td>Not improved (a)</td>
<td>6</td>
<td>0.67</td>
</tr>
<tr>
<td>Much improved (b)</td>
<td>14</td>
<td>10.85</td>
</tr>
<tr>
<td>Moderately improved (b)</td>
<td>4</td>
<td>10.75</td>
</tr>
<tr>
<td>Not improved</td>
<td>14</td>
<td>6.57</td>
</tr>
</tbody>
</table>

(a) At six weeks psychiatric assessment
(b) At six months psychiatric assessment
To a lesser degree a similar improvement pattern is seen in the performance gains of the functionals on the Serial Learning Task (see Table 41). However, for this test both younger and older sub-groups of functionals who were described as much improved showed a decrease in performance following treatment.

An examination of the type of error made by the three patient groups in the Serial Learning Task showed the controls made fewer random errors than the functionals or organics. In the initial testing functionals made slightly more random errors than the organics. On the second assessment random errors decreased for both groups, with functionals making fewer than the organics. More omission errors were made by organics than functionals or controls, and the number decreased for functionals following treatment. These results partially support the hypothesis that random and omission errors would be less in functionals than in organics (see Figures 20 and 21).

Organics made fewer transposition errors than either functionals or controls. Following treatment the number of transposition errors made by the functionals increased (see Figures 22 and 23).
Figure 20 - Serial Learning Test: Type of Error for Controls

Figure 21 - Serial Learning Test: Type of Error for Pre-Treatment Functionals
Figure 22 Serial Learning Test: Type of Error for Post-treatment Functionals

Figure 23 Serial Learning Test: Type of Error for Organics
These results support the prediction that the remitted functionals would make more transposition errors than pretreatment functionals, who would make more than the organics. Evidently errors of omission were exchanged for transposition errors, indicating a greater degree of response to the test following treatment. If omission errors are interpreted as a measure of cautiousness, or as Botwinick (1969) suggests, a tendency to avoid decisions of risk, then it may be inferred from these results that a depressive illness heightens this tendency in elderly people.

The Serial Learning Task consists of a series of eight items presented in five trials. Figure 24 represents the mean number of errors made on each trial for each of the three groups. There is almost no variation in the curve for the organics, which demonstrates their inability to learn almost any of the items throughout the complete presentation. For the ill depressives there is evidence of learning on the first trial, which is retained throughout four trials, but on the fifth and final trial there appears to be some loss of what has been learnt. This could be reflecting decreased inattention to the task, rather than actual learning loss. It may be seen clearly that learning continues across the trials for the controls and remitted depressives, with their best learning occurring on the final trial. We may conclude that following treatment the
Figure 24. Serial Learning Test: Number of Errors Per Trial for Organics, Functionals and Controls
learning of the functionals more closely resembles the learning of normal elderly subjects, than when they are ill.

When the serial position effect is examined (see Figure 25) again almost no variation in the curve is seen for the organics, although there is a miniscule dip for the first item. In the performance of the ill and remitted depressives and the controls, the first, second, and seventh items are the more frequently learned of the list, showing the primacy and recency effects. It would be expected that the final item would be more easily learned than the seventh. What is occurring is possibly an example of the von Restorff phenomenon, which results from the isolation of an item through a contrasting format or class. The seventh word in the list is 'woman' which may be more distinctive and less abstract than 'dozen' which succeeds it. The primacy effect is interpreted by Crowder (1976) as being dependent on some type of voluntary strategy applied during input, rather than on structural properties, thus it is a consequence of events at acquisition, while the recency effect, mediated by temporal distinctiveness, reflects an occurrence at the time of retrieval. Applying these distinctions to the learning of the organics, functionals and controls, it appears that the organics are acquiring tiny bits of information, which are then quickly lost. The functionals and controls are both acquiring and retrieving information, but there is greater difficulty at the acquisition stage for the functionals than for the controls.
Comparing the PALT and the Serial Learning Task as instruments used for aiding a differential diagnosis in the elderly, the PALT, with separate parts of increasing difficulty and clearly defined cut-off points, seems the more expedient of the two tests. The Serial Learning Task is not usefully employed for differential purposes, but would be more appropriately used to investigate the underlying mechanisms which are manifest in the performance deficits of elderly normal subjects and elderly psychiatric patients. These points of view will be taken up and discussed in relation to the other tests investigated in the concluding chapter.
CHAPTERXLV

THE NEGLECTED PERSONALITY OF THE ELDERLY PERSON

The examination of cognitive measures of psychomotor function, verbal fluency and verbal learning described earlier, was directed toward delineating more precise diagnostic criteria for a differential diagnosis of the elderly person, and for further elucidating the performance deficits in normal elderly persons and elderly psychiatric patients. The present writer, struck by the paucity of studies investigating both cognitive and behavioural psychotherapeutic procedures and personality variables in the elderly, chose to include the Eysenck Personality Questionnaire (E.P.Q.) in order to obtain some basic data on the personality of elderly depressives and elderly normals, and to see if there were any differences between the groups. The dementes were not included as they were mostly too disoriented to respond reliably to the questionnaire.

The E.P.Q., and its forerunners the Eysenck Personality Inventory (E.P.I.) and the Maudsley Personality Inventory (M.P.I.), have been studied extensively, their validity and reliability having been well established. The E.P.Q. is made up of four independent scales which measure neuroticism or emotionality (N), extraversion-introversion (E), dissimulation (L), and psychoticism or tough-mindedness (P). P refers to an
underlying personality trait which "if present in marked degree,. . . predisposes a person to the development of psychiatric illness" (Eysenck & Eysenck, 1975). The available evidence supports the view that a genetic factor contributes to the development of N, E, and P in the individual. Experimental studies have tended to support Eysenck's supposition that N is closely related to the inherited degree of lability of the autonomic nervous system, and E is closely related to the degree of excitation and inhibition prevalent in the central nervous system (Eysenck, 1967). The influence of drugs on the E-I dimension has been demonstrated, showing that stimulant drugs are introverting and depressant drugs, extraverting (Eysenck, 1967).

The standardization data for normal subjects revealed large sex and age differences on all the scales: men are higher on P and E and lower on L and N; N, P and E decline with age and L increases. However, information on the oldest group is limited as Eysenck has so few subjects. Also, he does not comment specifically on depressed old people, though he notes in general that psychiatric groups as a whole are markedly introverted and have elevated N and L scores. On the basis of the standardization data it is not surprising that elderly depressives have not been investigated, for their scores may well prove to be unreliable due to the greater degree of dissimulation found in both older people and psychiatric groups. Notwithstanding these cautionary thoughts this writer decided

*For women P, E and L increase with age.
it was worthwhile administering the questionnaire as the subjects were already co-operating in a research study and thus readily available, and if nothing else the results would provide some data regarding personality in the older person.

The predictions were limited to anticipating that the depressed group would be more introverted and have higher N scores than the control group. It was also predicted that the L scale would be as high as reported in the standardization norms for subjects over 60 years of age.

Method

Subjects

The subjects were 21 females and 4 males from the group of functionals described in Experiment 1. The control subjects were 23 females and 5 males from the control group described in Experiment 1, and who completed and returned the questionnaire.

Materials

Eysenck Personality Questionnaire (1973)

Procedure

Immediately following the initial testing session described in Experiment 1, the functionals were requested to complete the questionnaire that day during their own time. It was collected from them later by the experimenter. The same procedure was repeated following the second testing. The
controls were asked to complete the questionnaire at home as soon as possible, and were furnished with stamped addressed envelopes in which to return them. Only two questionnaires were not returned by the controls. Both groups were instructed to complete the questionnaire as they were presently feeling, and not how they felt at any time in the past.

Results

The age range of the functionals was from 62 to 80 years for females, and 60 to 74 years for males. The age range for the controls was 65 to 90 years for females, and 70 to 79 years for males. The mean scores and standard deviations for female ill depressives and controls are shown in Table 42. Students t test showed the N-score was significantly higher in female depressives than female controls (p<.001). There was a significant difference between the scores for male depressives and controls on the N scale (p<.001). The mean scores and standard deviations for remitted depressives are shown in Table 43. Students t test showed no significant differences between ill and remitted depressives.

Compared to the standardized norms for men and women sixty years and older, the P-scores of the subjects here were all lower than the norms. The L-scores for all the groups were higher than the standardized norms. Students t test showed the L-score for female depressives was significantly higher than female controls (p<.001).

When the male and female groups were combined a univariate
### TABLE 42

E.P.Q. SCORES FOR ILL DEPRESSIVES AND CONTROLS

<table>
<thead>
<tr>
<th>Females</th>
<th>n 21</th>
<th>n 23</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>9.57±4.21</td>
<td>11.39±5.21</td>
<td>1.2669</td>
<td>ns</td>
</tr>
<tr>
<td>N</td>
<td>15.28±4.65</td>
<td>9.47±5.15</td>
<td>3.9143</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>P</td>
<td>1.90-1.41</td>
<td>1.95-1.36</td>
<td>.1197</td>
<td>ns</td>
</tr>
<tr>
<td>L</td>
<td>16.28±3.16</td>
<td>13.95±3.4</td>
<td>2.3481</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Males</td>
<td>n 4</td>
<td>n 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>8.5±6.75</td>
<td>14.2±4.49</td>
<td>1.5250</td>
<td>ns</td>
</tr>
<tr>
<td>N</td>
<td>19.0±1.63</td>
<td>3.2±1.3</td>
<td>16.2364</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>P</td>
<td>2.0±1.41</td>
<td>1.6±1.8</td>
<td>.3613</td>
<td>ns</td>
</tr>
<tr>
<td>L</td>
<td>12.0±7.7</td>
<td>12.2±2.58</td>
<td>.0552</td>
<td>ns</td>
</tr>
</tbody>
</table>

### TABLE 43

E.P.Q. SCORES FOR REMITTED DEPRESSIVES

<table>
<thead>
<tr>
<th>Females</th>
<th>n 11</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>12.9±4.76</td>
<td>2.0331</td>
<td>ns</td>
</tr>
<tr>
<td>N</td>
<td>13.29±6.19</td>
<td>1.0255</td>
<td>ns</td>
</tr>
<tr>
<td>P</td>
<td>1.18±1.88</td>
<td>1.2227</td>
<td>ns</td>
</tr>
<tr>
<td>L</td>
<td>15.72±3.77</td>
<td>.4457</td>
<td>ns</td>
</tr>
</tbody>
</table>
analysis of variance showed a significant difference between the depressed and control groups on the E-I scale ($p<.0001$).

**Discussion**

The results show that the group of female ill depressives was slightly more introverted than the female controls, but the difference was not significant. However, following treatment the ill depressives who responded to the second questionnaire had a higher mean score on the E-I scale than the controls. As a group these depressives had lower pre-treatment scores than other female depressives (3.3 points), and following treatment their scores increased (4.9 points). This could be reflecting a number of environmental changes; their adaptation to a new milieu where there was greater opportunity for socialisation, the support and encouragement from physicians and nursing staff to socialise and take part in occupational and physical therapy regimes, and/or the effects of medication.

Controls, male and female, and female remitted depressives scored higher than the standardized norms for their age group on the E-I scale. For the controls this is not unexpected as they were from a community day centre where it can be assumed that those attending were expressing affiliate needs. The male depressives were lower than the standardized norms for both normals in their age group and depressives.
In line with the hypotheses the elderly women in the depressed group scored significantly higher than the normal elderly women on the neuroticism scale ($p < .001$). Following treatment their scores did not equal the female controls in this respect. However, whereas pre-treatment they more closely paralleled the standardized norms for depressed females, post-treatment they were closer to the norms for females in their age group. It appears that their high L-scores did not affect their responses to the N scale. Examination of subjects whose L-score decreased on the second testing showed no accompanying decrease in N, though an increase in E was noted in ten of the eleven subjects. It may well be that their status as hospitalised patients allowed them to reveal their degree of emotionality without fear of censure.

The score of the depressed males was significantly higher than the control males ($p < .001$). They were also 8.81 points above the standardized norms for men of their age, and 3.08 points above the standardized norms for depressed males. This, together with their lower E-I scores, indicates that they were an extreme group. This raises the question of whether men make known their depressive illness only when it has reached an acute state, for the social stigma attached to men "being ill" in this way is very high. Furthermore, if the results of the validation studies indicate men become more introverted as they age, there may be a stage of greater
vulnerability in the older male, when increased introversion combined with high neuroticism, could lead to overt expression of depression which hitherto had been successfully kept in abeyance.

These results indicate that the depressives were higher in N than the controls, and whilst ill, were more introverted than the group of normal elderly controls.

The L-scores for the males were only slightly higher than the standardized norms for men of their age. The L-scores for female controls and depressives were higher than the standardized norms for their age group, and the depressives' score was significantly higher than the controls ($p<0.05$). Figure 27 shows the frequency of L-scores for female controls and depressives. Eysenck and Eysenck (1975) advise dividing data into high and low scores when the mean L-score of a group seems high. When female controls were divided into those scoring 12 and below, that being closest to the standardized norm for their age group, their mean score rose by 1.71 points on the E-I scale, by 0.83 points on the N scale and by 0.035 points on the P scale. Depressives scoring 16 and below, that being the median L-score for their group, were partialled out from those scoring above 16. Their subsequent scores showed only very slight changes. Further discrimination was hampered by the small number of subjects.
Figure 26. Frequency of L-scores for female controls and depressives.

- Depressives
- Controls
The results not only supported the prediction that the L-scores would be as high as reported in the standardization norms, but also showed that this may not have affected the female scores on the N scale.

A study so limited in size can offer no definitive evidence for personality change in later age, but the results at least can direct attention to areas which warrent further investigation, especially as they relate to the disengagement from social intercourse of older people. Post (1969) has stated that neuroses and personality disorders rarely develop for the first time in later life. Usually they can be traced to life-long maladjustment or the presence of predisposing personality traits. As the incidence of depression rises in later life, and if cognitive variables differentiate between normals and depressives, then it is appropriate to also investigate personality traits, especially if they are related in-some way to central nervous system and autonomic nervous system functioning. Meanwhile the concluding word must be left with Post who aptly noted "old age is perhaps the ultimate 'personality test' revealing pre-existing weaknesses" (1969).

Psychological tests of psychomotor function, paired-associate learning, serial learning, verbal fluency and personality were used to examine the performance of elderly men and women from a community day centre, and depressed and dementing patients in a short-stay psychogeriatric unit. The tests were found to significantly differentiate between the patient groups and the normal group. Although following treatment the depressives' performance improved, a significant improvement was found only on the DCT, a test of psychomotor function. It remains necessary to evaluate which of the tests best discriminated between the groups, and to relate the empirical findings to theoretical propositions.

In order to facilitate the former a canonical correlation analysis was undertaken for the three groups, functionals, organics, and controls using eight tests: the DCT, DST, Verbal Fluency using Animal words and S words, the SLT, and the three parts of the PALT, Easy, Mediate and Hard. Canonical correlation analysis is a general method for analysing relations between two sets of variables. It thus aids this evaluation by determining linear combinations of the tests that are most highly correlated with linear
combinations of the groups. The two sets of new variables are then tested using Bartlett's Chi Square Test for significance of canonical variates, determining whether there is any significant linear relationship between them, and if so how many are significant. The weighted canonical variates together with the canonical variate means of the three groups are shown in Table 44. Figure 28 describes a plot of transformed observations for the variable 1 and 2. The results indicate the three groups were best discriminated by the Verbal Fluency Task using Animal words, the PALT Mediate and the PALT Hard. It is premature to reject out of hand the usefulness of the remaining tests. Certainly from this analysis it appears that the SLT, the PALT Easy and the Verbal Fluency Task using S words are of limited discriminatory value, and could be discarded from a test battery.

At this juncture it is useful to review the main structural and physiological changes that occur during the process of ageing, and relate them to functional changes evidenced in the forementioned tests. The volume and weight of the brain decreases and there is a shrunken appearance with an exaggerated pattern of cerebral cortical convolutions; the gyri are narrower and the sulci deeper and wider. This appears due to a reduction in total protein and lipid content thought to result from changes within the DNA molecule which disrupt the production of enzymes necessary for life. There is also an increase in the size of the lateral ventricles and the volume of cerebrospinal fluid.

1. The discriminating value of the verbal fluency task is further upheld by the lack of correlation found between Verbal IQ and verbal fluency (see page 167).
## TABLE 44

### CANONICAL VARIATES ANALYSIS

**ADJUSTED CANONICAL VARIATES**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCT</td>
<td>0.00929</td>
<td>0.00429</td>
</tr>
<tr>
<td>DST</td>
<td>0.04227</td>
<td>-0.02103</td>
</tr>
<tr>
<td>VERBAL FLUENCY (A)</td>
<td>0.13419</td>
<td>0.05049</td>
</tr>
<tr>
<td>VERBAL FLUENCY (S)</td>
<td>-0.03590</td>
<td>0.02584</td>
</tr>
<tr>
<td>SLT</td>
<td>-0.01872</td>
<td>-0.02289</td>
</tr>
<tr>
<td>PALT EASY</td>
<td>-0.04713</td>
<td>-0.03302</td>
</tr>
<tr>
<td>PALT MEDIATE</td>
<td>0.07866</td>
<td>-0.05693</td>
</tr>
<tr>
<td>PALT HARD</td>
<td>0.05876</td>
<td>0.04172</td>
</tr>
</tbody>
</table>

**CANONICAL VARIATE MEAN NO. 1 (FUNCTIONALS)**

3.03281  
-1.65925

**CANONICAL VARIATE MEAN NO. 2 (ORGANICS)**

0.69268  
-0.76601

**CANONICAL VARIATE MEAN NO. 3 (CONTROLS)**

4.95451  
-0.68711
Figure 27: Plot of transformed observations for Variables 1 and 2.

- B Centre for Organics (n=19)
- A Centre for Functionals (n=19)
- X - Variate 1
- Y - Variate 2
The neuronal and synaptic mechanisms differ quantitatively and possibly qualitatively. Although there is no clear understanding of the alterations occurring at the level of synaptic ultra-structure, the decrease in dendrite branching and dendrite spines suggest decreased synaptic contacts. Cellular losses vary from region to region and their relation to disease states and to senescence is unclear. The greatest decrease in cellular numbers occurs in the superior temporal gyrus, followed by the precentral gyrus. A critical site of neuronal loss is the cerebral cortex. Within the central nervous system (CNS) there is a general tendency toward neuronal loss and glia cell proliferation. The hypothalamic areas age in different ways and at different rates. Of great importance are the degenerative processes which affect the CNS and the autonomic nervous system (ANS). Both intrinsic disorders (eg. senile dementia, Alzheimer's and Pick's disease, Huntington's chorea) and extrinsic lesions (eg. vascular disease, Jacob-Creutzfeld disease, Parkinsonism, low-pressure hydrocephalus) affect the CNS. Within the ANS degenerative changes occur in the sympathetic and parasympathetic ganglia, post ganglionic nerve endings and the hypothalamus. Frolikis (1976) maintains that "the age-related changes involving increasing sensitivity and associated desynchrony of ANS end organs is a major factor in the..."

1. In presenile dementia these losses have been accompanied by "lawless" dendrite branching, clusters of new dendrite growth, appearing haphazardly along the dendritic or somal surface and with no relation to known presynaptic fields or gradients (Scheibel & Tomiyasu, 1973).
biologic disruptions of later life". The physiological parameters of the ANS, heart rate, blood pressure, skin conductance, potential and temperature, and free-fatty mobilization, can be related to behavioural parameters of vigilence, learning, memory, discrimination and WAIS Verbal-Performance scores.

Compared with normal senescence the structural changes found in senile dementia are quantitative rather than qualitative. The atrophy is most marked in the frontal, occipital and temporal regions. It is important to distinguish disorders due to exogeneous processes such as trauma, vascular diseases, infections of the brain and metabolic disease.

Let us consider the theoretical constructs which have been used to explain the decreased speed of psychomotor function in the elderly, remembering that this slowing has been shown to be accentuated in depressives, and more extreme in dments. It has been proposed that reduced reaction time results from changes in the CNS, while Kendrick has suggested that diminished performance on the DCT reflects the arousal level of the reticular activating system. Kendrick's suggestion seems plausible for the centre of the reticular activating system is in the brain stem where diffuse impulses are generated which increase the sensitivity and responsiveness of the cortex. Input comes from various sensory channels and there are connections with the ANS. The reticular activating system also appears to have connections with perceptual
mechanisms, and is thereby a mediator of generalised reactions to stress and motivation.

Peripheral mechanisms may reduce the strength of signals arriving which could result in a slower 'turn over', but considering the structural changes known to occur with ageing in the cerebral cortex where the primary sensory and motor centres are positioned, it seems more likely that the main source of limitation lies within this area. Nevertheless it cannot be ruled out that some of the psychomotor slowing associated with dementia is due to frontal lobe damage. Atrophy in the brain of a demented person is most marked in the frontal area. Perseveration is frequently encountered in the verbal and motor behaviour of a dementing person, and frontal lobe damage especially when it is bilateral is noted for producing this type of deficit (Goodglass & Kaplan, 1979; Jones-Gotman & Milner, 1977). Right frontal damage is associated with a decreased rate at which behaviour is emitted and difficulties in making mental and behavioural shifts (Lezak, 1977). Hécean (1964) found that 67% of patients with frontal lobe tumours exhibited confused states and dementia appearing as a general slowing and apathy.

Further support for this suggestion is found in the context of performance of verbal fluency, which was seen to be the best discriminator of the groups. Problems of fluency will affect speech, reading and writing (Lezak, 1976).
Impaired verbal fluency is associated with frontal lobe damage and is seen in patients with severe memory disorders (e.g., Korsakoff's psychosis).

Verbal learning performance was very poor in the dement. Almost no learning took place in the task of serial learning. The distinctions to be made are whether the material was adequately perceived and registered, and if so, was it still being rehearsed and therefore in primary memory (PM). It seems likely that the slight primacy effect observed would support this explanation. Their higher performance level attained on the Easy PALT may possibly be merely an example of automatized responding, for the word pairs were highly familiar, and may have even formed part of their repertoire of 'remote memories'. Underlying the incapacity of dement's to learn may be deficits of encoding ability, attention and/or perception due to a low arousal level for it has been shown by Gray (1972) that the reticular activating system is connected to the orbital frontal cortex.

A vastly different ball game is encountered when the performance deficits of depressives are explored. Here there are no demonstrated structural changes, and theory must perforce remain at a level of abstraction. Moreover, as a degree of misclassification occurred among the depressive group indicating a wide spectrum of performance level theorising must be highly circumspect.
ANS/CNS congruence or incongruence is a popular area from which to advance hypotheses relating to cognitive performance. There is still a great deal of controversy surrounding the issue. Most recent work is based on recognising that a balance exists between the two systems and is a requisite for effective adaptation, however the structure and physiology mediating the ANS/CNS relationships are unclear. If as Thompson and Nowlin (1973) proposed, there is an optimal range for each central and peripheral physiological variable then assessment of parameters reflecting this is of utmost importance to studies of the ageing process. Presumably, considering personality variables, if N is closely related to an inherited degree of lability of the ANS, and E is related to the degree of excitation and inhibition prevalent in the CNS, and if depressives are high in N and low on the E-I scale, then cognitive performance may be expected to reflect these states. Frolkis (1976) and Eisdorfer et al. (1970) have maintained that the ANS in the elderly is in a state of high arousal, whilst the CNS is diminished; if so then the psychomotor slowing evidenced in the performance of the depressives would be explained by the depressed CNS activity, while the verbal impairment would reflect the heightened ANS activity. The age related degenerative changes occurring in the ANS and previously described appear to increase hypothalamic sensitivity to the neurotransmitters serotonin and acetylcholine, and to thyroxine and insulin. It is this hypersensitivity which Eisdorfer et al. and Frolkis propose makes the older person more prone to hyperarousal.
The depressives' learning performance on the verbal task which was lower than the controls, could also be attributed to their poorer use of learning strategies. Their organisation strategies may be impaired through inattention or low motivation. Serial learning involves the selective use of multiple cues, and as older persons are known to not use mediators well, it is likely that depressives who are often also highly anxious, may be more than usually impaired in this manner. As well as viewing errors of omission as evidence of cautiousness it is equally cogent to view them from a level of linguistic structure. Brent (1969) demonstrated that as meaningful organisation increases the proportion of omission errors decreases, and the proportion of semantically or syntactically equivalent error increases. This occurred in the performance of the depressives, and supports the premise that they have poorer learning strategies when ill. Certainly it would be advantageous to examine this processing more systematically in elderly depressed persons.

Most age related memory deficits are not due to difficulties of perception or initial registration, and this is also apparent in the depressives' learning performance. For longer retention more elaborate coding is required and ageing deficits in secondary memory (SM) could be attributable to impaired acquisition not decrements during storage or at retrieval. Acquisition however, relies on organisational
strategies such as encoding, and this is an area where depressives have difficulty. It has been shown that encoding of a series can vary with situational conditions and subjects' characteristics (Anderson & Bower, 1973).

Waugh and Norman (1965) in their dualistic model of memory in which primary and secondary memory combine in an interactive system, indicate that it is the number of intervening items that are critical to what is lost from primary memory. Recent items are held and rehearsed in primary memory while previous items must be retrieved from secondary memory. When material to be learned exceeds the capacity of primary memory than age differences are observed, thereby implicating acquisition or retrieval difficulties. From the serial position effect observed in the learning curves of the depressives, it appears they have greater difficulty at the acquisition stage than for retrieval, and which is ameliorated following treatment.

This study has examined performance factors of elderly people and provided some basic data pertaining to particular groups. Because research is of necessity specifically narrow in focus a number of variables were ignored in the original experimental design, and which in future studies should be more exactly controlled. These include environmental influences, general health of the individual, the effects of medication on performance. It is important to separate the ageing and
depressive factors affecting performance, and although the biases inherent in cross-sectional studies are acknowledged, the investigation of younger depressed subjects in relation to verbal learning performance should be a high priority. It is similarly important to determine the effects of medication on the performance of depressives, as recent research has shown a number of prescribed drugs impair psychomotor performance and may affect learning through their influence on neurotransmitter systems.

1. Cross-sectional studies, which compare two or more age groups during a single time period, yield questionable data concerning age differences, for the results are confounded by various cultural effects (e.g. different educational opportunities, nutrition during infancy). Longitudinal studies in which subjects of one age are compared to themselves at an earlier age, help untangle the confounding between age and cultural effects. A number of research groups are now initiating cross-sectional studies and then following a portion or all of the original sample in longitudinal format. (Eisdorfer & Storrie, 1978). Miller (1980) has discussed the bias in cross-sectional studies and cites substantial evidence to show that when elderly subjects are directly compared with younger subjects, the decline in cognitive functioning which occurs as a result of normal aging is exaggerated. (Miller, E. In James E. Birren & R. Bruce Sloane (Eds.), Handbook of Mental Health and Aging. N.J.: Prentice-Hall, 1980.)
APPENDIX A
THE TESTS

Procedure

The subjects were seen individually. The experimenter assumed a supportive and encouraging attitude in order to maximise the subjects' performance and to elicit their cooperation for the entire testing session. If a subject was totally unwilling to complete a task, it was discontinued and the following task introduced, as willingness to continue overall was deemed more important.

Initial Instructions

On the first occasion of testing all subjects were instructed as follows:-

I have here a number of different things I would like you to try. Some are quite difficult and some are fairly easy. None of them are very long, so don't worry; if we get to something hard, we'll soon stop it and go on to something easier.

On the second occasion, the instructions were:

I expect you remember doing some of these things before...

If the subject indicated they did not remember, the initial instructions were repeated.
Order of Tests

Experiments 1,

Session I
Gresham Ward Questionnaire
Mill Hill Vocabulary
Raven's Coloured Progressive Matrices
Serial Learning Test
Digit Copying Test
Paired-Associate Learning Test
Digit Symbol Test
Square Drawing
Synonym Learning Test
Fluency
Mood Scale

Session 2
Gresham Ward Questionnaire (Parts 1 & 4)
Serial Learning Test
Digit Copying Test
Paired-Associate Learning Test
Digit Symbol Test
Square Drawing
Synonym Learning Test
Fluency
Mood Scale
Experiment 2

As Experiment 1, Session 1, except that the Raven's Progressive Matrices was omitted.

Administration and Scoring of Tests

Gresham Ward Questionnaire (Institute of Psychiatry, 1973)

This was administered in the standard manner either by the registrar in charge of the case soon after admission to the hospital, or by the experimenter. During the second session and for all control subjects, it was administered by the experimenter. Total scores, and scores for parts 1 and 4 were extracted as appropriate.

Mill Hill Vocabulary Form A (Senior) (Raven, 1958)

Administration This was administered by either the registrar in charge of the case, or by the experimenter. For control subjects it was administered by the experimenter. If a subject found the words difficult to read, they were read to him.

Scoring The raw score was converted to an I.Q. equivalent, using norms supplied by Kendrick (1964b).

Coloured Progressive Matrices (Raven, 1966)

Administration This was administered by the experimenter in the manner described by Raven (1962).

Scoring The raw score was converted to an I.Q. equivalent using norms supplied by Kendrick (1964).
Comment due to lack of time available for testing controls, this test was not administered to the control subjects.

Serial Learning Test

Material The list was composed of eight five-letter disyllabic words given by Eisdorfer et al. (1963). These words are highly familiar; occurring at least 41 times in a million as rated by the Thorndike-Lorge, 1944, word count; and highly meaningful as defined in a study by Taylor (1959). The words were always presented in the following order: PUPIL, RIVER, TODAY, JEWEL, METAL, HONEY, WOMAN, DOZEN. Each word was printed upon an index card (127mm x 77mm) in heavy block capitals 15mm high. The deck of cards was faced with a card picturing an asterix.

Administration Exposure to the words was in both visual and auditory modalities. Each was exposed and read aloud by the experimenter, except when the subject had already given the correct response. The experimenter then said "good". The task was introduced as follows: I have here a pile of cards. On each card is written a word. Your task is to try to learn the order in which these cards appear. Now, the first word is 'pupil' (exposing it) and after 'pupil' comes 'river'...etc. Each word was shown for five seconds in the initial exposure; five self-paced anticipation trials were then given. The deck was placed with the asterix card showing and the subject was then asked: What was the first word?
If he responded "pupil" the card was exposed, and the experimenter said "good"; if he responded with some other word, the card was exposed and the experimenter said "no, pupil". If the subject indicated that he did not know, the card was exposed and the experimenter said "pupil". If he failed to respond in thirty seconds, the experimenter repeated the initial instruction, which was repeated again after another thirty seconds. After a total of ninety seconds, the experimenter said:

We had better see what it is.

and turned the card over, saying "pupil".

For the next item, the experimenter said:

What comes after 'pupil'?

In the event of a subject gaining a fully correct trial, he was credited with correct responses for the remaining trials.

**Scoring** Each of the forty responses was noted as being either correct, a transposition error, a random error or an omission error. Error scores were, therefore, the total for each of these three categories.

**Recognition**

**Materials** Sixteen cards were prepared, similar to those in the Serial Learning; half contained the words used in that task and the other half of the words were of a similar form and familiarity. The order was randomised except that not more than new or old words were allowed in sequence. The order used was:

DOZEN, COVER, JEWEL, TODAY, LIMIT, HONEY, FEVER, SUGAR, WOMAN, GAZER, RIVER, VISIT, NOVEL, PUPIL, METAL, BASIN. The pack was faced with a card picturing an O.
Administration. The pack was placed before the subject and he was told: -

Here I have another pack with more words in it. All I want you to do is look at each word and tell me whether you saw it in the last pack or not.

Most subjects went through the pack on their own, but if they had difficulty the experimenter turned the cards over and called out the words.

Scoring. The score was the total number of correct decisions. The number of false negatives and false positives was also noted.

Digit Copying Test (Kendrick, Parboosingh & Post, 1965)

Materials. The test consists of 100 digits randomly distributed in a 10 x 10 matrix; with each of the ten digits 0 - 9 occurring randomly ten times. In order to make the digits as clearly differentiated as possible each digit was placed in an outlined box measuring approximately 1" x \( \frac{1}{4} \)". The digits measured approximately 4/10" each.

Administration. The subject was instructed as follows: -

I want you to copy under each number the same number, as fast as you can. If you see a 2 put a 2 on the line below, if you see a 4 put a 4. Don't skip any numbers. Work across the lines and continue until you are told to stop. Ready, begin.

Scoring. The subject was allowed 120 seconds to complete the test. If the subject finished before the time elapsed, the time taken was recorded to the nearest tenth of a second. The score
was the average time per digit, whether the digit was correct or incorrect. The reciprocal of the mean time was then taken and multiplied by 100.

**Paired-Associate Learning Test (Inglis, 1959b)**

**Materials** The pairs used were those described by Inglis (1959b); the Inglis Hard being his 'new pairs' (flower-spark; table-river; bottle-comb); the Inglis Mediate being his 'mediate pairs' (cup-plate; cat-milk; gold-lead); and the Inglis Easy being his 'old pairs' (knife-fork; east-west; hand-foot). For session 2 of Experiment 1 a second set of Inglis Hard were used (cabbage-pen; knife-chimney; sponge-trumpet). Ten trials were given and a fixed random order was adopted for testing the pairs within each trial.

**Administration** This was described by Kendrick et al. (1965) with modified instructions as used by Whitehead (1971). Prior to the Inglis Hard, the subjects were told:

I have here some pairs of words. I want you to learn the words that go together so that when I say the first word, you can say the second word. When I say 'flower', I want you to say 'spark'; when I say 'table', I want you to say 'river'; and when I say 'bottle' I want you to say 'comb'. Now what do you say when I say 'table'? etc.

Inglis Mediate and Inglis Easy were introduced with the words:

Now I have some more of those pairs of words.
Thereafter they were administered in the same way as the Inglis Hard. Inglis Easy were given only to those subjects who were unable to learn any pair to criterion on either of the other two tasks.

**Scoring** The correct score was obtained as indicated by Kendrick et al. (1965), except that with only ten trials the maximum score was 30.

**Digit Symbol Test** (Weschler, 1955)

**Materials** The test as printed in the WAIS Scale booklet. It consists of four rows containing 100 small blank squares, each paired with a randomly assigned number from one to nine. Above the rows is a printed key that pairs each number with a different nonsense symbol.

**Administration** The procedure used was the one described by Weschler (1955).

**Scoring** Timing began after the subject had completed a practice trial of ten squares, and was then told to begin. The time limit was 90 seconds. One point was given for each square filled in correctly. For a reversed symbol a half credit was given. The ten squares in the practice trial were not included in the score. The maximum score was 90.

**Square Drawing**

**Materials** Blank quarto paper and pencil.

**Administration** The subject was told:
On this piece of paper I would like you to draw three squares for me.

Queries as to size of positioning were replied with:—

As you like.

The subjects were timed from the moment of beginning the first square

**Scoring** Time to draw the three squares.

**Synonym Learning Test** (Kendrick et al., 1965)

**Administration** This was in the standard manner. The meaning of 'pawky' was given as 'funny', for the reason indicated by Whitehead (1971), that subjects did not know the word 'satirical'.

**Scoring** The full score was obtained in the standard manner, with non-completion counted as failure. Scores were also extracted on the first five trials only.

**Fluency**

**Animals**

**Administration** The subject was told:—

I want you to tell me the names of as many animals as you can think of... animals.

If he failed to start within fifteen seconds, or said he did not know any, then the experimenter said:—

Tell me the name of any animal at all.

Timing began with the first animal given, and the total time allowed was 60 seconds. The subjects' responses were recorded verbatim.
Scoring  Any noun that could be used to denote any member of the animal kingdom was accepted (e.g. "fish" or "snail" were acceptable responses). The score was the total number of different animals named; repetitions were not scored.

S Words

Administration The subject was told:—

Now I want you to tell me as many words as you can that begin with the letter S.

If the subject failed to start within fifteen seconds, or indicated he did not know any words the experimenter then said:—

Tell me any words you know that begin with the letter S.

Timing began when the first S word was given, and a total time of 60 seconds was allowed. The subjects' responses were recorded verbatim.

Scoring Any word beginning with the letter S was accepted. The score was the total number of different words; repetitions were not scored.

Self-Rating Mood Scales (McNair & Lorr, 1964)

Material  Four moods—depression, confusion, tension and friendliness—were assessed using those items loading most highly on McNair's and Lorr's factors, and used by Whitehead (1971). For depression, there were seven adjectives—WORTHLESS, HELPLESS, UNHAPPY, DISCOURAGED, LONELY, GLOOMY, MISERABLE. For confusion, five items were used—FORGETFUL, ABLE TO CONCENTRATE, ABLE TO THINK CLEARLY, EFFICIENT, CONFUSED, and for tension, four items
TENSE, RELAXED, ANXIOUS, UNEASY. The first two items for friendliness were also used - FRIENDLY, CO-OPERATIVE. The words were printed in large letters on index cards, and the items defining the different moods were mixed together. Four cards were printed with category heads - NOT AT ALL, A LITTLE, QUITE A BIT, EXTREMELY.

**Administration** The category heads were placed in order before the subject and the experimenter said:

I would like to ask you how your mood has been in the last few days. For instance, have you felt at all tense in the past few days?

The card printed with the word "tense" was displayed. If the subject said "no", it was placed on the 'Not at all' pile; if he said "Yes", then the experimenter said:

Have you felt a little tense, quite a bit tense or extremely tense?

The categories were indicated at the same time. Until the subject began the categories himself ("very" being allowed for "extremely"), these instructions were repeated every time.

**Scoring** Each item was scored 0 - 3 according to its assigned category; four items that were in the direction opposite to their scale (e.g. "relaxed") were reversed for scoring. By summing across items, a total score was gained for each scale and this was converted to an average score by dividing the number of items in the scale.
Psychiatric Ratings

The overall rating of severity of depressive symptomatology was made by the consultant psychiatrist using the following rating schedule:

0. Absent
1. Minimal
2. Mild
3. Moderate
4. Severe
5. Extremely severe
<table>
<thead>
<tr>
<th></th>
<th>9</th>
<th>1</th>
<th>3</th>
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APPENDIX C

Procedure for Classification of Individual Subject

Scores for all tests are required. Multiply the values of the new test scores by the weights for the two canonical variates and sum each set of values so weighted. This gives a pair of co-ordinates which can be plotted on the diagram of transformed scores (see page 203). This will show the new subject in relation to the three groups and their possible classification.

Example

Subject R has the following scores: DCT 94, DST 14, Animal words 12, S words 10, SLT 5, PALT Easy 30, Mediate 30, Hard 14. These are then multiplied by the weights for the two canonical variates, e.g. 94 x .00929, and 94 x .00429. The scores for this subject are

\[
\begin{array}{cccc}
1 & 2 \\
.87325 & .40326 \\
.59178 & -.29442 \\
1.61028 & .60588 \\
-.359 & .2584 \\
-.0936 & -.11445 \\
-1.4139 & -.9906 \\
2.3598 & -1.7079 \\
.82264 & .58408 \\
4.39125 & -1.25575 \\
\end{array}
\]

When these two co-ordinates are plotted the subject is classified as a normal elderly, neither depressed nor dementing.
REFERENCES


Barbigan, N.M., Gardner, E., Miles, M.C. & Romano, J. Diagnostic consistency and change in a follow-up study of 1215 patients. Amer. J. Psychiat., 1965, 121, 895-901.


Birren, J.E. & Botwinick, J. The relation of writing speed to age and to the senile psychoses.


Orme, J. F. Non-verbal and verbal performance in normal old age, and senile dementia and elderly depression. J. Geront., 1957, 12, 408-413.


Roth, M. Classification and aetiology in mental disorders of old age. In D.W.K. Kay & A. Walk (Eds.), Recent developments in psychogeriatrics.


Ryan, C. & Butters, N. Learning and memory impairments in young and old alcoholics: evidence for the premature-aging hypothesis. Boston University School of Medicine, 1980.


Shapiro, M. B., Post, F., Lofving, Barbro & Inglis, J. 'Memory function' in psychiatric patients over sixty; some methodological and diagnostic implications. J. Nerv. Sci., 1956, 102, 233-246.


Talland, G. A. Age and warning effect on P. T. J. Geront., 1964, 19, 31-38.


