UNIVERSITY OF CAPE TOWN

DEPARTMENT OF PSYCHOLOGY

A PRELIMINARY INVESTIGATION INTO THE RELATIONSHIP BETWEEN AGE, GENDER, EDUCATION, OCCUPATION AND "RACE" AND PERFORMANCE ON SELECTED NEURO-PSYCHOLOGICAL TESTS IN A NON-CLINICAL ADULT SAMPLE.

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I hereby declare that this mini-dissertation is my own work and that I have not submitted it, nor part of it, for a degree at any other University.

R. Ahmed.

ABSTRACT

The present study investigated the relationship between the subject variables Age, Gender, Education level, Occupational Status and "Race" on neuropsychological test performance in a large, convenient, non-clinical sample. The Controlled Oral Word Association Test, Wechsler Paired-Associate Learning Test and Digit Supraspan was administered to 329 adults in the age range 18 - 80. The relationship between the subject variables and test performance was analysed by ANOVA.

It was found that a higher level of Education and a higher Occupational level was associated with superior performance, irrespective of "Race". Consistently significant ANOVA results were obtained for Education and Occupation and these variables also produced the most variation in test performance (percentage variance estimates ranged from 7 - 25%). Differences due to "Race" were marked at the lower levels of Education and Occupation and were minimal or absent at the higher levels of Education and Occupation. Age and Gender influenced test performance to a lesser extent. and performed less consistently. One exception was the influence of Age on performance on the Wechsler Paired Associate Learning Test, where the contribution was

relatively large (percentage variance 6 - 7%), where younger subjects (18 - 50) performed better than older subjects (51 - 80).

Generally, the results were consistent with previously published data and highlight the need for more complete normative data. Local normative data that takes into account the influence of these variables on neuropsychological test performance needs to be developed.

GLOSSARY OF TERMS

South African society is structured by the system of apartheid and therefore the terms used in the present study need clarification. Terms used by State Legislation have been retained and their usage is unavoidable but not without objection from the 'collective'. These terms appear in quotation marks throughout the text.

1. "Race" - a term used by the Government to classify people on the basis of ancestory.

2. "White" - a term used by the Government to classify people of European origin.

3. "Coloured" - a term used by the Government to classify people of mixed origin.

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1. INTRODUCTION

The use of standardised psychometric procedures in a neuropsychological assessment raises questions about the psychometric properties of the tests used. One issue that has received increasing attention has been the inadequacy of normative data for some of the more frequently used batteries like the Wechsler Memory Scale (WMS), as well as more specialised individual tests (Lezak, 1983; Loring & Papanicolaou, 1987; Prigatano, 1978). Locally, this issue has also received attention recently (Cornfield, 1989; Dugmore, 1987; Rosin & Levett, 1989). These studies have pointed to the danger of misclassifying subjects as brain-damaged as a result of inadequate normative data. While attempts have been made to generate more complete data both in North American studies (for example, Yeudall, From, Reddon & Stefanyk, 1986; Bak & Green, 1980) as well as locally (for example, Rosin & Levett, 1989), certain problems remain.

The first major limitation is surprising not because of its complexity but because of its simplicity. Test performance is influenced by a number of subject variables such as Age, Gender, Occupational Status, "Race" and Psychiatric Status, but little or no information is provided on these variables (Prigatano & Parsons, 1976). For example, Heaton, Baade and Johnson (1978) reviewed 94 studies in which neuropsychological test scores of psychiatric patients and brain-damaged patients were compared. In 38% of these studies, Age was not mentioned or the groups

differed with respect to Age and Heaton et al. (1978) themselves make no mention of Gender in their study.

In terms of the normative data this issue raises two problems. Firstly, very little or no information is provided on these variables. Secondly, very few studies have systematically investigated if and how these variables affect test performance. An examination of the studies on the Wechsler Memory Scale reviewed for the present study illustrates this point.

Of the seven studies attempting to generate more broadly based Age norms for the Wechsler Memory Scale, none of them examined the influence of Gender on test performance, only three report on Gender, and the others make no mention of gender at all. Only the Stanton, Jenkins, Savageau, Zyzanski and Aucoin (1984) study examines Age and Education as independent variables, and only McCarthy and Siegler (1982) examine more than two variables as well as providing variance estimates. Occupation is not even mentioned in these studies. This may be a significant omission since Occupation could influence performance as a consequence of the "overlearning" of specific skills (Parsons & Prigatano, 1978).

The second major limitation relates to the samples which the normative data have been based on. These samples have been relatively small and there has been an overrepresentation of institutionalised patients. For example, the original norms provided by Wechsler (1945) and the data provided by Bak and Green (1980) is based on a total of 96 and 15 subjects

respectively. Furthermore, only these studies use non-institutionalised patients. The use of institutionalised patients is questionable because these groups may perform differently from a non-clinical sample. Klonoff and Kennedy (1966) demonstrated that institutionalised octagenarians had poorer memory scores than non-institutionalised octagenarians on the Wechsler Memory Scale.

These limitations become even more problematic when considered in the specific context of South African society. Clinicians, the majority of whom are "white" are faced with the task of assessing "black" individuals from very different socio-economic backgrounds, differing education systems and differing cultural influences.

The local studies investigating the relationship between the variables identified and neuropsychological test performance highlight this issue. Three studies by Cornfield (1989), Dugmore (1987) and Rosin and Levett (1989) have investigated performance on the Trail Making Test in a non-clinical sample. Age, IQ (Cornfield, 1989; Rosin & Levett, 1989); Educational Level (Cornfield, 1989; Dugmore, 1987; Rosin & Levett, 1989) as well as Occupational Level (Dugmore, 1987) have been found to influence test performance. Furthermore, Cornfield (1989) found a large number of normal aged people were in fact misclassified as brain-damaged using the normative data from North American studies.

If this danger exists for a sample of "white" middle-class subjects, it surely raises the question of whether these problems

would be exacerbated in assessing patients drawn from other "race" groups, against whom State policy discriminates in terms of quality of Education and opportunities for occupational advancement.

This sort of finding has serious implications for both assessment and rehabilitation. Diagnostically, neuropsychologists have to consider the possibility of false positives (diagnosing brain damage when there is none) and the inadequacy of present normative data increases this chance. In terms of rehabilitation an incorrect diagnosis has far-reaching implications. It determines issues like further assessment, return to work as well as possible legal action. It is therefore essential that the clinician makes an accurate diagnosis.

It is clear then that the added dimension of "white" clinicians assessing other "race" patients makes the need for local normative data even more pressing. The review of the literature suggests that the kind of reference data most needed by clinicians is how performance is affected by the subject variables identified above. A systematic investigation of how these subject variables affect performance will enable the clinician to make more accurate diagnoses given the limitations of existing normative data.

The present study aims to investigate the relationship between Age, Gender, Occupation, Education, and "Race" on a large, convenient, non-clinical sample of South African adults on selected neuropsychological tests. This is intended as a

preliminary step to identify which of the variables affect performance and use these in the second phase of the investigation, which aims to provide normative data for the tests used. It therefore also limits itself in terms of the number and choice of tests selected for the present study. However, even the initial descriptive data reported in the present study is extensive when compared to the normative data presently available for these tests.

Three tests were selected for the present study: (1) The Wechsler-Paired Associates Learning Test - Immediate and Delayed Recall (Wechsler, 1945); (2) Digit Supraspan (Burbach, 1987); (3) The Controlled Oral Word Association Test (Benton & Hamsher, 1976, cited in Lezak, 1983).

2. A BRIEF REVIEW OF CLINICAL MEMORY ASSESSMENT AS AN AID TO TEST SELECTION

A detailed review of clinical memory testing is beyond the scope of this paper and excellent review articles already exist (see Erikson & Scott, 1977 and Loring & Papanicalou, 1987). What follows is a selective review insofar as it pertains to the selection of the tests for the present study and the modifications made to some of the tests. Both the Wechsler Paired-Associate Learning Test and Digit span in the present study were adapted from the Wechsler Memory Scale (1945). Two other tests, Visual Reproduction and Logical Memory were also adapted from the Wechsler Memory Scale, but these will be

investigated in the second phase of the study. The only test not selected from the Wechsler Memory Scale is the Controlled Oral Word Association which is from the Benton and Hamsher's multilingual Aphasia Exam (cited In Lezak, 1983).

While the Wechsler Memory Scale has been extensively criticised (Erickson & Scott, 1977; Loring & Papanicalaou, 1987; Prigatano, 1978; and Russel (1975) it remains the most widely used clinical test of memory. The major criticisms levelled against it in terms of its psychometric properties has been the inadequacy of its standardisation sample and consequently inadequate norms, little information about its reliability, disagreement about its factor structure and therefore its validity. The assumption that memory is a unitary phenomenon by its computation of a Mental Quotient score from the sum of all sub-test scores, and the fact that it does not allow for delayed recall has also been questioned.

In spite of these criticism, however, the test enjoys continued use probably due to the fact that it has the advantage of being brief and practical (Oresick & Broder, 1988), has reasonable construct validity as a test of short-term verbal memory (Prigatano, 1978), and perhaps the greatest advantage is, that it includes a variety of sub-tests that sample diverse areas of memory which are thought to be useful in isolating specific memory deficits associated with particular organic brain injuries. The recent clinical usage of the Wechsler Memory Scale has been towards the use of subtests that are clinically useful

rather than the idea of a Mental Quotient which may obscure important information about memory performance.

This present usage is supported by Russel's (1975) revision of the Wechsler Memory Scale as well as by several factor-analytic studies which suggest that the Wechsler Memory Scale is not a unitary scale (Bacharach & Mintz, 1974; Davis & Svenson, 1970; Dujoune & Levy, 1971; Ivinskis, Allen & Shaw, 1971; and Oresick & Broder, 1988). While there is not complete agreement over its factor structure the findings suggest two or three factors (Prigatano, 1978; Russel, 1975). The first factor (unspecified) loads on the Information and Orientation sub-tests of the Wechsler Memory Scale, the second factor (attention and concentration factor) loads on the Mental Control and Digit Span subtests and the third factor (retention or memory factor) loads on Logical Memory, Visual Reproduction and Associate learning sub-tests (Prigatano, 1978). These findings from the factor-analytic research guided the choice of a battery test for this investigation, and are supported by Erikson and Scott (1977) in their review of clinical memory testing. They suggest that a test battery for clinical memory testing should be brief and should include, amongst others, a digit span task and paired-associate task to assess verbal memory.

Logical memory, Visual Reproduction and Paired-Associate subtests from the Wechsler Memory Scale were selected in the initial data collection. As the focus in this phase of the investigation was on verbal memory, Visual reproduction which Russel (1975) considers a test of figural memory was left for the next phase of

the investigation. While both Logical Memory and Paired Associate Learning assess Verbal Memory functions (Russel, 1975), Paired-Associate Learning was selected for the present investigation for the following reasons:

(1) There is disagreement over scoring criteria for Logical Memory (Russel, 1975) and therefore possibly low inter-scorer reliability.

(2) The Logical Memory passage in clinical use in South Africa are an adaptation of the original Wechsler (1945) passages.

(3) Objectivity of scoring criteria for Paired-Associates (Loring, 1987).

The final issue considered in selection of the test-battery was the criticism that most memory tests measure learning rather than retention (Erickson & Scott, 1977) and there is a lack of a distinction between immediate, long-term or recent and distant memory (Russel, 1975). This issue was addressed by the inclusion of a half-an-hour delayed recall condition as suggested by Russel (1975) for the Paired Associate subtest.

The general issues raised above with regard to clinical memory testing determined the choice of the battery of tests selected for the present study. A description as well as a literature review more specific to each of the tests selected follows.

3. DESCRIPTION OF THE PRESENT TEST BATTERY AND REVIEW OF THE LITERATURE.

(i) The Controlled Oral Word Association Test

This is considered to be a test of verbal fluency (Lezak, 1983) and like other verbal fluency tests is measured by the number of words produced within a specified time-limit. While it is regarded as a measure of Verbal Short-term memory, Estes (1974) suggests it extends beyond this.

Estes (1974) suggests that this type of task involves the subject's Vocabulary, i.e. the availability of words, which are organised in the individual's long-term memory system. These words are retrieved from Long-term memory and recall involves Short-term memory because the individual must keep track of the words already given to avoid repetitions.

Successful performance depends on the subject's ability to organise output in terms of clusters of meaningfully related words. It is for this reason then that Estes (1974) suggests that verbal fluency tests provide an excellent means of finding out whether and how well the subject organises his/her thinking. Given that a certain amount of planning of output is required, it is not surprising then that Perret (1973) found word fluency to be reduced by left frontal lesions.

The Controlled Oral Word Association Test was developed as part of Benton and Hamsher's Multilingual Aphasia Exams (cited in Lezak, 1983, p. 330). It provides norms for two sets of letters

CFL and PRW which are selected on the basis of the frequency of English words beginning with these letters. The first letter of both sets is of a high frequency, the second letter being of a lower frequency and the third letter even lower frequency (Lezak, 1983).

The examiner asks the subject to say as many words as he/she can think of, excluding proper nouns, numbers and same words with a different suffix, in one minute. The high frequency letter "S" is used as a warm-up trial to see if the subject understands the task. The total score is obtained by the sum of all acceptable words in one minute trials for each letter (see Appendix).

Age, sex and education have been found to affect performance on this test and Benton and Hamsher (1976) (cited in Lezak, 1983, p. 331) provide an adjustment table for this test. The total score is adjusted for age, gender and education and the adjusted scores are then converted to percentiles which enable the clinician to identify brain pathology.

Presently, clinicians in South Africa use the adjustment tables provided by Benton and Hamsher (1976) (cited in Lezak, 1983, p. 331), as no South African norms exist. The raw scores for each letter were retained in the present investigation instead of the adjusted scores, as this is the first part of the investigation. The letters "C, F, L" were selected for the present investigation, because of their usage by clinicians in the Cape Town area.

(ii) Wechsler Associate Learning - Immediate and Delayed Recall

In the original version of this test (Wechsler, 1945), the subject is required to listen to a series of word pairs read aloud and then to recall the correct response to stimulus words over three trials. The series consists of ten pairs of words, six of which are "easy" associations (for e.g. North-South) and four are "hard" associations (for e.g. Cabbage-Pen). The final score is obtained by:

$$\text{Final Score} = \frac{\text{Sum of Easy Associates}}{2} + \text{Sum of Hard Associates}$$

over three trials.

For the present study the original administration and scoring procedures were retained, with one modification. A Delayed-Recall trial after a half-an-hour interval was introduced, using the same administration and scoring procedure for a single trial. The subjects therefore had two scores (1) Wechsler Paired Associates-Immediate Recall (score over 3 trials); (2) Wechsler Paired Associates-Delayed Recall (1 trial).

There is agreement that Paired Associate tasks are tasks of verbal memory (Erickson & Scott, 1977; Lezak, 1983). Erikson and Scott (1977) view this task as essential for memory assessment and Newcombe and Steinberg (1964) found a paired-associate task to be superior to the Graham-Kendall and Walton-Black tests in discriminating between functional and organic patients. The task is clinically useful (Kaszniak, Garron & Fox, 1979) and easily administered and scored.

There are some indications that the "easy" and "hard" associations may be tapping different memory processes. Dujoune and Levy (1971) found that the "easy" and "hard" associations had different factor loadings. Wilson, Bacon, Kasznicek and Fox (1982) investigated this difference. They suggest that learning "hard" or low associates is an Episodic memory task, while learning "easy" or high associate word pairs involves both new learning (Episodic memory) and the network of verbal associations in Semantic memory.

In terms of which factors affect performance on this test most of the studies to date have examined this test as part of Wechsler Memory Scale. The results of the normative studies reviewed earlier (Bak & Greene, 1980; Hulicka, 1966; Klonoff & Kennedy, 1965; and McCarthy et al. 1982) are fairly consistent and show a decline in Wechsler Memory Scale performance from around age 50. What also emerges is that the relationship between Age and performance varies as a function of the sub-test under consideration. Margolis and Scialfia (1984) point out that differences in Personal Information, Orientation, Mental Control and Digit Span appear to be of 'negligible clinical importance', while there are substantial mean age differences in Associate Learning, Logical Memory and Visual Reproduction. This finding is consistent with the results reported by Kear, Collwell and Heller (1978), and Klonoff and Kennedy (1965, 1966).

Delayed Recall for Paired Associate Learning has not been previously investigated and the studies investigating the

relationship between Age and Delayed Recall on Logical Memory have produced no significant results. While Delayed Recall was poorer for all ages there were no significant Age-related effects (Cauthen, 1977; Haaland, Linn, Hunt & Goodwin, 1983; McCarthy et al., 1982). While both Logical Memory and Paired Associate Learning are measures of Verbal Memory it is not clear if these results are applicable to Paired Associate Learning since task demands are different.

The studies by Bak and Greene (1981) and McCarthy et al. (1982) suggest that Education exerts a substantial influence on performance and McCarthy et al. (1982) report that Education produced the highest variance in test scores. The influence of occupation on performance has not been previously investigated.

This test has not been previously investigated locally. The norms used by clinicians are those provided by Wechsler (1945) and the subsequent extension of this data (Hulicka, 1966).
The Delayed Recall modification to the Wechsler Memory Scale is fairly recent (1975) and none of the studies reviewed have investigated Delayed Recall for Paired Associates.

(iii) Digit Supraspan

The Digit Span is a quickly and easily administered task that is used in many different contexts. It is one of the sub-tests of the South African Wechsler Adult Intelligence Scale as well as being included in the Wechsler Memory Scale. The Digit Span consists of two subtests, Digits Forward and Digits Backward.

Both tests consist of pairs of random number sequences that the examiner reads aloud at the rate of one per second. They therefore both involve auditory attention. However, according to Lezak (1983) this is where the similarity ends and for neuropsychological investigations they are best treated separately.

According to Black (1986), Griffin and Heffernan (1983) and Lezak (1983), Digits Forward and Backwards involve different mental activities and possibly even different neuroanatomy. Digits Forward is more of a passive process of holding information, while Digits Backward is a more complex process that involves the additional process of converting forwardly presented information into coordinates that represent the reversed order (Banken, 1985). A detailed review of this is beyond the scope of the paper and Black (1986) provides an excellent summary. The conclusion that can be drawn from the studies is that the process of combining Digits Forward and Digits Backward to obtain a composite score obscures information and for neuropsychological purposes raw-scores provide the most useful data (Lezak, 1983).

In terms of its clinical utility the Digit Span, like all other neuropsychological measures, should not be used in isolation because of the inconsistency of its findings in differentiating brain-damaged from normal subjects (Black, 1986; Lezak, 1983). There is a risk of false negatives (i.e. inability to detect brain dysfunction when it is present) because many elderly subjects and brain damaged patients have an immediate memory span as long as that of younger intact adults (Lezak, 1983). It is

for this reason that longer and more complex testing formats have been devised that have a greater sensitivity to memory deficits. One such variation is the Digit Supraspan which is the format used in the present study.

While Digits Forward is a measure of immediate verbal memory span, Digit Supraspan is a task of new learning (Burbach, 1987). The subject has to learn a sequence of numbers one longer than his or her immediate memory span within a maximum of twelve trials. In the present investigation the raw scores have been retained for both Digits Forward and Digit Supraspan and they are analysed as two separate tasks.

Gender (Chavez, Trautt, Brandon & Steyaert, 1983), and Age (Gilbert & Levee, 1971) do not seem to influence performance on Digits Forward. However, Crook, Ferris, McCarthy and Rae (1980), using a variation of the Supraspan task that required subjects to dial a telephone number rather than verbally report it found that no normal aged subjects performed significantly poorer than normal younger subjects. While Griffin and Heffernan (1983) report that both Digits Forward and Digits Backward are correlated with Intelligence, the influence of Education and Occupation on the tasks has not been documented.

This task has not been previously investigated in South Africa. Norms for combined Digits Forward and Digits Backward in Standard Score form are available in the South African Wechsler Adult Intelligence Scale. However, for the present study a cut-off score of twelve trials as suggested by Burbach (1987) is used.

According to Burbach (1987) subjects with a Digit Supraspan score of more than twelve could be classified as brain damaged.

4. SUMMARY, AIMS, AND HYPOTHESES

The use of standardised tests in neuropsychological assessment inevitably raises questions about the psychometric properties of the test. The present study has highlighted two major issues. Firstly, little or no information is provided on variables such as Gender, Education and Occupation in normative data and studies systematically investigating the influence of these variables on test performance have been the exceptions rather than the rule. Secondly, normative data has been based on relatively small samples of largely institutionalised patients.

These limitations cause greater concern when considered in the specific context of South African society. This inadequate data is used by clinicians who are mostly "White" to assess other "Race" patients from very different socio-economic, cultural and educational backgrounds as a consequence of the State policy of apartheid which regulates access to and quality of Education and Occupational advancement. There exists therefore the serious danger of misclassifying subjects as brain-damaged when in fact performance might be influenced by factors other than brain-damage.

The present study aims to address this problem by investigating the relationship between the Age, Gender, Education, Occupation

and "Race" on neuropsychological test performance. Due to the fact that none of the tests utilised have been standardised in languages other than English the sample was restricted. Clearly, there is a great need for obtaining normative data for subjects whose first langauge is not English. The present study therefore investigated the performance of a large, convenient, non-clinical sample of first language English speakers on three neuropsychological tests (1) Controlled Oral Word Association Test (2) Wechsler's Paired Associate Learning Test (3) Digit Supraspan.

The specific hypotheses that were investigated were as follows:-

1. Younger subjects (18 - 50 years) would perform significantly better than older subjects (51 - 80 years) on all dependent variable measures.

2. Female subjects would perform significantly better than males on the Controlled Oral Word Association Test.

3. Subjects with a higher level of Education would perform significantly better than those with a lower level of Education on all dependent variable measures, irrespective of "Race".

4. Professional and Clerical workers would perform significantly better than Blue-collar workers on all dependent variable measures irrespective of "Race".

5. METHOD

(i) Subjects

The subjects consisted of a convenient non-clinical sample of 329 adults in the age range 18 - 80. All were first language English speakers and there were 167 males and 162 females. The subjects were selected from two "Race" groups - "White" with a total of 266 and "Coloureds" with a total of 60.

(ii) Materials

The following tests were used:

1. Controlled Oral Word Association Test
   The letters "C, F, L"
   Benton and Hamsher (1976) cited in Lezak, 1983, p. 331.

2. Wechsler Paired Associates (Wechsler, 1945)
   (i) Immediate Recall
   (ii) Delayed Recall.

3. Digit Supraspan (Burbach, 1987, page 14)
   (1) Digits Forward
   (2) Digit Supraspan.

The administration and scoring procedures have been described in detail in the introduction and are also included in the appendix.

(iii) Procedure

The data was collected in 1987 by students at the University of Cape Town as part of a course requirement for Psychology III. The students underwent a rigorous programme in administration of the test battery which involved an initial training session, a pilot run and a final debriefing session.

The entire test battery (See Appendix 1) was then administered to a sample of subjects selected by the students on the basis of the variables Age and Occupation. This data together with other biographic data was handed to the present author. Students selected subjects on the basis of two variables, Age and Occupation. The documenting of other biographic data permitted an analysis of more than two variables and Gender, Education and "Race" were included in the analysis.

Since the data was obtained from field research it was not possible to control testing conditions. Students, however, were required to include testing conditions in the project report that they submitted. Protocols were scored by the students and then re-scored by the present author.

In terms of occupation, the subjects were divided into three groups:

1) Professionals - This group consisted of subjects in established professions, such as lawyers, doctors as well as students with more than two years University education.

2) Clerical Workers - This group consisted of all subjects in clerical and administative positions such as receptionists, typists and office clerks.

3) Blue-collar Workers - This group consisted of all subjects who engage in largely "unskilled" work such as packers, machinists, garage attendants and domestic workers.

6. RESULTS

The results are presented in two sections. In the first section the results of the present study are compared with available normative data. In the second section the relationship between Age, Gender, Education, Occupation, "Race" and Performance are analysed using ANOVA.

(i) Section One: Comparison of the Present Results with North American Normative Data.

Comparisons were restricted by the availability of normative data, the fact that not all normative data is reported in a standard form. Furthermore, the present battery of tests has not been investigated in this form elsewhere.

Controlled Oral Word Association Test (Benton and Hamsher, cited in Lezak, 1983, page 331)

Published normative data in raw score form for this test is only available for the letters "F", "A", "S" (Yeudall et al 1983) and is therefore not comparable. However, Benton and Hamsher (cited in Lezack, 1983, p. 331) do provide a table of adjustment scores as well as a classification table, based on percentile ranges. Group mean scores for each of the variables was classified according to Benton and Hamsher (1976, cited in Lezack, (1983)). Table of percentile ranges (Table 1).

TABLE ONE: BENTON & HAMSHER'S (1976, CITED IN LEZACK, 1983)) CLASSIFICATION TABLE OF PERCENTILE RANGES.

Adjusted Scores	Percentile Range	Classification
53+	96+	Superior
45-52	77-89	High normal
31-44	25-75	Normal
25-30	11-22	Low normal
23-24	5-8	Borderline
17-22	1-3	Defective
10-16	<1	Severe defect
0-9	<1	Nil—Trace

TABLE TWO: CLASSIFICATION OF TOTAL SCORE GROUP MEANS FOR AGE

Group	N	Mean for Total Score	Classification
Age 18-50	245	41,44	Normal
Age 51-80	82	37,18	Normal

TABLE THREE: CLASSIFICATION OF TOTAL SCORE GROUP MEANS FOR GENDER

Group	N	Mean for Total Score	Classification
Male	167	39,19	Normal
Female	162	41,52	Normal

TABLE FOUR: CLASSIFICATION OF TOTAL SCORE GROUP MEANS FOR EDUCATION

Group	N	Mean for Total Score	Classification
Standard 1-6	29	23,41	Borderline
Standard 7 & 8	48	33,31	Normal
Standard 9 & 10	102	42,59	Normal
University/ College Education *	145	44,5	Normal

TABLE FIVE: CLASSIFICATION OF TOTAL SCORE GROUP MEANS FOR OCCUPATION

Group	N	Mean for Total Score	Classification
Manual Labourers	84	32,01	Normal
Clerical Workers	97	41,63	Normal
Professionals	145	44,27	Normal

*Note: The terms University/College Education and Post-Matric are used interchangeably in the Results and Discussion and refer to the same level of education.

TABLE SIX: CLASSIFICATION OF TOTAL SCORE GROUP MEANS FOR RACE

Group	N	Mean for Total Score	Classification
"White"	266	42,80	Normal
"Coloured"	60	29,33	Low Normal

While the group means are not directly comparable to adjusted Standard scores, the following observations can be made. Firstly, even without adjustment scores, none of the groups fell in the defective range. If adjustment scores are added, then classification would change. For example, the Standard One to Standard Six group, has less than nine years education and an adjustment score of between 9-12 would be added. It would thus clearly fall in the 'normal' classification. Secondly, group means for 'Education', "Race" and Occupation were the lowest. This is investigated in the second section.

WECHSLER'S PAIRED ASSOCIATE LEARNING - IMMEDIATE RECALL

The following table is from Hulicka (1966) and contains normative data from Wechsler (1945) and Hulicka (1966). The data by Cauthen (1977) is reported separately because it contains IQ scores.

TABLE SEVEN: MEANS AND STANDARD DEVIATIONS FOR WECHSLER PAIRED-ASSOCIATE LEARNING FROM HULICKA (1966).

Age Range	N		Wechsler Paired-Associate Learning
15-17	43	Mean	15.71
		SD	2.96
20-29 (Wechsler)	50	Mean	15.72
		SD	2.81
30-39	53	Mean	15.48
		SD	3.48
40-49 (Wechsler)	46	Mean	13.91
		SD	3.12
60-69	70	Mean	11.94
		SD	4.53
70-79	46	Mean	10.98
		SD	4.78
80-89	25	Mean	9.98
		SD	3.28

TABLE EIGHT: MEANS AND STANDARD DEVIATIONS FOR WECHSLER PAIRED-ASSOCIATE LEARNING FROM CAUTHEN (1977).

Age Range	IQ Range	N		Wechsler Paired-Associates Immediate Recall
	80-106	8	Mean	10,9
			SD	4,3
60-69	107-118	6	Mean	12,3
			SD	2,1
	119-140	6	Mean	15,2
			SD	2,0
	80-106	4	Mean	10,5
			SD	5,1
70-79	107-118	5	Mean	12,2
			SD	2,0
	119-140	9	Mean	13,1
			SD	3,2
	80-106	9	Mean	9,6
			SD	2,2
80-89	107-118	7	Mean	12,6
			SD	2,2
	119-140	6	Mean	12,5
			SD	3,7

TABLE NINE: RESULTS OF PRESENT STUDY

MEANS AND STANDARD DEVIATIONS FOR WECHSLER PAIRED-ASSOCIATE LEARNING BY AGE.

Age Range	N		Wechsler Paired-Associates Learning
18 - 19	5	Mean	16,9
		SD	4,13
20 - 29	145	Mean	16,22
		SD	3.37
30 - 39	22	Mean	14,11
		SD	3,79
40 - 49	60	Mean	15,15
		SD	3,65
50 - 59	24	Mean	15,31
		SD	3,39
60 - 69	53	Mean	13,66
		SD	3,93
70 - 79	16	Mean	12,56
		SD	4,43
80	2	Mean	10,75
		SD	3,89

Generally, the results of the present study are comparable to those reported by Hulicka (1966) and Cauthen (1977) although the means in the present study tend to be slightly higher. This is possibly due to the large number of Professionals and/or University or College Educated people in the group. Since the above means are only reported for Age. As with other studies

there was also a consistent decrease in mean scores with Age (the exception being the 30 - 39 group).

Digit Supraspan

A criterion score of 12 trials is used for this test. Subjects who take more than 12 trials are considered brain damaged (Burbach, 1987). Here again, group scores were compared using this criterion for individual assessment.

TABLE TEN: RAW SCORE GROUP MEANS FOR AGE.

Group	N	Mean for Supraspan	Above (+) or (-) Criterion (i.e.12)
Age 18-50		3,67	-
Age 51-80		4,21	-

TABLE ELEVEN: RAW SCORE GROUP MEANS FOR GENDER

Group	N	Mean for Supraspan	Above (+) or (-) Criterion (i.e.12)
Male		4,01	-
Female		3,60	-

TABLE TWELVE: RAW SCORE GROUP MEANS FOR EDUCATION

Group	N	Mean for Supraspan	Above (+) or Below (-) Criterion (i.e.12)
Standard 1-6	26	4,31	-
Standard 7 & 8	40	4	-
Standard 9 & 10	85	4	-
University/College Education	125	3,5	

TABLE THIRTEEN : RAW SCORE GROUP MEANS FOR OCCUPATION

Group	N	Mean for Supraspan	Above (+) or Below (-) Criterion (i.e.12)
Manual Labourers	74	4,28	-
Clerical Workers	82	4,01	-
Professionals	121	3,31	-

TABLE FOURTEEN: RAW SCORE GROUP MEANS FOR "RACE"

Group	N	Mean for Supraspan	Above (+) or Below (-) Criterion (i.e.12)
"White"	227	3,77	-
"Coloured"	50	4,06	-

While group means do not reflect individual performance, it is clear that group mean scores are well below the criterion score and group mean differences are relatively small.

ii) Section Two - Analysis of the Data

The results were analysed by using seperate one way ANOVAS for the variables Age, Gender, Education, Occupation and "Race". To examine possible interaction effects between Education, Occupation and "Race" these three variables were subjected to further two-way ANOVAS. Howell's (1987) method One was used to deal with the problem of unequal sample sizes. In this method each effect is adjusted for all other effects (Howell, 1987, page 526). The results for each test are reported separately.

Controlled Oral Word Association Test

Separate one-way ANOVAS by Age, Gender, Education, Occupation and "Race" for ech of the letters "C, F, L" as well as the Total score for the Controlled Oral Word Association Test are reported on the following page.

TABLE 15: ONE-WAY ANOVA FOR THE CONTROLLED ORAL WORD ASSOCIATION TEST.

SOURCE OF VARIATION												
AGE		GENDER		EDUCATION LEVEL				OCCUPATION			"RACE"	
- 50	51 - 80	MALE	FEMALE	STD 1 - STD 6	STD 7 & STD 8	STD 9 & STD 10	POST MATRIC	PROFESSIONALS	CLERICAL WORKERS	BLUE COLLAR	"WHITE"	"COLOURED"
245	N = 82	N = 167	N = 162	N = 29	N = 48	N = 102	N = 145	N = 145	N = 97	N = 84	N = 266	N = 60
14,34	$\bar{X}$ = 12,26	$\bar{X}$ = 13,12	$\bar{X}$ = 14,54	$\bar{X}$ = 7,52(A)*	$\bar{X}$ = 11,54(B)	$\bar{X}$ = 14,75(C)	$\bar{X}$ = 15,19(C)	$\bar{X}$ = 15,48(A)	$\bar{X}$ = 13,97(B)	$\bar{X}$ = 10,71(C)	$\bar{X}$ = 14,63	$\bar{X}$ = 10,22
= 4,61	SD = 5,23	SD = 4,94	SD = 4,64	SD = 3,16	SD = 3,80	SD = 4,86	SD = 4,20	SD = 4,30	SD = 4,39	SD = 4,82	SD = 4,52	SD = 4,68
df = 1 F = 11,75 P< 0,01 ω = 3,5%		df = 1 F = 7,24 P< 0,01 ω = 2,1%		df = 3 F = 31,96 P< 0,01 ω = 23%**				df = 2 F = 30,37 P< 0,01 ω = 15,8%			df = 1 F = 45,95 P< 0,01 ω = 12,4%	
245	N = 82	N = 167	N = 162	N = 29	N = 48	N = 102	N = 145	N = 145	N = 97	N = 84	N = 266	N = 60
13,69	$\bar{X}$ = 12,60	$\bar{X}$ = 13,05	$\bar{X}$ = 13,75	$\bar{X}$ = 8,14(A)	$\bar{X}$ = 11,10(B)	$\bar{X}$ = 13,93(C)	$\bar{X}$ = 14,81(C)	$\bar{X}$ = 14,70(A)	$\bar{X}$ = 13,98(A)	$\bar{X}$ = 10,44(B)	$\bar{X}$ = 14,22	$\bar{X}$ = 9,62
= 4,37	SD = 5,49	SD = 4,83	SD = 4,54	SD = 3,77	SD = 3,80	SD = 4,79	SD = 4,08	SD = 4,21	SD = 4,41	SD = 4,60	SD = 4,50	SD = 3,67
N.	S.	N.	S.	df = 3 F = 25,30 P< 0,01 ω = 19%				df = 2 F = 26,45 P< 0,01 ω = 14%			df = 1 F = 54,61 P< 0,01 ω = 14,4%	
245	N = 82	N = 167	N = 162	N = 29	N = 48	N = 102	N = 145	N = 145	N = 97	N = 84	N = 266	N = 60
13,41	$\bar{X}$ = 12,33	$\bar{X}$ = 13,02	$\bar{X}$ = 13,23	$\bar{X}$ = 7,76(A)	$\bar{X}$ = 10,67(B)	$\bar{X}$ = 13,90(C)	$\bar{X}$ = 14,50(C)	$\bar{X}$ = 14,10(A)	$\bar{X}$ = 13,68(A)	$\bar{X}$ = 10,86(B)	$\bar{X}$ = 13,95	$\bar{X}$ = 9,50
= 4,54	SD = 5,85	SD = 5,44	SD = 4,35	SD = 3,63	SD = 4,11	SD = 4,68	SD = 4,64	SD = 4,47	SD = 4,65	SD = 5,31	SD = 4,73	SD = 4,18
N.	S.	N.	S.	df = 3 F = 24,05 P< 0,01 ω = 18,4%				df = 2 F = 13,25 P< 0,01 ω = 7,5%			df = 1 F = 45,17 P< 0,01 ω = 12,2%	
245	N = 82	N = 167	N = 162	N = 29	N = 48	N = 102	N = 145	N = 145	N = 97	N = 84	N = 266	N = 60
41,44	$\bar{X}$ = 37,18	$\bar{X}$ = 39,19	$\bar{X}$ = 41,52	$\bar{X}$ = 23,4(A)	$\bar{X}$ = 33,31(B)	$\bar{X}$ = 42,59(C)	$\bar{X}$ = 44,50(C)	$\bar{X}$ = 44,27(A)	$\bar{X}$ = 41,63(A)	$\bar{X}$ = 32,01(B)	$\bar{X}$ = 42,80	$\bar{X}$ = 29,33
= 11,7	SD = 15,2	SD = 13,30	SD= 12,30	SD = 9,53	SD = 10,64	SD = 12,86	SD = 10,37	SD = 10,75	SD = 12,12	SD = 13,34	SD= 11,83	SD = 11,59
df = 1 F = 6,89 P< 0,01 ω = 2%		N.	S.	df = 3 F = 36,47 P< 0,01 ω = 25,5%				df = 2 F = 29,17 P< 0,01 ω = 15,3%			df = 1 F = 63,86 P< 0,01 ω = 16,5%	

* Student - Newman Keuls Post-Hoc test.
Means with the same subscript, read horizontally, are not significantly different.

** Percentage-Variance Estimate.
N.S. Non-significant.

An inspection of Table 15 reveals that Age produced significant results only for the letter "C" and the Total Score, while Gender produced significant results for the letter "C" only. On the other hand, the variables Education, Occupation and "Race" produced significant results for all the letters as well as the "Total Score". There was also a marked difference in the percentage variance that each contributed to in the dependent variable measure, with Education, Occupation and "Race" accounting for between 18-25% compared to Age and Gender accounting for between 2-4% only. The relationship between Education, Occupation and "Race" was then further explored by means of separate Two-way ANOVAS.

TABLE SIXTEEN: TWO WAY ANOVA (EDUCATION X RACE) FOR THE CONTROLLED ORAL WORD ASSOCIATION TEST

Test Used	Source of Variation		
	Education	"Race"	Education * Race
"C"	df = 3 F = 13,24 P<0,01	N.S.	N.S.
"F"	df = 3 F = 9,30 P<0,01	df = 1 F = 7,45 P<0,01	N.S.
"L"	df = 3 F = 9,68 P<0,01	df = 1 F = 4,94 P<0,05	N.S.
Total	df = 3 F = 6,97 P<0,01	df = 1 F = 14,52 P<0,01	N.S.

For the Education x "Race" ANOVA (Table 16) there was a significant main effect on all letters as well as the Total Score. A main effect for "Race" was found only on the letters "F" and "L" as well as the Total Score. There were no significant interaction effects. The means for each of the Education x "Race" ANOVA cells as well as the graphs are presented below.

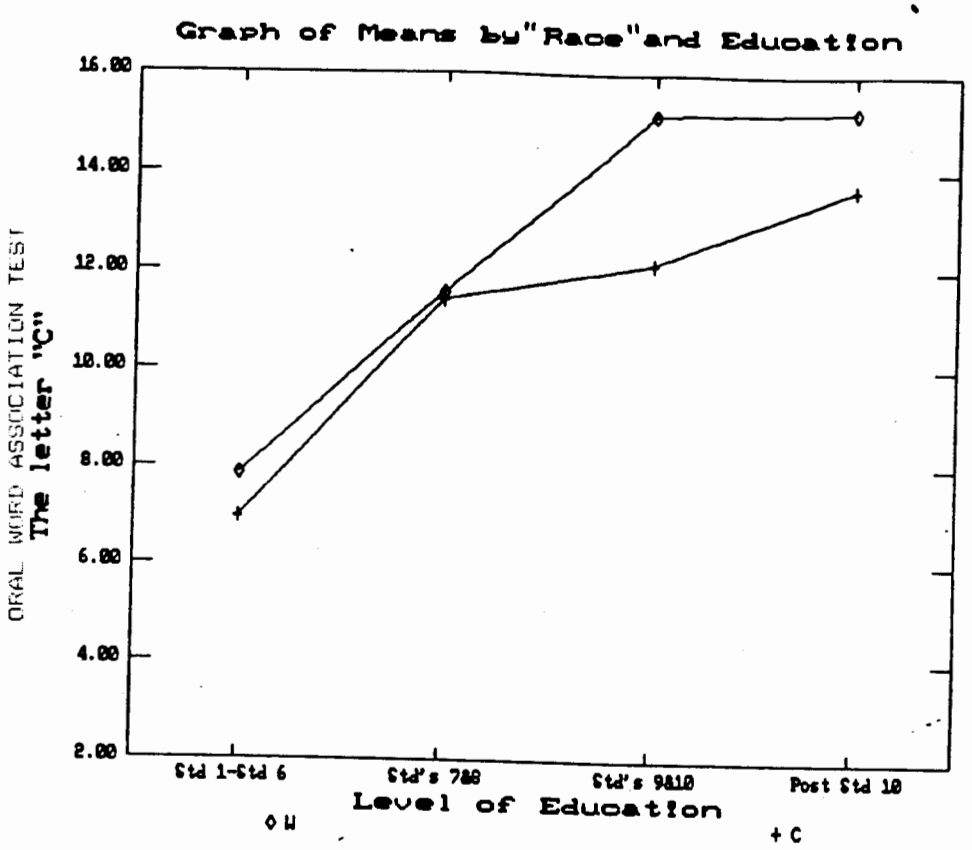
TABLE SEVENTEEN: TWO-WAY ANOVA (EDUCATION X "RACE) CELL MEANS FOR THE CONTROLLED ORAL WORD ASSOCIATION TEST.

		"C"		"F"		"L"		TOTAL SCORE	
		"White"	"Coloured"	"White"	"Coloured"	"White"	"Coloured"	"White"	"Coloured"
Standard One to Standard Six	N	N = 7	N = 21	N = 7	N = 21	N = 7	N = 21	N = 7	N = 21
	MEAN	7,86	6,95	9,14	7,24	9	6,90	26	21,10
Standards Seven and Eight	N	N = 28	N = 19	N = 28	N = 19	N = 28	N = 19	N = 28	N = 19
	MEAN	11,57	11,42	11,89	9,79	11,32	9,63	34,79	30,84
Standards Nine and Ten	N	N = 88	N = 13	N = 88	N = 13	N = 88	N = 13	N = 88	N = 13
	MEAN	15,17	12,15	14,28	11,62	14,36	11,23	43,82	35
Post Matric	N	N = 139	N = 6	N = 139	N = 6	N = 139	N = 6	N = 139	N = 6
	MEAN	15,26	13,67	14,88	13,17	14,51	14,17	44,65	41

GRAPHS OF TWO-WAY ANOVA (EDUCATION X "RACE" CELL MEANS FOR THE CONTROLLED ORAL WORD ASSOCIATION TEST.

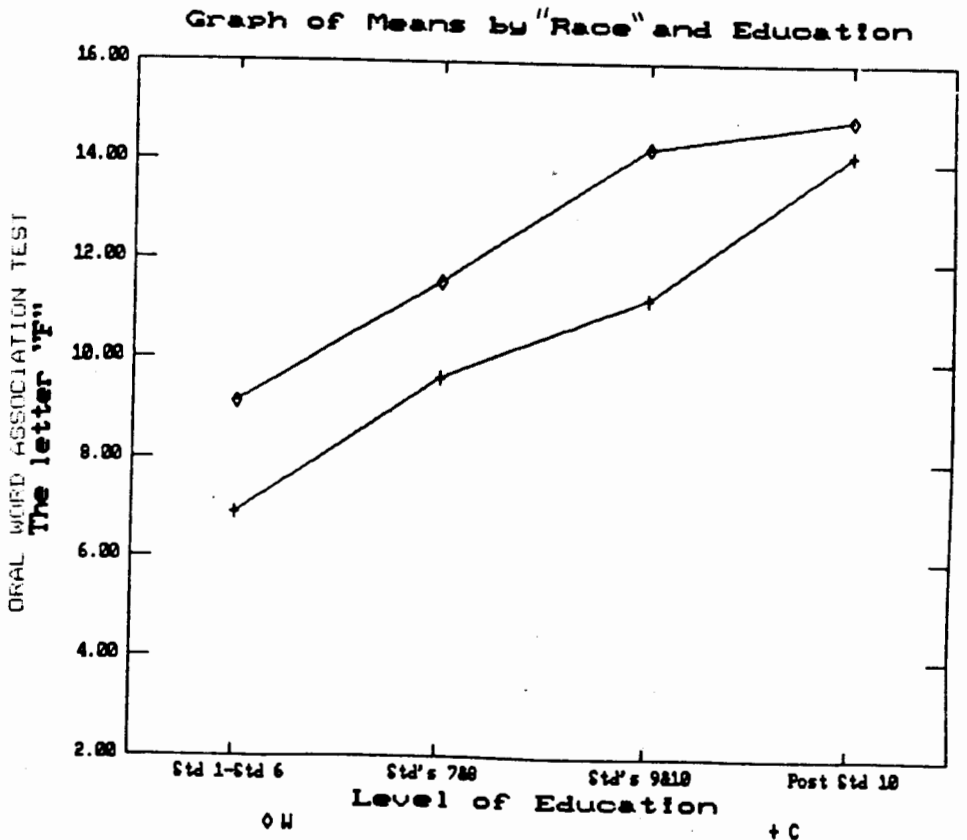
GRAPH 1

◊ W = "White"
+ C = "Coloured"



GRAPH 2

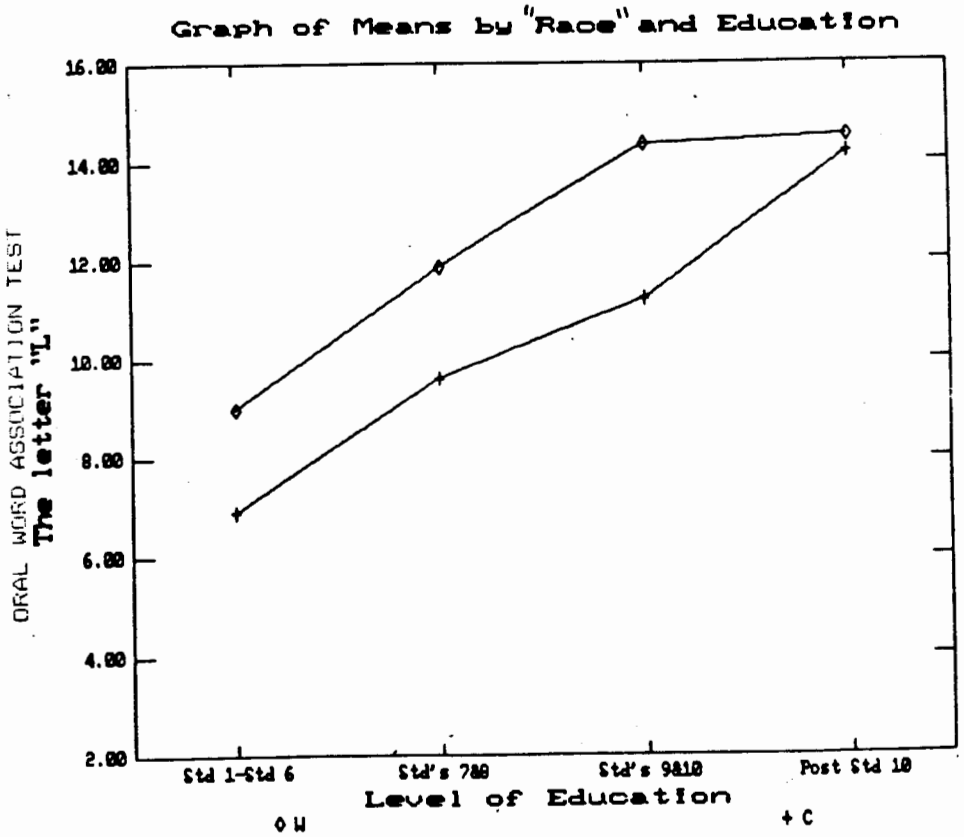
◊ W = "White"
+ C = "Coloured"



GRAPHS OF TWO-WAY ANOVA (EDUCATION X "RACE" CELL MEANS FOR THE CONTROLLED ORAL WORD ASSOCIATION TEST.

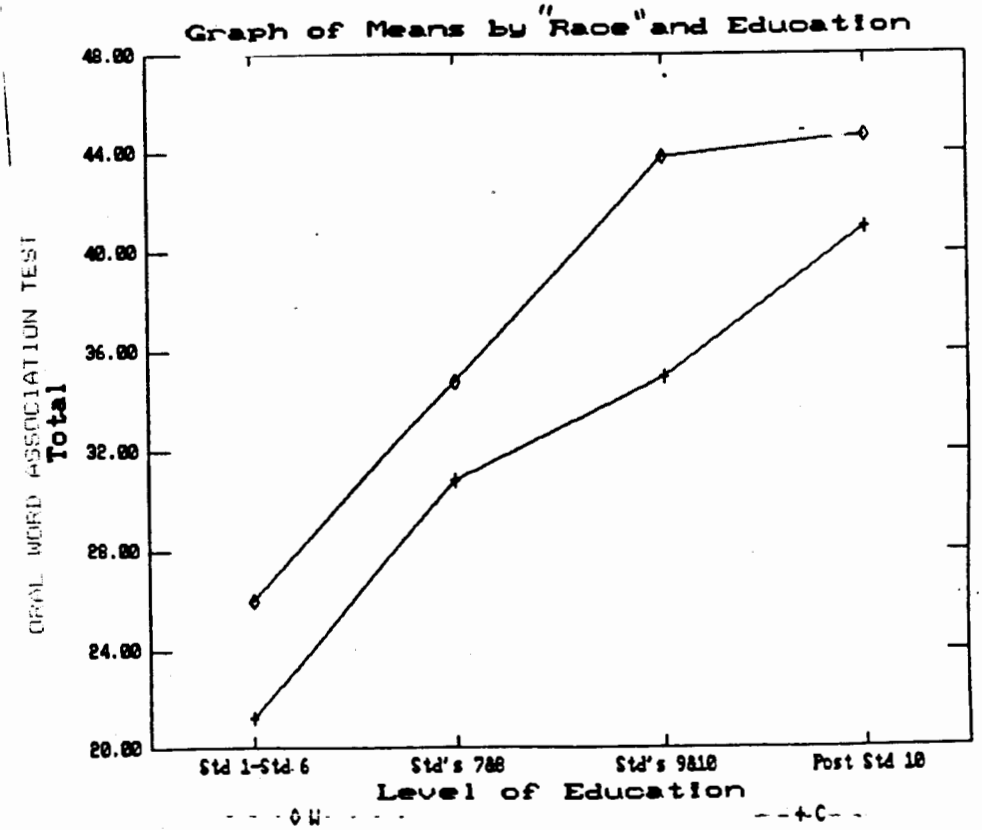
GRAPH 3

◇ W = "White"
+ C = "Coloured"



GRAPH 4

◇ W = "White"
+ C = "Coloured"



An inspection of the graphs (Graphs 1 - 4) reveals the following. The influence of Education on performance is clearly visible on all four graphs. There is consistent tendency for a higher level of Education to be associated with higher scores, irrespective of "Race". However, for the "White" group differences at the higher levels (ie between Standard 9 and 10 and University/College Education) are less marked than at the lower levels of education (ie Standards 1 - 6 and Standards 7 and 8). By contrast for the "Coloured" group there are marked differences at all four levels of Education.

The absence of a main effect for "Race" on the letter "C" (Graph 1) is possibly due to similar performance for the two "Race" groups at the lower levels of Education (ie Standards 1 - 6 and Standards 7 and 8). What is also evident is that the mean differences between "Races" is minimal at the highest level of Education ie. University/College Education) on the occupation x "Race" ANOVA. These results for "Race" on the two-way Race x Education ANOVA are different from those on the one-way ANOVA where "Race" produced significant results on the letter "C" as well.

The absence of a main effect of "Race" for the letter "F" (Graph 2) on the Education x "Race" ANOVA is different from the one-way ANOVA where "Race" produced a significant result on the letter "F".

TABLE EIGHTEEN: TWO WAY ANOVA (OCCUPATION X RACE) FOR THE CONTROLLED ORAL WORD ASSOCIATION TEST.

Test Used	Source of Variation		
	Occupation	"Race"	Occupation * Race
"C"	df = 2 F = 18,46 P<0,01	df = 1 F = 8,65 P<0,01	df = 1 F = 4,70 P<0,01
"F"	df = 2 F = 9,24 P<0,01	df = 1 F = 17,17 P<0,01	N.S.
"L"	df = 2 F = 4,94 P<0,01	df = 1 F = 15,60 P<0,01	N.S.
Total	df = 2 F = 13,37 P<0,01	df = 1 F = 18,15 P<0,01	df = 2 F = 3,11 P<0,05

There was a significant main effect for occupation as well as "Race" on all letters as well as the total score. There were also interaction effects for the letter "C" and the Total score. Cell means for the Occupation x "Race" ANOVA, and graphs are reported on the following page.

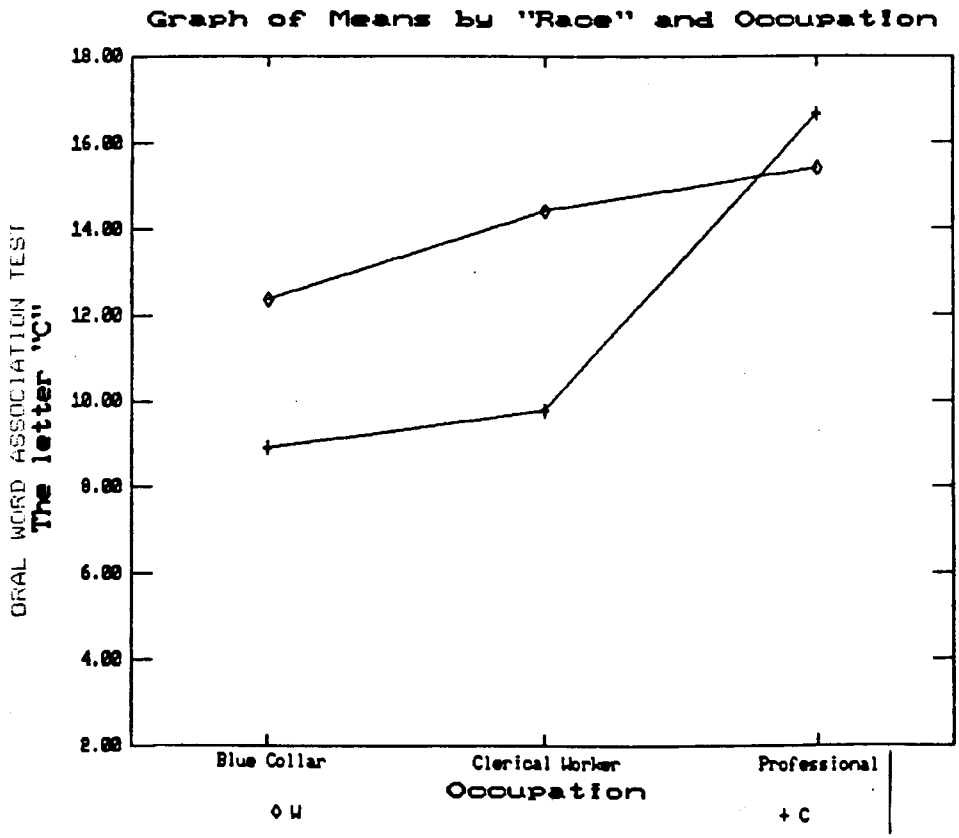
TABLE NINETEEN: TWO-WAY ANOVA (OCCUPATION X RACE) CELL MEANS FOR THE CONTROLLED ORAL WORD ASSOCIATION TEST.

		"C"		"F"		"L"		TOTAL SCORE	
		"White"	"Coloured"	"White"	"Coloured"	"White"	"Coloured"	"White"	"Coloured"
Blue Collar Workers	N	N = 41	N = 42	N = 41	N = 42	N = 41	N = 42	N = 41	N = 42
	MEAN	12,39	8,93	11,83	8,96	12,95	8,67	37,17	26,45
Clerical Workers	N	N = 86	N = 9	N = 86	N = 9	N = 86	N = 9	N = 86	N = 9
	MEAN	14,45	9,78	14,45	9,56	14,20	9,56	43,09	28,89
Professionals	N	N = 136	N = 9	N = 136	N = 9	N = 136	N = 9	N = 136	N = 9
	MEAN	15,40	16,67	14,79	13,22	14,15	13,33	44,34	43,22

GRAPHS OF TWO-WAY ANOVA (OCCUPATION X "RACE" CELL MEANS FOR THE CONTROLLED ORAL WORD ASSOCIATION TEST.

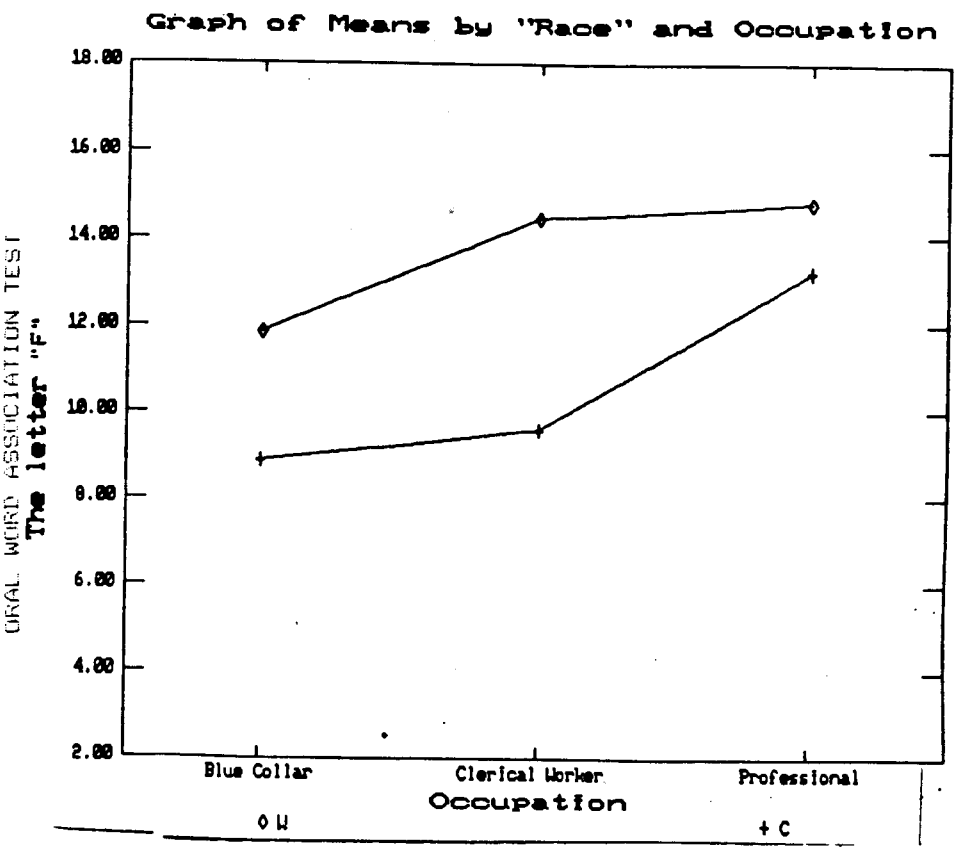
GRAPH 5

◇ W = "White"
+ C = "Coloured"



GRAPH 6

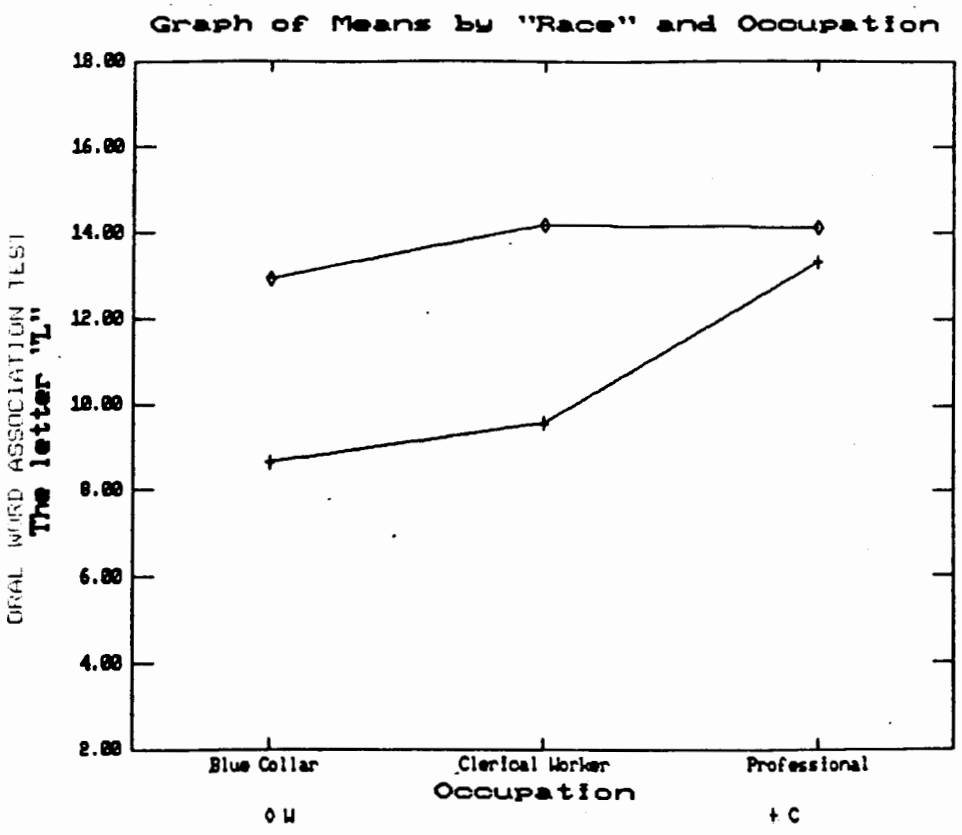
◇ W = "White"
+ C = "Coloured"



GRAPHS OF TWO-WAY ANOVA (OCCUPATION X "RACE" CELL MEANS FOR THE CONTROLLED ORAL WORD ASSOCIATION TEST.

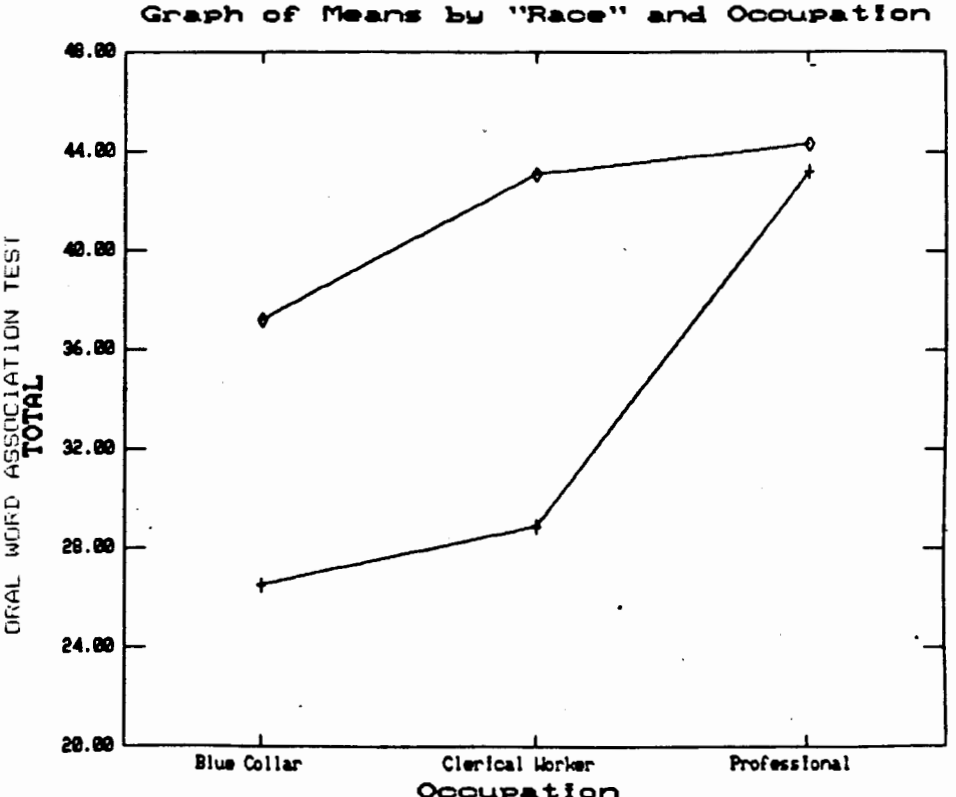
GRAPH 7

◇ W = "White"
+ C = "Coloured"



GRAPH 8

◇ W = "White"
+ C = "Coloured"



An inspection of the graphs (Graphs 5 to 8) reveals the following: a higher occupational status, i.e., defined as (1) Professional, (2) Clerical (3) Blue-collar worker is associated with higher test scores, irrespective of Race. However, for the "Coloured" group there is a marked difference in scores due to occupational status, whereas for the "White" group differences in scores due to occupational status are less marked. Mean differences between the "Race" groups are also minimal at the level of the Professional. In fact the "Coloured" Professional group perform better on the letter "C" (Graph 5) than the "White" Professional group.

WECHSLER'S ASSOCIATE LEARNING - IMMEDIATE AND DELAYED RECALL

Separate One way ANOVAS for Age, Gender, Education, Occupation and "Race" for Wechsler Paired Associate Learning, both Immediate and Delayed Recall are reported on the next page.

TABLE 20: ONE-WAY ANOVA FOR WECHSLER PAIRED ASSOCIATE LEARNING - IMMEDIATE AND DELAYED RECALL

SOURCE OF VARIATION												
AGE		GENDER		EDUCATION LEVEL				OCCUPATION			"RACE"	
18 - 50	51 - 80	MALE	FEMALE	STD 1 - STD 6	STD 7 & STD 8	STD 9 & STD 10	POST MATRIC	PROFESSIONALS	CLERICAL WORKERS	BLUE COLLAR	"WHITE"	"COLOURED"
N = 245	N = 82	N = 167	N = 162	N = 29	N = 48	N = 102	N = 145	N = 145	N = 97	N = 84	N = 266	N = 60
$\bar{X}$ = 15,77	$\bar{X}$ = 13,50	$\bar{X}$ = 14,71	$\bar{X}$ = 15,72	$\bar{X}$ = 10,97(A)	$\bar{X}$ = 13,76(B)	$\bar{X}$ = 15,86(C)	$\bar{X}$ = 16,07(C)	$\bar{X}$ = 16,08(A)	$\bar{X}$ = 15,63(A)	$\bar{X}$ = 13,27(B)	$\bar{X}$ = 15,73	$\bar{X}$ = 13,16
SD = 3,56	SD = 3,90	SD = 4,01	SD = 3,42	SD = 2,97	SD = 3,48	SD = 3,52	SD = 3,43	SD = 3,40	SD = 3,89	SD = 3,51	SD = 3,62	SD = 3,54
df = 1		df = 1		df = 3				df = 2			df = 1	
F = 23,73		F = 6,09		F = 21,91				F = 17,23			F = 24,79	
P< 0,01		P< 0,01		P< 0,01				P< 0,01			P< 0,01	
ω^2 = 6,8%		ω^2 = 1,8%		ω^2 = 17%**				ω^2 = 9,6%			ω^2 = 7,1%	
N = 245	N = 82	N = 167	N = 162	N = 29	N = 48	N = 102	N = 145	N = 145	N = 97	N = 84	N = 266	N = 60
$\bar{X}$ = 5,80	$\bar{X}$ = 4,87	$\bar{X}$ = 5,27	$\bar{X}$ = 5,88	$\bar{X}$ = 4,52(A)	$\bar{X}$ = 4,84(A)*	$\bar{X}$ = 5,58(B)	$\bar{X}$ = 5,99(B)	$\bar{X}$ = 5,98(A)	$\bar{X}$ = 5,57(B)	$\bar{X}$ = 4,89(C)	$\bar{X}$ = 5,67	$\bar{X}$ = 5,23
SD = 1,36	SD = 1,54	SD = 1,48	SD = 1,37	SD = 1,67	SD = 1,50	SD = 1,43	SD = 1,23	SD = 1,26	SD = 1,38	SD = 1,62	SD = 1,40	SD = 1,49
df = 1		df = 1		df = 3				df = 2				
F = 29,64		F = 15,19		F = 14,50				Fo = 16,17			N.	S.
P< 0,01		P< 0,01		P< 0,01				P< 0,01				
ω^2 = 7,6%		ω^2 = 4,4%		ω^2 = 11,9%				ω^2 = 9,1%				

* Student - Newman Keuls Post-Hoc test.
Means with the same subscript, read horizontally, are not significantly different.

** Percentage-Variance Estimate.
N.S. Non-significant.

An inspection of Table 20 reveals that all the variables except "Race" produced significant results on both Immediate and Delayed Recall. "Race" was significant only on Immediate Recall. Education, Occupation, Age, and "Race" (only on Immediate Recall) accounted for the largest percentage variance (between 6 - 17%) in the dependent variable measure. The relationship between Education, Occupation and "Race" was further explored by means of two separate two-way ANOVAS.

TABLE TWENTY ONE: TWO WAY ANOVA - (EDUCATION X "RACE") FOR WECHSLER PAIRED-ASSOCIATE LEARNING TEST.

Test Used	Source of Variation		
	Education	"Race"	Education * Race
Wechsler Paired Associates Immediate Recall	df = 3 F = 10,80 P<0,01	N.S.	N.S.
Wechsler Paired Associates Delayed Recall ($^1/_2$ hour)	df = 3 F = 6,09 P<0,01	N.S.	N.S.

There was a significant main effect of Education only on both Immediate and Delayed Recall. Cell Means for the Education x "Race" ANOVA and graphs are reported on the following page.

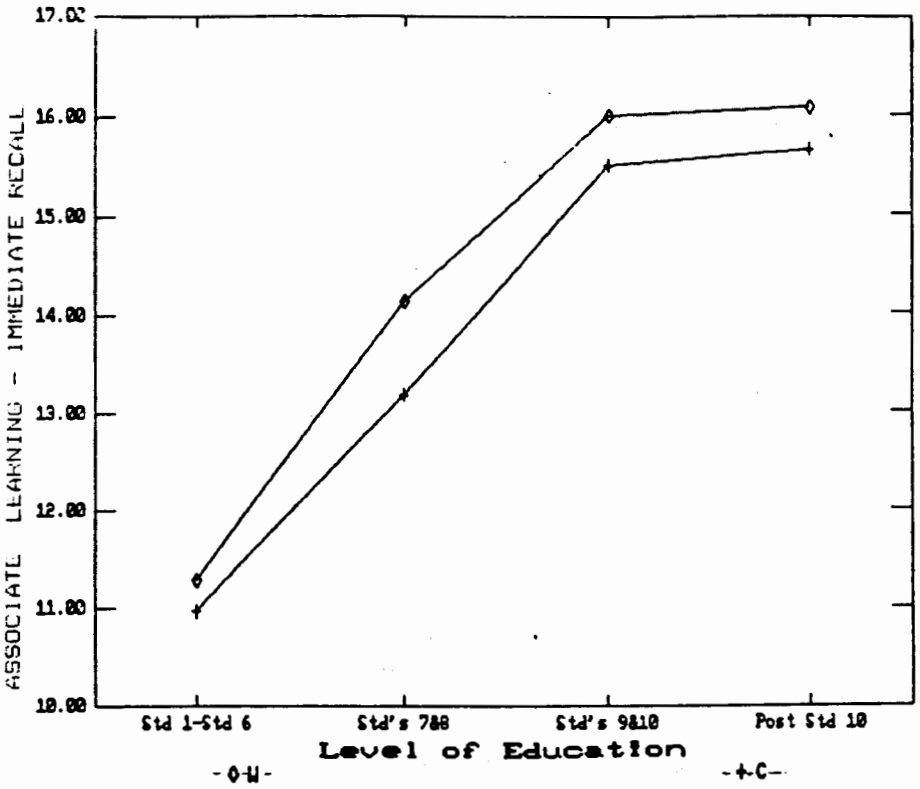
TABLE TWENTY TWO: CELL MEANS BY (EDUCATION X "RACE") FOR THE WECHSLER PAIRED ASSOCIATE LEARNING TEST - IMMEDIATE AND DELAYED RECALL.

		Associate Learning Immediate Recall		Associate Learning Delayed Recall	
		"White"	"Coloured"	"White"	"Coloured"
Standard 1 to Standard 6	Number	7	21	7	21
	Mean	11,29	10,98	4,50	4,74
Standard 7 to Standard 8	Number	28	19	28	19
	Mean	14,14	13,18	4,52	5,26
Standard 9 to Standard 10	Number	88	13	88	13
	Mean	16	15,5	5,62	5,56
University or College Education	Number	139	6	139	6
	Mean	16,09	15,67	5,98	6,17

GRAPHS OF TWO-WAY ANOVA (EDUCATION X "RACE" CELL MEANS FOR WECHSLER PAIRED ASSOCIATE LEARNING.

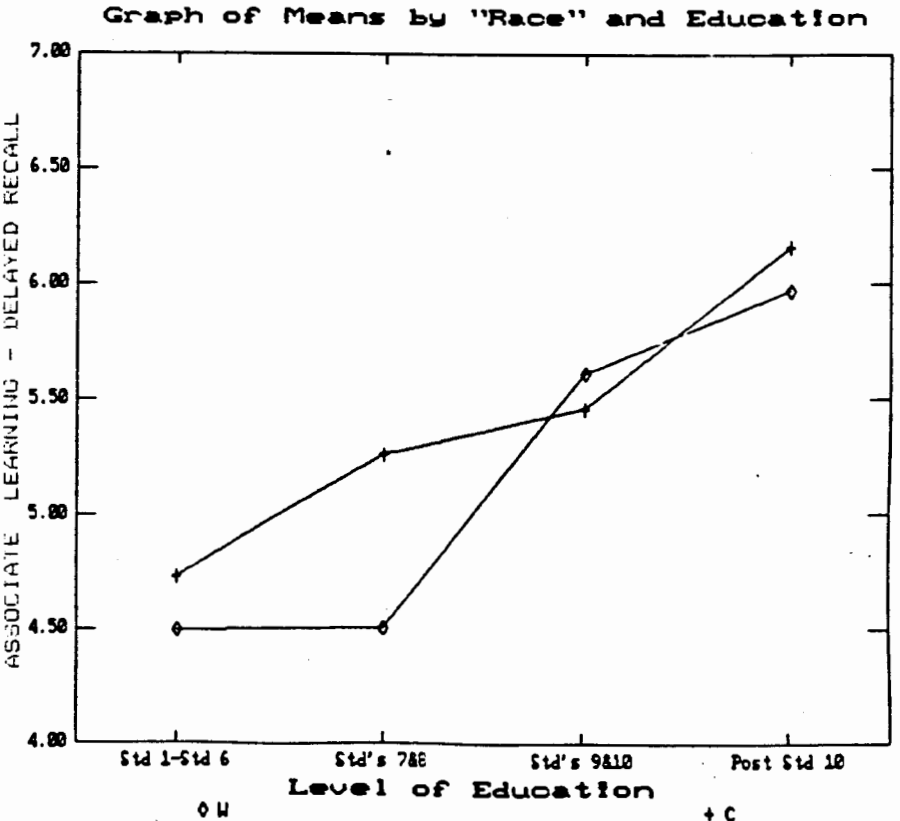
GRAPH 9

◇ W = "White"
\+ C = "Coloured"



GRAPH 10

◇ W = "White"
\+ C = "Coloured"



There was no main effect of "Race" and this is visible on graphs 9 and 10. In fact the "Coloured" group perform better at the level of Standard 9 and 10 for Wechsler Paired Associate Learning - Delayed Recall. A higher educational level was associated with improved performance irrespective of "Race".

TABLE TWENTY THREE: TWO WAY ANOVA (OCCUPATION X "RACE") FOR THE WECHSLER PAIRED ASSOCIATE LEARNING TEST.

Test Used	Source of Variation		
	Occupation	"Race"	Occupation * Race
Wechsler Paired Associates Immediate Recall	df = 2 F = 6,37 P<0,01	df = 2 F = 5,37 P<0,01	N.S.
Wechsler Paired Associates Delayed Recall (½ hour)	df = 2 F = 8,39 P<0,01	N.S.	N.S.

There was a significant main effect for occupation on both Immediate and Delayed Recall. There was a main effect of "Race" only on Immediate Recall. Cell means for Education x "Race" ANOVA and graphs are reported on the following page.

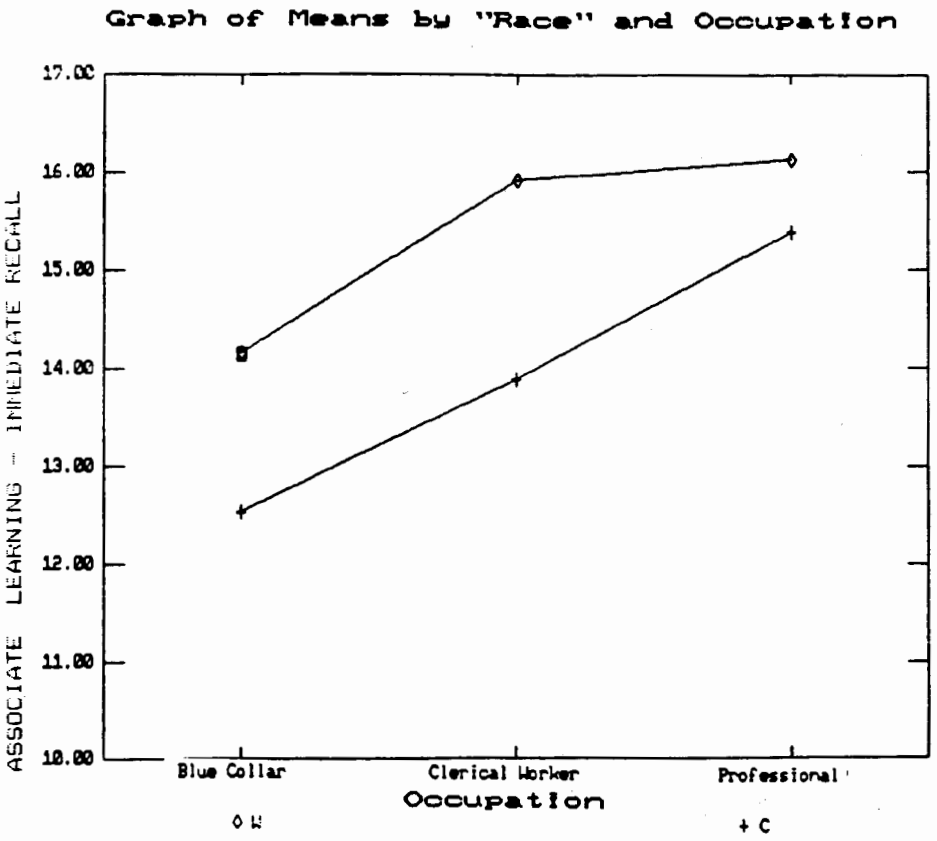
TABLE TWENTY FOUR: TWO WAY ANOVA (OCCUPATION X "RACE") CELL MEANS FOR THE WECHSLER PAIRED ASSOCIATE LEARNING TEST - IMMEDIATE AND DELAYED RECALL.

		Associate Learning Immediate Recall		Associate Learning Delayed Recall	
		"White"	"Coloured"	"White"	"Coloured"
Blue-Collar Workers	Number	N = 41	N = 42	N = 41	N = 42
	Mean	14,16	12,53	4,80	5.08
Clerical Workers	Number	N = 86	N = 9	N = 86	N = 9
	Mean	15,92	13,89	5,66	4,89
Professional	Number	N = 136	N = 9	N = 136	N = 9
	Mean	16,13	15,39	5,96	6,22

GRAPHS OF TWO-WAY ANOVA (OCCUPATION X "RACE") CELL MEANS FOR WECHSLER PAIRED ASSOCIATE LEARNING.

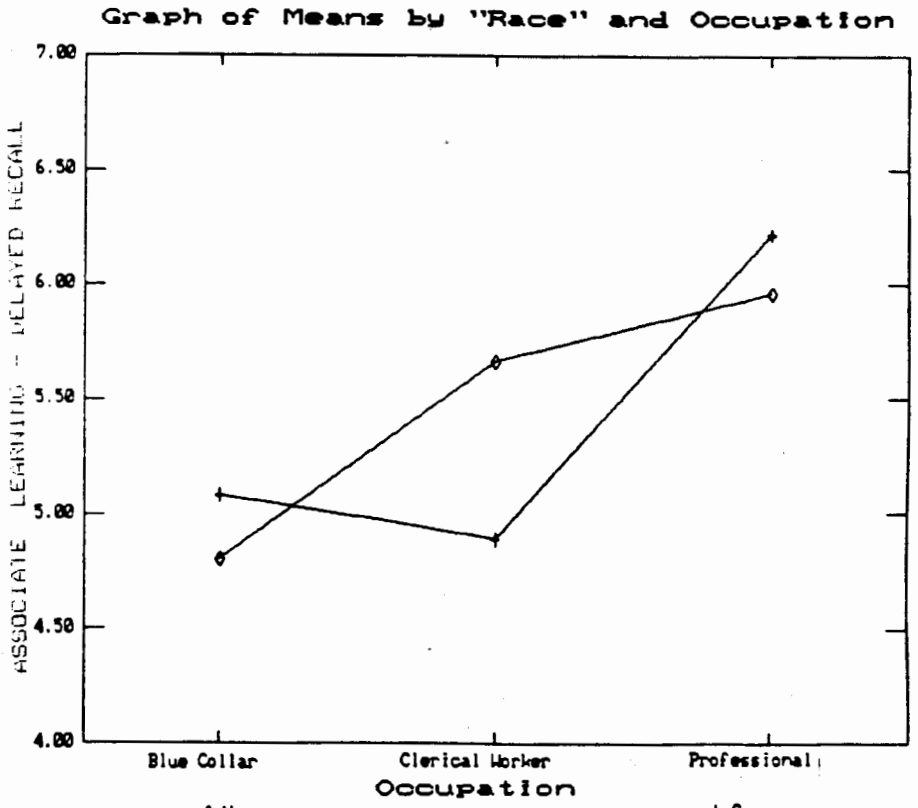
GRAPH 11

◇ W = "White"
+ C = "Coloured"



GRAPH 12

◇ W = "White"
+ C = "Coloured"



As can be seen a higher level of occupation was associated with improved performance on Wechsler Paired Associate Learning on both Immediate and Delayed Recall (Graphs 11 and 12) irrespective of "Race". In fact on Wechsler Paired Associate Learning Delayed Recall (Graph 12) the "Coloured" group perform better at two levels.

Digit Supraspan

Separate one way ANOVAS for Age, Gender, Education, Occupation and "Race" for both Digits Forward and Digit Supraspan are reported on the next page.

TABLE 25: ONE-WAY ANOVA FOR DIGITS FORWARD AND DIGIT SUPRASPAN

SOURCE OF VARIATION													
AGE		GENDER		EDUCATION LEVEL				OCCUPATION			"RACE"		
8 - 50	51 - 80	MALE	FEMALE	STD 1 - STD 6	STD 7 & STD 8	STD 9 & STD 10	POST MATRIC	PROFESSIONALS	CLERICAL WORKERS	BLUE COLLAR	"WHITE"	"COLOURED"	
= 243	N = 82	N = 165	N = 162	N = 29	N = 48	N = 100	N = 145	N = 145	N = 96	N = 83	N = 264	N = 60	
= 7,47	$\bar{X}$ = 7,52	$\bar{X}$ = 7,55	$\bar{X}$ = 7,41	$\bar{X}$ = 6,45(A)*	$\bar{X}$ = 7,04(B)	$\bar{X}$ = 7,60(C)	$\bar{X}$ = 7,74(C)	$\bar{X}$ = 7,70(A)	$\bar{X}$ = 7,60(A)	$\bar{X}$ = 6,94(B)	$\bar{X}$ = 7,61	$\bar{X}$ = 6,87	
= 1,18	SD = 1,34	SD = 1,23	SD = 1,21	SD = 1,18	SD = 1,30	SD = 1,07	SD = 1,16	SD = 1,19	SD = 1,05	SD = 1,32	SD = 1,12	SD = 1,44	
N.	S.	N.	S.	df = 3 f = 12,84 P< 0,01 ω = 10,8%**				df = 2 F = 17,23 P< 0,01 ω = 9,6%			df = 1 F = 21,79 P< 0,01 ω = 7,1%		
= 202	N = 76	N = 146	N = 134	N = 26	N = 40	N = 85	N = 125	N = 121	N = 82	N = 74	N = 227	N = 50	
= 3,67	$\bar{X}$ = 4,21	$\bar{X}$ = 4,01	$\bar{X}$ = 3,60	$\bar{X}$ = 4,31(A)	$\bar{X}$ = 4,00	$\bar{X}$ = 4,11	$\bar{X}$ = 3,50	$\bar{X}$ = 3,31(A)	$\bar{X}$ = 4,01(A)	$\bar{X}$ = 4,28(B)	$\bar{X}$ = 3,77	$\bar{X}$ = 4,06	
= 1,95	SD = 2,95	SD = 2,63	SD = 1,79	SD = 3,13	SD = 1,87	SD = 2,75	SD = 1,76	SD = 1,55	SD = 2,06	SD = 3,13	SD = 2,17	SD = 2,72	
N.	S.	N.	S.	N.S.				df = 2 F = 16,17 P< 0,01 ω = 9,1%			N.	S.	

* Student - Newman Keuls Post-Hoc test.
Means with the same subscript, read horizontally, are not significantly different.

** Percentage-Variance Estimate.
N.S. Non-significant.

From Table 25 it can be seen that Occupation produced significant results for both Digits Forward and Digit Supraspan. Education and "Race" produced significant results for only Digits Forward. The relationship between Education, Occupation and "Race" was further explored by means of separate two-way ANOVAS reported below.

TABLE TWENTY SIX: TWO WAY ANOVA (EDUCATION X "RACE") FOR DIGITS FORWARD AND DIGITS SUPRASPAN.

Test	Source of Variation		
	Education	"Race"	"Education x "Race"
Digits Forward	df = 3 F = 5,98 P<0,01	N.S.	N.S.
Digit Supraspan	N.S.	N.S.	df = 3 F = 3,19 P <0,05

Table 26 reveals a significant main effect of Education for Digits forward as well as a significant interaction effect for Digit Supraspan. Cell Means for Education x "Race" ANOVA and graphs are reported on the following page.

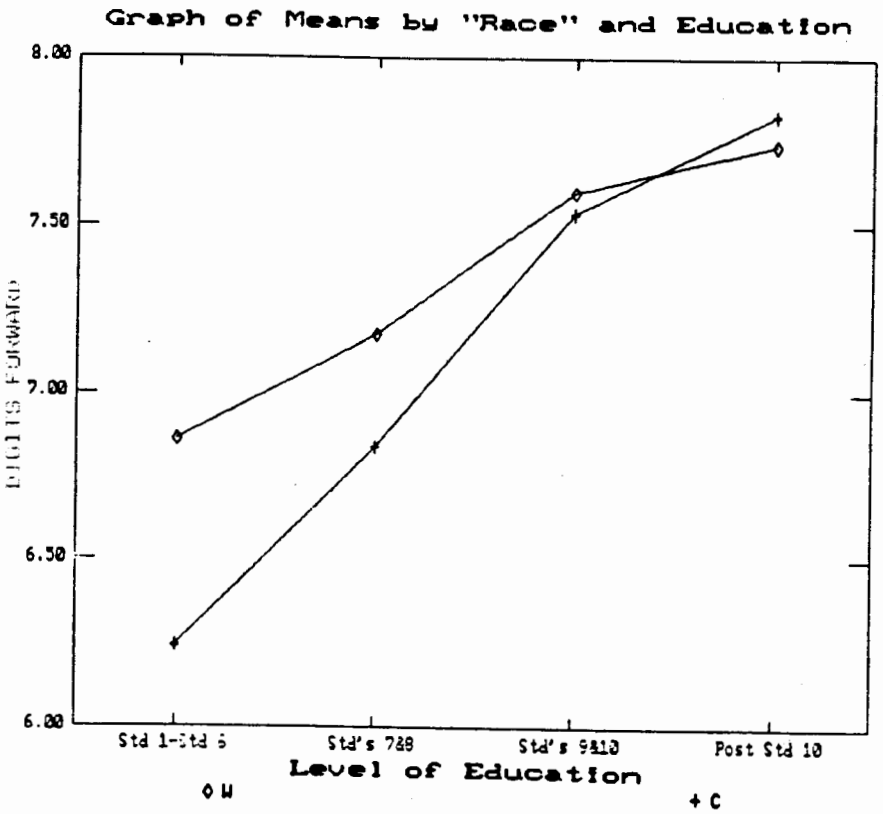
TABLE TWENTY SEVEN: TWO WAY ANOVA (OCCUPATION X "RACE") CELL MEANS FOR DIGITS FORWARD AND DIGIT SUPRASPAN.

		Digits Forward		Digit Supraspan	
		"White"	"Coloured"	"White"	"Coloured"
Standard 1 to Standard 6	Number	N = 7	N = 21	N = 6	N = 19
	Mean	6,86	6,24	5,67	3,95
Standard 7 to Standard 8	Number	N = 28	N = 19	N = 22	N = 17
	Mean	7,18	6,84	4,41	3,47
Standard 9 to Standard 10	Number	N = 86	N = 13	N = 75	N = 9
	Mean	7,60	7,54	4,04	4,89
University or College Education	Number	N=139	N = 6	N=121	N = 4
	Mean	7,74	7,83	3,42	5,75

GRAPHS OF TWO-WAY ANOVA (EDUCATION X "RACE") CELL MEANS FOR DIGITS FORWARD AND DIGIT SUPRASPAN.

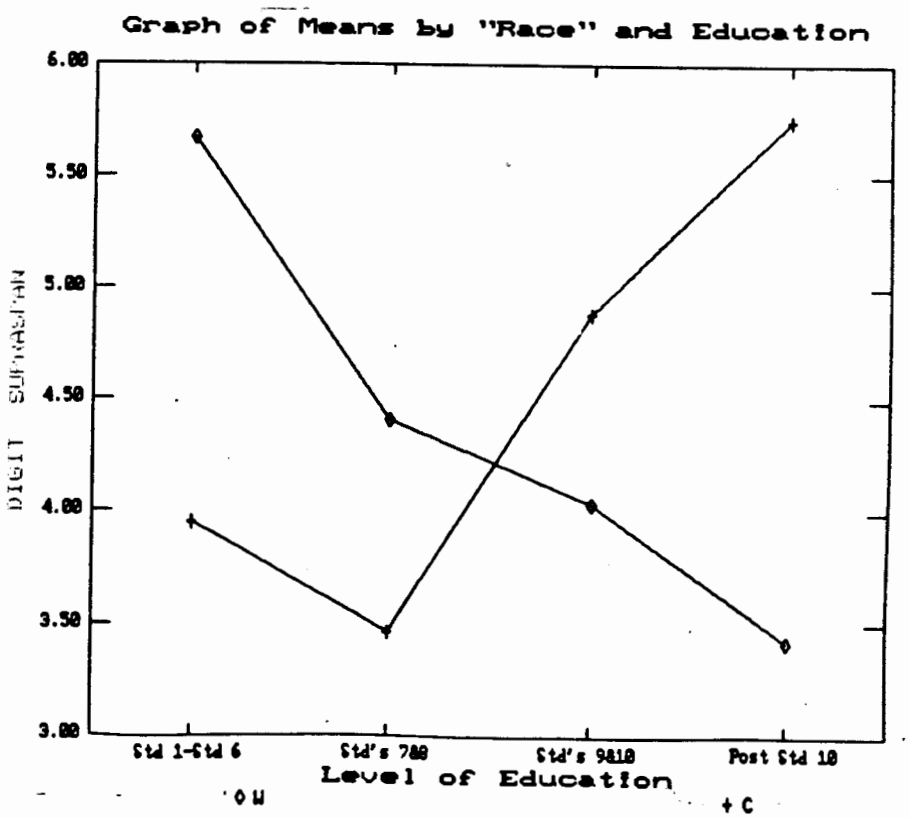
GRAPH 13

◇ W = "White"
+ C = "Coloured"



GRAPH 14

◇ W = "White"
+ C = "Coloured"



On Digits Forward (Graph 13) differences between the "Race" groups are minimal at the higher levels of Education and there is improved performance with a higher Education level, irrespective of Race. On Digit Supraspan (Graph 14) two trends are noticeable. For the "White" group a higher level of Education was associated with superior performance whereas for the "Coloured" group the reverse occurred, a higher level of Education was associated with poorer performance.

TABLE TWENTY EIGHT: TWO WAY ANOVA (OCCUPATION X "RACE" FOR DIGITS FORWARD AND DIGIT SUPRASPAN.

Test	Source of Variation		
	Occupation	"Race"	Occupation x "Race"
Digits Forward	df = 23 F = 3,62 P<0,01	df = 1 F = 4,65 P<0,05	N.S.
Digit Supraspan	N.S.	N.S.	N.S.

There was a significant main effect of both Occupation and "Race" Digits Forward only. Cell Means and graphs are reported on the following page.

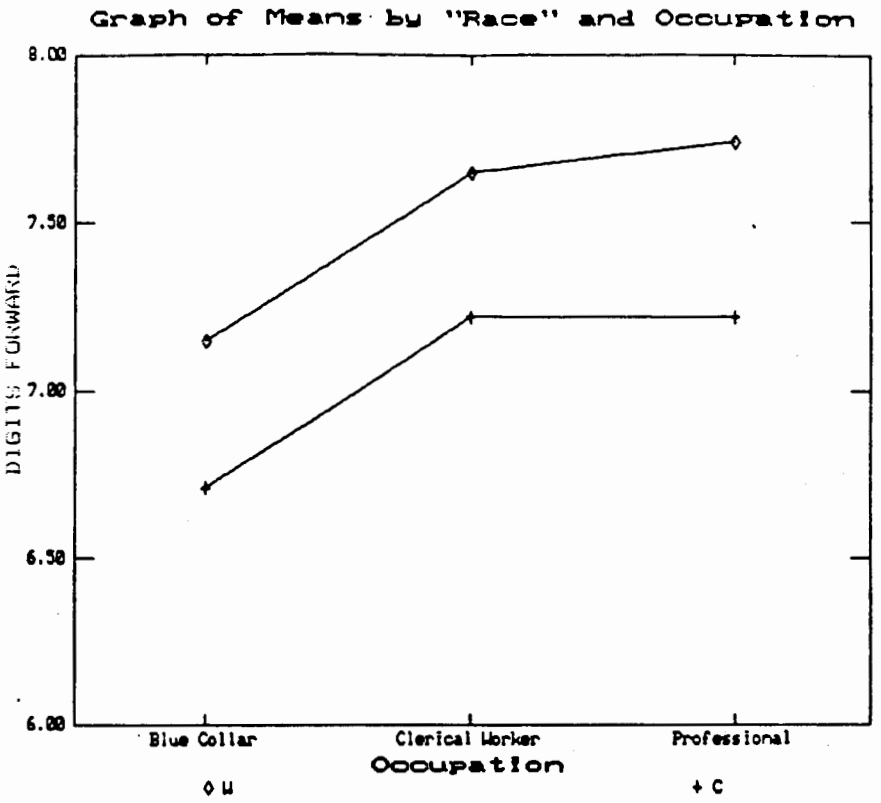
TABLE TWENTY NINE: TWO WAY ANOVA (OCCUPATION X "RACE") CELL MEANS FOR DIGITS FORWARD AND DIGIT SUPRASPAN.

		Digits Forward		Digit Supraspan	
		"White"	"Coloured"	"White"	"Coloured"
Blue-Collar Workers	Number	N = 40	N = 42	N = 35	N = 38
	Mean	7,15	6,71	4,49	4,13
Clerical Workers	Number	N = 85	N = 9	N = 74	N = 6
	Mean	7,65	7,22	4	4,5
Professional	Number	N = 136	N = 9	N = 115	N = 6
	Mean	7,74	7,22	3,31	3,17

GRAPHS OF TWO-WAY ANOVA (OCCUPATION X "RACE") CELL MEANS FOR DIGITS FORWARD AND DIGIT SUPRASPAN.

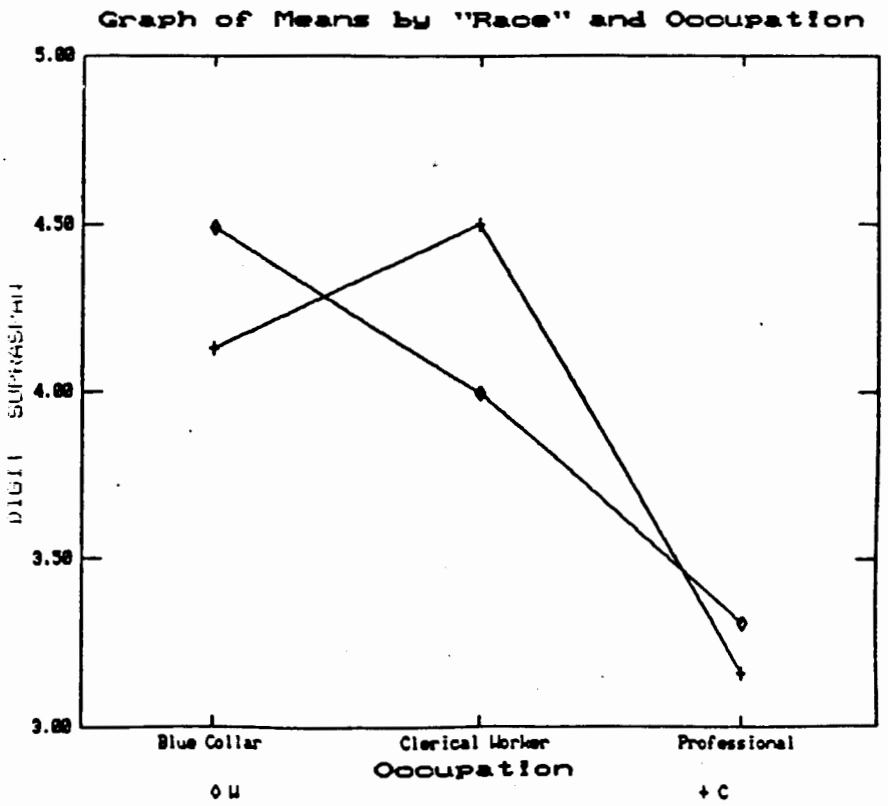
GRAPH 15

◇ W = "White"
\+ C = "Coloured"



GRAPH 16

◇ W = "White"
\+ C = "Coloured"



An inspection of Digits Forward (Graph 15) clearly reveals the main effect of both Occupation and "Race" on performance. Digit Supraspan (Graph 16) was not significant for both Occupation and "Race".

7. DISCUSSION

Controlled Oral Word Association Test

Significant differences between males and females were found only on the high frequency letter "C" with female subjects performing better than male subjects. Previous research has not directly investigated this test in this form (i.e. raw scores for the letters "C F L" and total score) but two studies are relevant here. The standard tables of adjustment scores in clinical use provided by Benton and Hamsher (cited in Lezak, 1983, p. 331) add a higher score for males, which imply that females performed better. However, it cannot be determined from these tables which letter set ("CFL", "PRW" or "FAS") was used and where the source of the differences, i.e. in individual letters or the total score. The study by Yeudall et al. (1983) reports the data in raw score form for the letter set "FAS" and they report no significant differences due to gender.

One explanation for this may be that the different letter sets ("CFL vs PRS" vs "FAS") as well as the letters within sets (C vs F vs L) are not directly comparable. While this is essentially a task of verbal fluency memory (Lezak, 1983) the component

processes and abilities involved (i.e. long-term memory, short-term memory, retrieval and vocabulary ability) may interact differentially with test demands i.e. verbal output within a specified time limit for letters of different frequencies. The present study does not allow this hypothesis to be directly tested but what emerged consistently was that effect of the different variables on test performance was not the same for all the letters, in terms of significant results as well as percentage variance. Yeudall et al. (1983) report a similar trend.

Younger subjects performed better than older subjects on the letter "C" and the Total score. This is similar to the results by Yeudall et al. (1983) who report significant age differences on the letters "F", "A" and average score in subjects between 15-40 years of age. The results of the present study suggest that these age differences continue beyond age 40. Since there were no significant age differences in the present study on the lower frequency letters "F,L" it may be that speed rather than vocabulary ability that affected performance. Similarly, Botwinick and Storand (1971) found Age more important in predicting speed of response as compared to vocabulary ability. However, this test taps many different processes and abilities and this confounds a clear interpretation.

Education significantly affected performance on all letters as well as the total score and had the highest variance estimate (18-25%) of all the variables. A higher level of Education was associated with superior performance, irrespective of "race".

This is consistent with the adjustment tables, reported by Benton and Hamsher (cited in Lezak, 1983), and clearly support the observation that this test is highly influenced by Education.

The studies to date have not examined the relationship between Occupation and performance on this test. The results of the present study suggest that Occupation significantly affects performance and a higher occupational level was associated with improved performance, irrespective of "Race". The higher Educational level associated with a higher occupational status confounds a clear interpretation and it is not clear to what extent there may be differences in performance due to skills used in different occupations (for e.g. difference between a clerk and a domestic worker).

"Race" influenced performance independent of both Education and Occupation. However, at the higher levels of Education and Occupation mean differences between the "Race" groups were far smaller than the differences at lower levels of Education and Occupation. For example, for the letter "C" when "Race" was taken together with Education, the "Coloured" group at post-matric level performed better than the "White" group. This suggests that "Race" differences are associated with Education and Occupational status and this influence is minimal at higher levels of education and occupational status.

Wechsler Paired Associate Learning - Immediate and Delayed Recall

Younger subjects performed better on Wechsler Paired Associate Learning - Immediate Recall and this is consistent with previous research on this task (Bak & Green, 1980; Hulicka, 1966; McCarthy et al., 1982). There was a steady but small decline by decades (the exception was the 30-39 year group) and the variance estimate (6 - 8%) was small. This is consistent with the results by Haaland et al., (1983) which suggest that the age related decline for this test is small. There was also a significant age difference on delayed recall. While delayed recall on this test has not been previously investigated, Cauthen (1977) and Logue and Wyrrick (1979) report a significant relationship between age and delayed recall on Logical Memory which is also a test of verbal memory. However, these tests are not directly comparable because they involve different cognitive processes (Dujoune & Levy, 1971).

Gender influenced performance on both immediate and delayed recall. Female subjects performed better than male subjects. This has not been previously investigated and the contribution of this variable in the present study (1 - 5%) was small.

The results for Education clearly demonstrate that a higher level of Education is associated with superior performance on both Immediate and Delayed Recall. Cauthen (1977) and Back and Green (1980) also demonstrate that a higher level of education and a higher IQ is associated with superior performance. The influence

of occupation on performance on this test has not been previously investigated. The results of the present study reveals the influence of occupation on performance, with subjects in the higher occupational levels performing better than those at a lower level, on both Immediate and Delayed Recall.

"Race" had an influence on immediate recall independent of Education and Occupation. However, for both Education and Occupation, higher levels were associated with improved performance irrespective of "Race" on both Immediate and Delayed Recall. There was also a consistent tendency for differences on scores between "Race" groups to narrow at higher levels and when "Race" was taken together with "Education" on Delayed Recall the "Coloured" group performed better at the standard 9 and 10 level. This was very similar to the results obtained for the Controlled Oral Word Association Test.

Digit Supraspan

There were no significant differences on this test between younger and older subjects and between males and females on both Digits Forward and Digit Supraspan. These findings are consistent with previous results reported for age and gender. Gilbert and Levee (1971) report that Digit Span remains stable with advancing age and Chavez et al. (1983) found no differences between males and females on Digit Span performance.

The results for Education, Occupation and "Race" suggest that performance on Digits Forward and Digit Supraspan is

differentially affected by these variables. Higher levels of Education and Occupation, irrespective of "race" were associated with superior performance on Digits Forward. There was again a marked and consistent trend for differences between "Race" groups to narrow at the higher levels of Education and Occupation. Only Occupation produced sigifnicant results for Digit Supraspan. A higher level of Occupation was associated with superior performance.

8. CONCLUSIONS

The present study examined the relationship between level of Age, Gender and Education, Occupation, and "Race", and performance on selected tests of memory and learning in a non-clinical population. Generally, most of the hypotheses raised were supported and the subject variables selected significantly affected performance on most of the tests selected. There were, however, differences in terms of the specific test measures as well as the percentage variance that each variable contributed.

Education and Occupation were the two variables that performed most consistently. They contributed largest percentage variance (estimates 7-25%) and produced significant results on all tests, almost without exception. A higher level of Education and a higher occupational status was associated with superior performance irrespective of "Race". The findings for Education were consistent with other studies and supports the well documented influence of Education on neuropsychological test (Finlayson, Johnson & Reitan, 1977). Occupation has not been

previously investigated and this may be a serious omission since there may be an overlearning of certain skills (Prigatano, 1978). The present results clearly support this observation, with professionals performance being far superior to Blue-collar workers on measures of Verbal Memory. However, the higher level of Education associated with a higher occupational status confounds a clear interpretation. Further research is needed to investigate the relationship between Education and Occupation on tasks other than those involving Verbal Memory.

"Race" influenced performance independently of Education and Occupation, but its effects were less consistent than either of these two variables. There was a consistent and marked tendency for a higher level of education and a higher occupational status to be associated with superior performance, irrespective of "Race". Similarly, there was a consistent tendency for differences in test scores between "Race" groups to narrow with a higher level of Education and a higher occupational status. In fact, on some tests (for example, Associate Learning - Delayed Recall) the "Coloured" groups performed better than the "White" groups.

The results for Age and Gender were less consistent and the percentage variance of these variables on performance was much smaller (3 - 8% and 1 - 4% respectively). The results were, however, consistent with those reported previously (for example, Hulicka, 1966; Chavez et al. (1983)). While younger subjects performed better than older subjects it cannot be determined to

what extent this is a true decline with age since the data is cross-sectional (McCarthy, 1980).

The subject variables investigated also differed as a function of the test used. On the Controlled Oral Word Association test, Age, and Gender affected the high frequency letter "C", while "Race" affected the lower frequency letters "F" and "L". Clearly, there exists the need for local normative data utilising raw scores as was done in the present study.

While the data for the Wechsler Associate Learning is comparable to the North American studies, this was only in terms of an Age comparison. Mean scores in the present study for the Anovas for Education and Occupation were lower than those simply reported by Age and given that Education, Occupation as well as "Race" significantly affected performance and produced lowered scores, the present normative data based on Wechsler's (1945) and Hulicka's (1966) data is certainly inadequate. Local normative data that takes into account the influence of these variables is clearly needed.

The subject variables differentially affected performance on Digits Forward and Digit Supraspan. While Education, occupation and "Race" influenced performance on Digits Forward, only Occupation influenced performance on Digit Supraspan. However, even when Occupation is taken into account, group mean scores were well below the criterion for brain damage, i.e. 12 trials and this test was least influenced by the subject variables is

investigated in the present study. This makes it a useful test to use in neuropsychological assessment.

The present study aimed at providing initial data from a large non-clinical population as the first phase in an attempt to generate norms for selected neuropsychological tests. Hence, while the sample is large and provides useful information for the data, there are certain limitations which need to be addressed.

While the present data was obtained from a large sample, it cannot be seen as being representative of the general population since there were a large number of "White" professionals in the sample. The results for some of the groups with small cell numbers may also be unreliable. While fairly stringent control procedures were used in data collection, data obtained in the field-setting raises questions about standardised testing conditions and administration procedures. Hence, future research should use the variables identified as well as the limitations noted above to develop normative data. The use of a trained professional using a sample of more carefully matched subjects, and a more representative sample would provide more reliable data.

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— APPENDIX —

PSYCHOLOGICAL ASSESSMENT PRACTICAL 1987

TESTING MANUAL

I ORDER OF INTERVIEW AND TEST ADMINISTRATION

1. Introduction: simple, short tests; part of very important research study; find out how normal people do in order to compare patients with brain damage to normals; are no SA norms.

Administration of test battery

2. Associate Learning test. Note time testing commenced.

3. Visual Reproduction test.

4. Logical Memory test.

5. Word Association test.

6. Digit Span and Supraspan.

7. Personal information sheet to be completed by interviewer.

Delayed recall tests to be administered a minimum of 30 minutes after testing commenced (i.e. (2)).

8. Associate Learning test - delayed recall (30 minutes).

9. Visual Reproduction test - delayed recall (30 minutes).

10. Logical Memory test - delayed recall (30 minutes).

11. Conclude the interview - thank the subject and reassure re confidentiality, etc.

II ADMINISTRATION OF ASSOCIATE LEARNING TEST

(i) Read the instructions to the subject as printed on the test form.

(ii) Read presentation list 1 at a rate of 1 pair every 2 seconds.

(iii) After reading the first presentation allow 5 seconds and test by presenting the first recall list.

(iv) Give the first word of pair and allow a maximum of 5 seconds for response.

(v) If the subject gives correct reply, say, "That's right", and proceed with the next pair.

(vi) If patient gives incorrect reply, say, "No", supply the correct association, and proceed with the following pair.

(vii) After the first recall has been completed allow a 10 second interval and repeat the procedure with lists 2 and 3.

THIRTY MINUTE DELAYED RECALL

Without warning tell the subject that you would like to see "how much you remember" and present the recall list. Do not present the word pairs - simply read the recall list as before.

III ADMINISTRATION OF VISUAL REPRODUCTION TEST

There are three test cards which are given in order (a), (b), (c).

(i) For cards (a) and (b) say: "I am going to show you a drawing. You will have 10 seconds to look at it; then I shall take it away and let you draw it from memory. Don't begin to draw until I say 'go'. Ready?".
After exposing the card for 10 seconds, remove card and say "Now draw it, go".

(ii) For card (c) say: "Here is one that is a little harder. This card has 2 drawings on it. I want you to look at them carefully - again you will have only 10 seconds to look at the card, then I shall take it away and let you make both drawings; the one on the left side - here (point) and the right one - here (point). Ready?".
Expose for 10 seconds, remove card and say, "Now draw it, go".

THIRTY MINUTE DELAYED RECALL

Without warning tell the subject that you would "also like to see how much you remember of the cards I asked you to draw earlier". Present the delayed recall blank form and encourage the subject to draw as much as they remember.

IV ADMINISTRATION OF THE LOGICAL MEMORY TEST

(i) Read the instruction to the subject as printed on the test form.

(ii) Read the first passage at an average speed, speaking clearly and distinctly.

(iii) After reading the passage say, "What did I read to you? Tell me everything and begin at the beginning".

(iv) Record the subject's response verbatim.

(v) Introduce the second paragraph (as printed), read it and proceed as before.

THIRTY MINUTE DELAYED RECALL

Without warning tell the subject that you would "also like to see how much you remember of the stories I read to you earlier".

Passage A: "Do you remember what the first story was about? Tell me everything and begin at the beginning".

Passage B: "Now the other story. Tell me everything, begin at the

V ADMINISTRATION OF THE CONTROLLED ORAL WORD ASSOCIATION TEST

(i) Read the instructions to the subject as printed on the test form.

(ii) Warm up trial: Read instructions as printed.
Terminate the trial after 2 appropriate "S" words have been volunteered.

(iii) Test trials: Three 1 minute trials are presented once the subject understands what is required.
Words beginning with C, F, L are required for the 3 trials, respectively (excluding proper nouns, numbers, and the same word with a different suffix).
See test form for instructions. Repeat instructions before every trial.

(iv) Errors (e.g. "Cape Town", "five", "favourable, favourably") should be corrected after the relevant 1 minute trial. Do not interrupt the subject during a trial.

e.g. "That was good, but please remember not to say proper nouns such as Cape Town, in the next trial".

VI ADMINISTRATION OF THE DIGIT SPAN AND SUPRASPAN TESTS

(A) Digit Span

(i) Read the instructions to the subject as printed on the test form.

(ii) Digits should be read at a rate of one per second.

(iii) Start with the three-digit series.

(iv) If a subject repeats Trial 1 of a series correctly it is scored and the next higher series is given.

(v) If a subject fails on Trial 1 administer Trial 2 of the same series.

(vi) Discontinue if subject fails on both trials of a given series.

(B) Digit Supraspan

(i) Re-administer the last set of digits (at the point of breakdown) until the subject can repeat them.

For example: If the subject completes 5 digits correctly but fails both trials of the 6 digit sequence then say "You almost got that one right - I'm going to repeat that last set of numbers to see if you can get it". Repeat the second set (Trial 2) of 6 digits. Record the subject's answer. If the subject again fails say "Almost right/not quite right; let's try again with the same numbers" and Repeat. Etc. etc.

(ii) Continue until the subject gets the digits correct ("well done") or discontinue the test after 12 trials ("this is a very hard test; you didn't quite get it but you tried hard").

VII SCORING PROCEDURES

(a) Associate Learning

One credit for correct response if given within 5 seconds.

Immediate recall final score: add credits obtained on EASY associations and divide score by 2; add credits on HARD associations to this score.

$$\text{FINAL SCORE} = \frac{(E1 + E2 + E3)}{2} + (H1 + H2 + H3).$$

Delayed recall final score: divide credits on EASY associations by 2; add credits on HARD associations; then multiply this score by 3.

$$3 \times \left(\frac{E}{2} + H\right)$$

(b) Visual Reproduction

Scoring:

(a)	1.	Two lines crossed, four flags	1
	2.	Correctly facing one another	1
	3.	Accuracy (lines nearly equal, nearly bisected, nearly at right angles, flags nearly square	1
		Maximum score	3
(b)	1.	Large square with two diameters	1
	2.	Four small squares within a large square	1
	3.	Two diameters in each small square	1
	4.	Sixteen dots, each alone in a small square	1
	5.	Accuracy of proportion (width of spaces around the four small squares between 1/4 and ½ the width of the 16 smallest squares	1
	6.	If design is complete but with superfluous square or lines	3
		Maximum score	5

Score each design separately

(c1)	1.	Large rectangle with small rectangle inside	1
	2.	All vertices of inner rectangle connected to vertices of larger rectangle	1
	3.	Smaller rectangle currently shifted to the right and approximately that of exposed figure	1
		Maximum score	3
(C2)	1.	Open rectangle with corrct loop at each end	1
	2.	Centre and either left or right side currently reproduced	1
	3.	Figure correct except one of loop incorrectly reproduced	2
	4.	Figure correctly reproduced and in approximate	

Total maximum score on all figures 14

(c) Logical Memory

Score one point for every memory unit (idea) correctly recalled.

Score ½ point if one half of semantic unit correctly recalled.

Final score is average of number of ideas correctly reproduced on both passages (total score $\frac{A + B}{2}$)

Note: Scoring is based on content recall of paragraph, not verbatim recall, i.e. semantic units are scored.

Implications of this approach are that the words in brackets in the paragraph do not have to be recalled to get 1 point, because they are redundant (they should still be read to the subject).

e.g.	/office(building)/	: 1 pt	e.g.	/police(station)/	
	office	: 1 pt		police	: 1 pt
	building	: ½ pt		station	: 0 pts

It is also clear from the above example that 'police' and 'station' are not equal parts of the memory unit, i.e. not ½ pt each. To say "she went to the police" implies station, but to say "she went to the station" means that the meaning is lost.

Other scoring examples (Passage A)

(i)	/the night before/	: 1 pt.	If the subject answers "last night"		: 1 pt
	night	: ½ pt.		last	: ½ pt
	before	: ½ pt.		night	: ½ pt.

These two answers have the same meaning.

(ii) /of fifteen Rand/ "some money" : 0 pts.
"12/20 etc. Rand : ½ pt (because S remembered that she was robbed of Rands and not cents, which are both possible elements of the semantic field "currency".

(iii) /little children/ "children" : ½ pt
"little kids" : 1 pt

(iv) /for two days/ "for days" : ½ pt

(v) /felt sorry for the woman/ "felt sorry" : ½ pt
"felt sorry for her" : 1 pt

(vi) /and collected money/ "gave money" : ½ pt
/for her/ "to her" : 1 pt.

Scoring examples from Passage B

(i) /killed/; /fatally injured/; /seriously hurt/: the degrees of damage are important and this must be brought out during recall.

/fatally injured/	"seriously injured and fatally hurt"	: 2 pts
/seriously hurt/	"seriously hurt and injured"	: 1½ pts
	"seriously injured and hurt"	: 1½ pts
	"fatally hurt and injured"	: 1½ pts
	"fatally injured and hurt"	: 1½ pts
(ii) /and others/	"and"	: 0 pts.
	"others"	: 1 pt.
(iii) /when a bomb/	"bomb"	: 1 pt
(iv) /in the town/	"in the city"	: 0 pts
	"in the dorp"	: 1 pt
	(dialectal variation is not penalized)	
(v) /only two/	"only some"	: ½ pt
	"two"	: ½ pt.
(vi) /escaped minimized/	"were uninjured"	: 1 pt
	"got out alive"	: 0 pts
	"were not hurt"	: 1 pt
	"got out uninjured"	: 1 pt

(d) Controlled Oral Word Association Test

(i) Add number of acceptable words produced during the three 1 minute trials.

(ii) Correct this score for age, sex and education (Table 11.4, below).

(iii) Convert score to percentiles (Table 11.5, below).

Table 11-5 Controlled Oral Word Association Test: Summary Table

Adjusted Scores	Percentile Range	Classification
53+	96+	Superior
45–52	77–89	High normal
31–44	25–75	Normal
25–30	11–22	Low normal
23–24	5–8	Borderline
17–22	1–3	Defective
10–16	<1	Severe defect
0–9	<1	Nil—Trace

(Adapted from Benton and Hamsher, 1976)