

**THE EFFECTIVENESS OF DYNAMIC ASSESSMENT AS AN
ALTERNATIVE APTITUDE TESTING STRATEGY**

by

STEFANO ALBERTO ZOLEZZI

Submitted in fulfilment of the requirements for the degree of

DOCTOR OF EDUCATION

in the subject

PSYCHOLOGY OF EDUCATION

at the
UNIVERSITY OF SOUTH AFRICA

Promoter: Dr H E Roets

JUNE 1995

SUMMARY

The present study sets out to evaluate the effectiveness of a dynamic approach to aptitude testing. It was proposed that it is not always appropriate to use conventional aptitude tests to predict future academic success in the South African context. The study posited the belief that an alternative testing format could be facilitated by using a test-train-test procedure within a learning potential paradigm.

The learning potential paradigm as formulated through Vygotskian and Feuersteinian theory is operationalised in the form of a Newtest Battery. The Newtest procedure is in direct contrast to traditional approaches to aptitude testing. The latter approaches both implicitly and explicitly adopt a static view of ability, whereas the Newtest approach focuses on the learning potential of the testee, as well as consequent performance. However, the assessment of learning potential poses problems of its own. Modifications were introduced to ensure that the Newtest format is both appropriate and psychometrically defensible. The construction and evaluation of the Newtest Battery is described.

A sample of both advantaged and disadvantaged students were tested on a battery of traditional aptitude tests. This group of students was contrasted with another sample of both advantaged and disadvantaged students who undertook the Newtest Battery in the modified dynamic testing format. The traditional measures of aptitude were found to be invalid predictors of university success. Matric results showed a relationship with academic success for both groups. The Newtest measures enhanced the prediction of academic success for both advantaged and disadvantaged students. The Deductive Reasoning dynamic measure was found to be a valid predictor of university success for the disadvantaged students.

The results thus successfully extend the learning potential paradigm into the realm of group aptitude testing. The validity of traditional aptitude test measures has been brought into question by the findings of the study. The study points the way forward to a more equitable and relevant aptitude testing procedure.

Finally, it was shown that the testing environment forms part of the socio-educational context. Personnel involved in the administration of aptitude tests are given guidelines with the aim of equalising the test process.

Key Terms:

Academic performance; Academic prediction; Aptitude testing; Culture-fair testing; Deductive reasoning; Disadvantaged students; Dynamic testing; Inductive reasoning; Intelligence; Learning potential; Mediated learning; Psychometric measures.

"I declare that the *effectiveness of dynamic assessment as an alternative aptitude testing strategy* is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references."



Stefano A Zolezzi.

The financial assistance of the Centre for Science Development towards this research is hereby acknowledged. Opinions expressed in this thesis and conclusions arrived at, are those of the author and are not necessarily to be attributed to the Centre for Science Development.

Acknowledgements

I would like to express my sincere gratitude to:

My promoter, Dr Elsabe Roets, for her support, encouragement and sound advice.

Dr N Cloete, Head of the Counselling and Careers Unit at the University of the Witwatersrand, whose co-operation made this study possible.

Janine Davids, Career Counsellor at the Counselling and Careers Unit, who assisted in the collection of data.

My wife, Berdette, who devoted many hours of proof reading and editing.

TABLE OF CONTENTS

DECLARATION.....	i
ACKNOWLEDGEMENTS.....	iii
TABLE OF CONTENTS.....	iv
ORIENTATION TO THE STUDY	1
1.1 Awareness of the problem	1
1.2 Analysis of the problem	3
1.2.1 <i>Limitations of school performance as a predictor of University Academic Success</i>	4
1.2.2 <i>Limitations of Aptitude Test Scores as Predictors of University Academic success</i>	5
1.2.3 <i>Learning Potential Assessment as a possible alternative - Theory and Research</i>	6
1.2.4 <i>Limitation of Learning Potential Assessment as a predictor of University academic success</i>	9
1.3 Statement of the Problem	11
1.4 Objective of the present study	13
1.5 Statement of the hypothesis	13
1.6 Clarification of terms	14
1.7 Proposed outline for subsequent chapters	15
TRADITIONAL TESTING: THEORY AND RESEARCH.....	17
2.1 The context of academic prediction	17
2.2 Factors in Academic Achievement	18
2.2.1 <i>Differences in intelligence</i>	18
2.2.2 <i>Differences in Socioeconomic Status</i>	22
2.3 Intelligence and Individual Differences	23
2.3.1 <i>The Genetic Position</i>	23
2.3.2 <i>The Environmentalist Position</i>	25
2.3.3 <i>The Adaptability position</i>	26
2.4 The Anti-test Movement	26
2.5 Culture-fair testing	27
2.6 Comparison and evaluation of the different approaches to intelligence	28
2.7 Intelligence, aptitude and academic prediction	30
DYNAMIC TESTING: THEORY AND RESEARCH	32
3.1 Introduction	32
3.2 Shortcomings of Traditional Approaches to Testing	33
3.2.2 <i>Potential, intelligence and testing</i>	36
3.3 Foundations of Dynamic Testing: The Zone of Proximal Development	37
3.4 Models of Dynamic Testing	38
3.4.1 <i>Mediational assessment</i>	38
3.4.2 <i>Testing-the-limits Testing</i>	39
3.4.3 <i>Graduated Prompting Testing</i>	40
3.4.4 <i>Mediated and Graduated Prompting Testing</i>	41

3.5	Test-Train-Test Testing.....	42
3.5.1	<i>Clinical Interaction/General Skills</i>	43
3.5.2	<i>Clinical interaction/domain-specific skills</i>	44
3.5.3	<i>Standardised instruction/General Skills</i>	45
3.5.4	<i>Standardised Instruction/Domain-specific skills</i>	46
3.6	Comparison of dynamic testing models.....	47
3.7	Dynamic testing in a Multicultural context.....	49
THE DYNAMIC TEST BATTERY: CONTENTS AND PROCEDURE.....		51
4.1	Introduction.....	51
4.2	Limitations of current approaches to Dynamic Testing.....	51
4.2.1	<i>Non-Standardised mediation</i>	51
4.2.2	<i>Based on a deficit model</i>	52
4.2.3	<i>Test items are non-standard</i>	52
4.2.4	<i>Pre-test and Post-test ceiling effect</i>	52
4.2.5	<i>Unreliability of improvement scores</i>	53
4.2.6	<i>Time and labour intensive</i>	53
4.2.7	<i>Difficulty in grading mediation</i>	54
4.2.8	<i>Generalisability of learning across task domains</i>	54
4.2.9	<i>Generalisability to normal student populations</i>	55
4.3	Theoretical basis of the Construction of the Group Dynamic Test Battery (Newtest).....	55
4.3.1	<i>Budoff and Standardised Dynamic Testing</i>	56
4.3.2	<i>Ferrara and Domain-specific skills</i>	57
4.3.3	<i>Feuerstein and the modification of the test situation</i>	58
4.4	Choosing the tests.....	59
4.4.1	<i>The Deductive Reasoning Test</i>	60
4.4.2	<i>The Pattern Relations Test</i>	60
4.5	Standardising the Mediation.....	61
4.6	Operationalising Learning Potential.....	62
4.7	Modifying the Tests.....	62
DESCRIPTION OF THE EMPIRICAL STUDY.....		64
5.1	Introduction.....	64
5.2	The Design.....	64
5.3	The Sample.....	65
5.4	The Subject Variables.....	67
5.5	The Predictor Variables : Traditional.....	69
5.5.1	<i>School results</i>	69
5.5.2	<i>Mental alertness B/75</i>	70
5.5.3	<i>Reading Comprehension</i>	71
5.5.4	<i>Arithmetic reasoning</i>	71
5.5.5	<i>Raven's matrices</i>	71
5.6	The Predictor Variables : Dynamic Test Battery.....	72
5.6.1	<i>Deductive Reasoning</i>	72
5.6.2	<i>Pattern relations</i>	72
5.6.3	<i>Dynamic measures</i>	74
5.7	The Criterion Variables.....	74

THE EMPIRICAL TESTING PROCEDURE AND RESULTS.....	77
6.1 The Testing Procedures	77
6.1.1 <i>Aptitude testing in the CCU: Traditional Approach</i>	77
6.1.2 <i>Aptitude Testing in the CCU: Dynamic Approach (Newtest)</i>	77
6.2 The testing Sequence and Materials.....	78
6.3 Testing Conditions.....	79
6.3.1 <i>Ensuring consistency in the different testing groups</i>	79
6.3.2 <i>Clarity of vision and hearing</i>	80
6.3.3 <i>Ensuring no copying or cheating during enriched testing</i>	80
6.4 Statistics.....	80
6.5 Data Collection	80
6.6 Results	81
6.6.1 <i>Introduction</i>	81
6.6.2 <i>Investigation of Hypothesis I</i>	81
6.6.4 <i>Investigation of Hypothesis II</i>	88
6.6.5 <i>Investigation of Hypothesis III</i>	94
6.6.6 <i>Summary of Results</i>	94
DISCUSSION AND CONCLUSIONS	97
7.1 Introduction	97
7.2 Discussion of Results.....	97
7.3 Implications for the objective of the present study.....	99
7.4 Implications for Aptitude Testing and Academic Prediction	101
7.5 Implications for Disadvantaged students.....	103
7.6 Implications for current research in academic prediction and aptitude testing.....	106
7.7 Limitations of the present study and future research	107
7.8 Summary and Conclusions.....	109

LIST OF TABLES

Table 1:	Per capita expenditure (R) on school education expressed as % of amount spent on White education.....	5
Table 2:	Classification of current approaches in Test-Train-Test assessment.....	43
Table 3:	Models of Dynamic Testing.....	48
Table 4:	Distribution of sample by Faculty.....	66
Table 5:	Distribution of sample by Sex.....	66
Table 6:	Distribution of sample by Age.....	67
Table 7:	Distribution of subject variables by Faculty and Sex.....	68
Table 8:	Comparative Education Statistics 1990.....	68
Table 9:	Summary of subjects according to categorisation of disadvantage.....	69
Table 10:	Matric rating conversion scale.....	70
Table 11:	Summary of Predictor variables : Traditional.....	73
Table 12:	Summary of Predictor variables : Dynamic.....	74
Table 13:	Summary of criterion variables.....	75
Table 14:	Summary of the Empirical Study.....	76
Table 15:	Mean scores and standard deviation of scores of the traditional tests and the November results per faculty. (1992/93 group).....	82
Table 16:	Correlations between traditional measures and November Examinations 1992/93 group ($p < 0.05$).....	82
Table 17:	Correlations between the dynamic Newtest measures and November Examinations - 1993/94 group ($p < 0.05$).....	83
Table 18:	Mean scores and Standard deviations of scores of the dynamic and traditional measures, as well as November results (1993/94 group).....	84
Table 19:	Learning potential scores for the full group of students in the Dynamic tests as operationalised by DR/E less DR/T and PR/E less PR/T. (Highest LP to lowest LP).....	85
Table 20:	Correlations between the Traditional measures and November examinations for the Full group (1992/93) in the Faculty of Arts ($p < 0.05$).....	86
Table 21:	Correlations between the Dynamic Test measures and November examinations for the Full group (1993/94) in the Faculty of Arts ($p < 0.05$).....	87
Table 22:	Correlations between the Dynamic Test measures and November examinations for the Full group (1993/94) in the Faculty of Commerce and Science ($p < 0.05$).....	87
Table 23:	Correlations for Advantaged students in the traditional test Group (1992/93). Traditional measures and November examinations ($p < 0.05$).....	89
Table 24:	Correlations between Dynamic test measures and November Exams for the Advantaged students in the 1993/94 group ($p < 0.05$).....	89

Table 25:	Correlations between Traditional measures and November Exams for the Disadvantaged students in the 1992/93 group ($p < 0.05$).....	90
Table 26:	Correlations between Dynamic measures and November Exams for the Disadvantaged students in the 1993/94 group ($p < 0.05$).....	90
Table 27:	The Mean and standard Deviation measures for the disadvantaged and advantaged students in the 1993/94 group ($p < 0.05$).....	91
Table 28:	Correlations between the Traditional and Dynamic measures for the Advantaged students in the 1993/94 group as per Faculty ($p < 0.05$).....	92
Table 29:	Correlations between the dynamic measures and the November exams for the Disadvantaged students in the 1993/94 group in the Faculty of Science ($p < 0.05$).....	92
Table 30:	Correlations between the Dynamic Measures and November Exams for the High potential students in the 1993/94 group. ($p < 0.05$).....	93
Table 31:	Correlations between the Dynamic Measures and November Exams for the Low potential students in the 1993/94 group. ($p < 0.05$).....	93
Table 32:	Correlations between learning potential measures and the traditional ability measures for the full group of students - 1993/94 group ($p < 0.05$).....	94
Table 33:	Correlations between predictor measures and criteria measures for the whole study (Summary).....	95

LIST OF FIGURES

Figure 1: Psychological educational essences of a dynamic test context..... 8
Figure 2: Vernon's hierarchical model of Intelligence.....20

LIST OF APPENDICES

APPENDIX 1: CCU PROPOSAL FOR MODIFICATION OF TRADITIONAL TESTING PROGRAMME.....	112
APPENDIX 2: CCU PROPOSAL FOR TRAINING OF TESTERS.....	115
APPENDIX 3: MEDIATED LEARNING EXPERIENCE	118
APPENDIX 4: THE COGNITIVE MAP OF FEUERSTEIN	120
APPENDIX 5: COGNITIVE PROCESSES IN PATTERN RELATIONS.....	122
APPENDIX 6: COGNITIVE PROCESSES IN DEDUCTIVE REASONING	124
APPENDIX 7: FORMAT OF THE DYNAMIC TEST BATTERY (DTB).....	126
APPENDIX 8: DESCRIPTION OF THE DTB	128
APPENDIX 9: ADMINISTRATION OF THE DTB.....	131
APPENDIX 10: MEDIATION OF DEDUCTIVE REASONING.....	133
APPENDIX 11: MEDIATION OF PATTERN RELATIONS	138
APPENDIX 12: SCORING OF THE DTB.....	144
APPENDIX 13: INTERPRETATION OF DTB RESULTS.....	146
APPENDIX 14: THE TRAINING PROGRAMME FOR MEDIATORS.....	148
APPENDIX 15: EVALUATION QUESTIONNAIRE OF DTB	150
APPENDIX 16: THE RULES OF REASONING MEDIATION WALL-CHART	152
APPENDIX 17: INSTRUCTIONS FOR DEDUCTIVE REASONING TEST	154
APPENDIX 18: SAMPLE OF ITEMS IN DEDUCTIVE REASONING	157
APPENDIX 19: SCORESHEET FOR DEDUCTIVE REASONING	159
APPENDIX 20: INSTRUCTIONS FOR PATTERN RELATIONS TEST.....	161
APPENDIX 21: SAMPLE OF ITEMS IN PATTERN RELATIONS TESTS.....	164
APPENDIX 22: ANSWER SHEET FOR PATTERN RELATIONS ENRICHED	166

APPENDIX 23: THE COGNITIVE FUNCTIONS AND DYSFUNCTIONS OF FEUERSTEIN..	168
APPENDIX 24: THE LPAD MODEL.....	170
APPENDIX 25: THE CRITERIA OF MEDIATION.....	172
APPENDIX 26: COMPONENTS OF THE MENTAL ACT.....	174

Chapter 1

ORIENTATION TO THE STUDY**1.1 Awareness of the problem**

This year, thousands of South African adolescents will sacrifice a Saturday morning or schoolday for the privilege of agonising over some form of aptitude testing. They submit to this three or four hour ordeal in the hope that the test results will reveal significant information which might facilitate a realistic study or career decision. However, the strategy of using traditional, standardised tests for the purposes of academic prediction has frequently been questioned, and there is an increasing accumulation of literature pointing to the limitation in this approach (Glaser, 1982; Mann, 1979; and Silverman, 1985). Glaser (1981: 923) suggests that psychologists should 'reexamine their testing practices and their interpretations of tests as professional tools that contribute to educational goals'. The question 'is there an important place for traditional measures of aptitude and achievement in modern education?' raised by Nunnally (1975: 7) becomes pertinent to our testing practices and procedures.

The psychological-educational categories of involvement, significance attribution and experience appear to be short-changed in traditional testing procedures. Testees are not fully involved in an active goal-directed manner. This arises because the testee does not have an opportunity to become acquainted with the test and test items. Furthermore, no mention is made as to the rationale of being tested. The testee is unable to attribute significance to the test items and is left unclear as to the relationship between test results and career directions. Ultimately, the testee does not experience the testing procedure as interesting, relevant or stimulating. The process does not allow for any feedback whereby the testee is able to monitor self-knowledge. Identity formation is stifled and the realisation of potential is limited to traditional modes of interpretation.

It was from a psychological-educational viewpoint that the present researcher seriously questioned the usefulness of traditional aptitude testing. This occurred at a time where there was a growing interest in examining the viability of a range of testing procedures that provide for more leeway in the testing process (Campione, Brown & Connell, 1989; Cross, 1990; and Ferrara, 1987).

There is widespread and increasing dissatisfaction with traditional standardised psychometric tests (Adelman & Taylor, 1979; and Glaser, 1981). Subsequent criticism of conventional tests has focused on the dubious reliability, validity, ethical basis and usefulness of the results of such testing (Ysseldyke, 1983: 226). In South Africa, the usefulness of standardised tests for students from culturally different backgrounds is particularly questionable. Most of the conventional tests do not have norms based on students from the various population and cultural groups that make up the diverse South African population. Inadequate performance on such tests may simply reflect the lack

of appropriate learning experience (Murray, 1988: 12). Often these scores are interpreted as a measure of ability and seen as relatively fixed and resistant to change. This assessment may provide a dramatic underestimate of the potential level of performance of disadvantaged students.

The socio-political dispensation of South Africa has dictated that different racial groups should live and be educated in a segregated fashion. For each of the four different racial groups there has been an unequal system of education. The three groups other than White, (namely African, Asian and Coloured), who constitute some 86% of the population, have been subjected to varying degrees of inferior provision, facilities and resources (Hartshorne, 1986: 54). Also, a large proportion of the teachers in the non-white segregated schools are unqualified. Not surprisingly, students from disadvantaged educational backgrounds score at below-average levels on tests which purport to assess ability. However, the deflated performance could also be explained by the handicaps that such students bring to the testing situation. They are not familiar with the problem contents, are fearful of the testing process, expect to do poorly, are often insensitive to speed requirements, and do not develop spontaneously the most effective strategies to solve the problems (Babad & Budoff, 1974: 439).

Yet, many of these disadvantaged students are competent problem-solvers outside the formal schooling environment, having mastered the skills, knowledge, and strategies necessary to maintain a successful adjustment.

The above mentioned factors :

- limited realisation of psychological-educational categories
- criticisms of traditional testing, and
- lack of validity and reliability of conventional tests in the South African context

when administered to disadvantaged students, all provided the impetus for the present researcher to explore alternative ways of testing within the South African context.

The initial research centred around the importance of distinguishing between psychometric tests that measure differences among individuals, and those designed to measure the gains and improvement of individuals. An important stimulus for the proponents of alternative assessment procedures is a disillusionment with static testing. Students are required to solve specific problems without any assistance from the tester. Thus the final score is taken to be an estimate of the student's current level of ability.

However, these students do learn and profit from relevant experiences more successfully than their ability scores and school achievements indicate. This discrepancy in competence may merely

represent a mismatch between the demands of the testing situation and the student's existing schemata in his familiar world. The development of different types of schema has been described by Piaget (1972). A child's schema is the active, organised setting within which new experiences are influenced by previous reactions. Initial schemata may be hereditary but their expansion into new areas are the basis of cognitive growth. The schemata of highly abstract relationships is developed by adapting to and understanding the environment. Testing for ability should therefore incorporate assessment procedures which are relevant to the culturally heterogeneous and largely sociopolitically disadvantaged population in South Africa.

The present researcher further felt that a promising approach which aims to go beyond the current state of affairs to be dynamic assessment. Such procedures discriminate between performances under adverse conditions and learning potential. Dynamic approaches were developed under inter alia by Budoff (1987), Feuerstein (1979), and Vygotsky (1962). The work of the first two are of special relevance to the South African situation, in that their approaches have been developed with groups who have traditionally been labelled as culturally disadvantaged.

The main problem in South African testing procedures is the inappropriate interpretation of test results for a large group of testees who see little meaning in being assessed, are uninvolved in the test process, and experience the procedure as unpleasant and threatening.

The rationale underlying the present study is that students who undergo aptitude tests come from diverse educational backgrounds. Students other than those within the White system are disadvantaged. For these students it would be unfair and invalid to use school results and conventional tests as the basis to predict for future academic success. Yet, the matriculation marks are generally accepted to be the best readily available predictor of success at universities in South Africa.

1.2 Analysis of the problem

There is a close relationship between economic status and the number of university students in a population. If South Africa wished to maintain its economic position and develop its human resources optimally, it must increase the number of students at university. It has long been the intent of aptitude testers to find reliable prediction of academic success for this increasing number of prospective university students.

In 1990 there were about 68000 school leavers who had at least the minimum requirements for university entrance in South Africa (Survey of Race Relations 1990). Of these 28000 were White, 27000 Black, 6000 Coloured and 7000 Indian (Survey of Race Relations 1990). It is estimated by the year 2000, the number of Black school leavers will have risen to 130000 (Hartshorne 1989). There is thus an urgent need to examine our current attempts to predict academic success for the different

prospective student populations. Current approaches to aptitude testing and academic prediction are fraught with ideological and methodological problems in their ability to predict for future academic success. The following sections will look at the shortcomings of traditional predictors of academic success.

1.2.1 Limitations of school performance as a predictor of University academic success

The use of school performance as a predictor of future academic success is based on the assumption that all students have previously been exposed to similar educational opportunities. This assumption holds true for many western educational systems where the society is more homogeneous, wherein all students benefit from more or less comparable educational opportunities (Taylor, 1989: 5).

However, it has been well documented that education in South Africa is in a crisis (Hartshorne, 1984; Molteno, 1984; and Shochet, 1986). The legacy of such a segregated system is a 3% rate of university entry for White students as compared with a 0.3% rate of entry for Blacks. This entry rate prevails despite the fact that 76% of all enrolled pupils are Black, 11% White, 10% Coloured and 3% Asian (Boeyens, 1989: 2). Of the total expenditure on education, 32.5% was spent on Black education, 49.8% on White education, 12.1% on Coloured education and 5.4% on Asian education. Hartshorne (1983: 56) has highlighted additional discrepancies besides low expenditure which include untenable pupil-teacher ratios. According to Cooper (1985) the pupil-teacher ratio for Whites was 18.7:1, and 41.2:1 for Blacks. The ratios for Coloured and Asians were 25.4:1 and 22.5:1 respectively. Further evidence of the impoverishment of Black education is the large proportion of unqualified teachers and authoritarian teaching styles (Auerbach, 1977). The greatest disadvantage of students coming from the Black Education system is not lack of knowledge as much as prolonged exposure to inappropriate styles of learning which rely on parrot fashion swotting as opposed to studying for meaning. Another problem which the students carry through is the ethos prevalent in Black schools of having a low level of expectation, which leads to a passive approach and an attitude of despondency and defeat.

Given the vast disparity between White and Black education in South Africa it is not surprising that only 9.8% of Black candidates under the Black Education System matriculate (Hartshorne, 1984), as opposed to 46.6% of White students in the White School system (Hartshorne, 1984). Thousands of White students achieve a C aggregate in Matric, whereas, at the end of 1990, of 230000 students passing through the Black schools, fewer than 1000 achieved a C aggregate, fewer than 100 a B and fewer than 10 an A symbol (Survey of Race Relations, 1990). Hartshorne (1989: 93) has established that matric results in the higher range of scores are a reasonable predictor of success for White matriculants. Shochet (1986) argues that serious doubt can be placed on school results as predictors of success at university for Black and Coloured students. This is due to the high degree of

disadvantage evidenced in these school systems as well as the concomitantly low matric results. Table 1 highlights the different allocations of expenditure for the different groups. The data has been provided by Cooper (1985) in the Survey of Race Relations.

Table 1

Per capita expenditure (R) on school education expressed as % of amount spent on White education.

<u>Year</u>	<u>White</u>	<u>%</u>	<u>Indian</u>	<u>%</u>	<u>Coloured</u>	<u>%</u>	<u>Black</u>	<u>%</u>
1981	913	(100)	513	(56)	253	(27)	92	(10)
1982	1048	(100)	670	(63)	356	(33)	118	(11)
1983	1211	(100)	711	(58)	467	(38)	146	(12)
1984	1511	(100)	905	(59)	501	(33)	166	(11)

Research has in fact found current academic achievement in Black schools to be a poor predictor of post-school academic performance (Hall, 1979, and Visser, 1978). Subsequent findings have demonstrated the unreliability of Black school results (Potter, Jamotte and Van der Merwe, 1983). Because the predictive validity of the matric results for university success has not been established for Black schools, it cannot be assumed. These results are insufficient in themselves to reliably and accurately predict future academic success particularly in the marginal ranges. In the South African context the problem becomes especially acute, in that there is a complete lack of relationship between Black school results (where there is a high proportion of marginal scores) and university academic performance (Culverwell, 1989; Shochet, 1986). In particular, there is a concern about using school results as a predictor of future academic success for students who are currently or manifestly lower functioning. This larger body of students might still have the potential to succeed at university.

The present researcher comes to the conclusion that the lack of predictive validity of school results, instead of providing the impetus for the development of dynamic approaches to assessment, has led researchers to the use of standard tests of ability and aptitude to predict academic performance.

1.2.2 Limitations of aptitude test scores as predictors of University academic success

A number of studies have attempted to explain more of the variance in academic prediction by supplementing school results with aptitude tests. The results confirm that such tests do not significantly add to the variance explained by school results (Dalton, 1976; Houston, 1983; and Slack & Porter, 1980). Only in exceptional cases have researchers been able to explain more than 25% of the variance in university marks, and that is when multiple correlations including school marks are

used. Additional research has also indicated a decline in the predictive validity of traditional intelligence measures (Hartman & Bell, 1978; and Husseini, 1978). Intelligence testing and its successor aptitude testing have been shown to demonstrate cultural and socio-economic bias (Evans and Waites, 1981: 169). There has been an ongoing concern about the use of these intelligence and aptitude measures among Black students or disadvantaged students (Baggaley, 1974; and Sedlacek, 1972). The development of aptitude tests grew out of the general intelligence testing movement and the concern about culture-fairness in testing. Jencks and Crause (1982: 24) agree that the idea is false and that aptitude tests were developed to assess students on the basis of future potential rather than current levels of performance. They asserted that most aptitude tests were really only achievement tests which have their origins in traditional intelligence testing.

Aptitude tests were seen as a positive development as they were not based on a single global measure such as an overall intelligence score, but on a set of scores demonstrating an individual student's characteristic strengths and weaknesses. According to Anastasi (1976) aptitude tests were developed due to the failure of general intelligence tests to accurately predict future academic success. Aptitude tests that measure the current level of acquired knowledge within a specific domain are reasonable predictors of success at university (Hunt, 1980; and Taylor, 1985). This approach which relies on second order factors (verbal, number, spatial, etc) has continued to inform the area of aptitude testing in that performance on these tests is considered to be a function of innate abilities. Entwistle (1977: 225) argues that there is a lack of consensus on what constitutes aptitude. Separate abilities are seen as 'traits' and are merely descriptive categories not underlying entities (Anastasi, 1976: 45).

Aptitude tests are as damaging for Black students as are achievement tests. Shochet (1986) concludes that such tests predict equally badly for White and Black students and sometimes even show a negative relationship for the latter. Such tests provide a pessimistic view of students who perform poorly. They are based on an assumption that intelligence is fixed and are almost as inappropriate for predicting the potential of disadvantaged students as school marks are.

The present researcher came to the conclusion from the previous paragraphs that aptitude tests are geared to establishing students' current levels of performance but yield no information on potential levels of performance. They may tell us where someone is at a given point in time, but not how that person may improve from that point on (Anastas, 1982: 86). In this sense, they provide at best only a partial picture of student capabilities.

1.2.3 Learning Potential Assessment as a possible alternative - Theory and Research

From a psychological-educational viewpoint it appears that traditional tests fail to allow the testee an opportunity to develop a self-identity regarding the potential to succeed in a specific area of aptitude. Viewed from a group work perspective, such tests often fail to elicit an awareness of testing which is

the groundwork required for exploration of self-meaning. Ultimately, no personalisation takes place because testees are inhibited within the static testing procedure.

It has been further argued that standardised intelligence and aptitude tests were designed to provide profiles of ability that should allow for analysis of strengths and weaknesses of students. It was demonstrated that such approaches have not yielded much in the way of encouraging results, as they are based on static notions of intelligence and ability. The tests rely heavily on the assumption that all testees have had comparable backgrounds and opportunities to acquire the information requested.

A promising approach which represents a fundamental change in paradigm toward intelligence and academic prediction which also directly addresses disadvantaged students, is that of learning potential assessment. This is a learning orientated approach to testing, designed to more effectively distinguish between low test performance caused by a lack of specific acquired knowledge, and poor performance due to weakness on general learning processes. Emphasis is placed on potential rather than manifest performance (Brown, 1979; Feuerstein, 1979; Murray, 1988; and Vygotsky, 1962).

The work of Vygotsky (1962, 1978, 1979) provides an appropriate theoretical basis for an alternative model of aptitude testing and academic prediction. Vygotsky (1978: 144) notes that static tests do not provide information about:

‘those functions that have not yet matured but are in the process of maturation, functions that will mature tomorrow but are in the embryonic stage. These functions could be called the ‘buds’ or ‘flowers’ rather than the fruits of development. The actual developmental level characterises mental development retrospectively, while the zone of proximal development characterises mental development prospectively.’

Vygotsky negates the importance of biological readiness, and instead claims that the quality of the learning opportunities afforded to the student results in improved cognitive development. Vygotsky's notion is of a testing environment, incorporating some kind of social support, that will create a zone of proximal development in which students will be able to demonstrate the embryonic skills not tapped by static test procedures. The emphasis is that much learning is mediated through social interactions. Students experience cognitive activities in social situations and come to internalise them gradually over time. It is this gradual transfer to self-regulation that is sought in learning potential assessment. Vygotsky refers to the distance between the level of performance a student can reach unaided and the level of participation that can be accomplished when guided by a more knowledgeable participant. Vygotsky thus turns the popular assumption, that the level of complexity of useful instruction should never exceed the present capabilities of the student, on its head. The individual's potential to benefit from instruction is the most important variable and it is the assessment of emergent skills that provides a better estimate of an individual's potential for proceeding beyond current competence. This assertion has given rise to a large body of research on

the relationship between intelligence, learning potential and academic performance (Brown & Campione, 1986; Brown & Ferrara, 1985; and Campione, Brown & Ferrara, 1982).

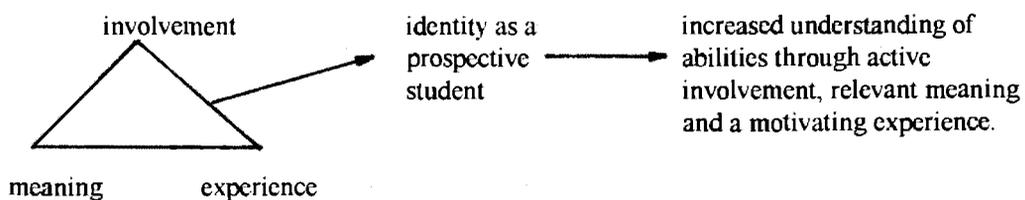
The assessment process suggested by Vygotsky involves an initial assessment of competence, followed by instruction on the target task(s). Students with high degrees of readiness (broad zones of proximal development) should benefit considerably from instruction, whereas those with less readiness will not perform much better with this help than they did prior to it. The measure of gain is presumed to possess greater predictive utility than the initial, unaided level of performance.

This framework has informed subsequent work in learning potential assessment. The most systematic and documented work in this area has been done by the Israeli psychologist, Feuerstein (1979, 1980). According to Feuerstein (1979) it is the quality of mediated learning experience which will determine the extent to which an individual's level of intellect will develop to approximate potential.

An overriding practical argument for supporting such a dynamic approach to assessment as an alternative to traditional aptitude measures is that the student is actually involved in a structured learning process from which specific information will be obtained of the student's learning potential, and cognitive strengths and weaknesses. The dynamic testing environment facilitates the involvement, meaning-making and experiencing essences of student identity formation. Knowledge is attained through self-exploration of one's own abilities, thereby forming a realistic concept of oneself as a prospective student (Vrey, 1979). An identity is formed through active involvement with the test content and mediation, facilitated by meaningful explanation of the process of testing and the concomitant experiencing of the test procedure as personally relevant and motivating. The process of identity formation can be expressed more succinctly through a flow diagram.

Figure 1

Psychological educational essences of a dynamic test context



Dynamic Test Context

Specifically, the inclusion of a learning dimension to testing creates the opportunity for each testee to actively seek out the limits of ability, while experiencing feedback on existing levels of competence. There is recognition of the testee's potential to succeed and achieve a self-identity regarding learning potential with adequate environmental support.

As a means of assessing learning potential, the Feuersteinian approach emphasises a conceptual shift from the traditional assessment approach, in that it utilises a dynamic interactional approach to the tester involving active teaching, as opposed to a standardised, prescribed form of questioning with no prompting or assistance. This mediated learning experience (MLE) allows the student to demonstrate learning effectiveness in that it offers the opportunity to apply learned skills and knowledge. Where individuals or groups have been deprived of MLE, as can be postulated to be the case in South Africa (Skuy & Mentis, 1992), the later provision of appropriate mediated learning experiences can reverse the cognitive effects of such deprivation.

The first step in assessing potential for change is to measure the functioning of which the student is potentially capable after the provision of appropriate MLE. For this purpose (Feuerstein, 1979) devised the Learning Potential Assessment Device (LPAD) which has successfully been used with, inter alia, the mentally retarded (Feuerstein, Miller & Jensen, 1981), the disadvantaged, gifted (Skuy & Gaydon, 1990), and deaf children (Katz & Bucholz, 1984).

Feuerstein's approach to assessment is similar in method of testing and in the focus of interest to the clinical assessment procedure of Vygotsky. A few studies in South Africa have attempted to adopt Feuerstein's approach to testing in terms of academic prediction (Murray, 1988; and Shochet, 1986). Shochet adapted local tests normed on South African students to include a component of mediation. While supporting the value of dynamic assessment for disadvantaged students, the study highlighted various limitations in the learning potential approach to assessment.

1.2.4 Limitation of Learning Potential Assessment as a predictor of University academic success

There are several shortcomings in the research conducted within the field of learning potential assessment. With little exception, the studies have concentrated on mentally retarded and/or pre-adolescent children. Very few studies have investigated learning potential of normal students at a tertiary educational level. Shochet (1986) found that this approach did not significantly enhance academic prediction. It was also difficult to establish that the cognitive skills, advanced by Feuerstein, were in any way related to the application of knowledge in the academic context (Culverwell, 1989: 42). These problems emerge because assessment is conducted in a clinical opportunistic fashion that combines evaluation and instruction. The testing procedure eschews the use of standardised instruction and argues for a flexible, individualised and highly interactive format (Feuerstein, 1979:

(Feuerstein, 1979: 40). A neutral, unresponsive stance is seen to reinforce the testee's already negative test-taking capacity. Instead the tester must be responsive to the testee in a multiplicity of ways, doing everything possible to teach the student how to solve the test problems.

The major drawback to these approaches is a grave disregard for the psychometric problems of reliability and validity. In such clinical assessments where there is a one-to-one testing situation, the problem of biased instruction becomes an important factor. Where a tester assesses the learning potential of an individual testee it can be argued that the amount of rapport between tester and testee will have a significant effect on the amount of potential assessed. Given the flexible nature of assistance, it is questionable to compare the learning potential of different testees (Slonimsky and Turton, 1985). The problem is exacerbated if students are assisted by different testers in that each might apply different approaches.

The learning potential assessment takes place with specially developed materials that intentionally bear little relationship to formal schooling tasks (bear in mind that they were originally developed for the learning disabled). It is quite possible for students to improve on their ability to deal with these tasks and yet show no appreciable gains in academic disciplines. The instruction is often divorced from the actual context of schooling. The LPAD of Feuerstein is adapted from conventional intelligence tests, such as the Ravens Progressive Matrices. Such tests are typically not guided by any formal theory, thus making it difficult to assess difficulty levels of items. Therefore, it is impossible to accurately determine the improvement of the testee. When test items are varied, the internal reliability of the test is low, leading to a higher error of measurement. The testee's improvement in such tests is the difference between the pre-test and post-test scores. The reliability of a difference score is reduced by the error in the pre-test and the post-test scores. As there is always some error in both these scores, the reliability of the difference score is always lower than the reliability of both the pre-test and post-test scores.

Most learning potential procedures evidence a disregard for this type of reliability (Boeyens, 1989: 39). This is because most of the conventional tests used are unable to yield sufficiently large difference scores to be usable as instruments for assessing learning potential. Traditional aptitude tests such as the South African High Level Battery are structured in such a way that virtually every item requires a different set of operations to be performed in order to arrive at a solution. Thus mediation on earlier items will have no bearing on subsequent items. In order to facilitate the transfer of learning from one item to another, it is imperative that the test used is internally consistent with regard to the requirements of the task. Such a test should measure the same basic operation within the same modality while the level of complexity may vary. Most of the tests used in assessment of learning potential have not been previously normed on university students, so that the items are either too trivial or too complex. It is necessary to use tests that are complex enough to ensure that there is no ceiling effect on the test scores, even after training (Shochet, 1986).

Many of the current learning potential measures do not have face validity as regards prediction of university academic success (Boeyens, 1989; Culverwell, 1989). Appropriate tests must appear to measure many of the pre-requisite skills necessary for success at university. In short, the learning potential assessment procedure needs to be standardised in order to eliminate tester bias. The tests chosen must be reliable complex tests, normed on university students, and must test a consistent operation in a consistent modality, and must appear to assess skills found to be important in university success.

A serious shortcoming of learning potential assessment is that it is labour intensive and too time-consuming to offer a viable alternative to traditional aptitude testing. A lengthy clinical approach is not practical when dealing with groups of prospective students (Feuerstein, 1980: 62). Researchers, using the clinical approach to dynamic assessment, make inter-individual comparisons in terms of the hints required during mediation by each testee. However, this limits the interpretability of the results as it is easier to grade the difficulty of items than it is to grade the significance of hints and prompts.

From the above review, it seems that the most important step in the investigation of using learning potential in aptitude testing would be to develop a testing procedure with viable measuring instruments that overcome most, or all, of the shortcomings mentioned above.

1.3 Statement of the Problem

The writer's problem then is to test the effectiveness of dynamic assessment as an alternative aptitude testing strategy. In particular, the problem poses certain challenges in the sense that there are certain prerequisites that have to be met to assess the validity of a dynamic testing procedure within a heterogeneous student context.

Due to the diverse nature of the prospective student population in South Africa, it is necessary in terms of aptitude testing, to obtain an estimate of ability or abilities derived from reasoning problems of suitable difficulty, after the student has had an opportunity to learn how to solve the problem(s). If the student can demonstrate, following a short period of mediation on an appropriate task, that he or she can perform at a level approximating average university performance, then this can be interpreted as the ability to succeed in those academic domains that demand those reasoning skills.

The learning potential assessment procedure must help the student to become familiar with the test content in a context calculated to enhance a sense of competence. Mediation helps equalise the differences in experiences and acquired knowledge. At the same time, the assessment procedure should satisfy certain criteria in order to be psychometrically defensible:

1. it should be based on a standardised procedure where all students are presented with equivalent opportunities to demonstrate potential, and
2. it should be time and cost effective.

The assessment instruments should also attempt to satisfy certain criteria relating to reliability and validity:

1. tests should be normed on university students,
2. tests should allow for item construction of easy and difficult tasks that eliminate both floor and ceiling effects,
3. tests should assess a consistent operation in a consistent modality,
4. predetermined difficulty levels should be built into the tests in order to facilitate problem-solving proficiency,
5. items must appear to be measuring prerequisite skills necessary for university success in different academic domains,
6. pre-tests and post-tests should be highly analogous, so that improvements after assistance can be accurately assessed,
7. pre-tests and post-tests should be highly analogous so that the difference score will have a reasonable reliability.

The problem is to introduce an aptitude testing procedure based on dynamic assessment, which incorporates all the prerequisites just mentioned. In addition, it is necessary to use instruments which adhere to the principles outlined above. The process of testing should explore the dimension of identity formation in the ability to explore possible areas of future competence.

The present study argues that a new approach to aptitude testing is needed which takes cognisance of learning potential. This proposal can be facilitated by extending dynamic assessment procedures to group ability testing for diverse population groups. If this is successful, then an alternative model of aptitude testing for prospective students, which focuses on potential rather than current performance, might become more viable as an approach within testing institutions.

1.4 Objective of the present study

The objective of the present study is to develop a dynamic assessment battery which is appropriate in the South African context. The aim is to present an alternative aptitude testing procedure which is capable of identifying students (particularly disadvantaged students) who have the potential to succeed at university.

The new approach to aptitude testing must satisfy both theoretical and practical criteria in order to achieve predictive validity. To achieve this objective, the study compares the predictive validity of traditional aptitude testing with a dynamic aptitude test procedure among prospective students at a Counselling and Careers Unit (CCU) within a traditional White university.

We will examine the merits and usefulness in using school marks and conventional aptitude tests as predictors of academic success. Thereafter, we look at learning potential assessment as a viable alternative within the South African context. The two approaches to testing will be contrasted in terms of being valid predictors of academic success.

1.5 Statement of the hypothesis

There are three major hypotheses in the present study:

HA 1:

It can be expected that prediction of university success will be significantly enhanced through a dynamic testing situation as operationalised for the purpose of the present study.

The present study is attempting to compare the effectiveness of dynamic aptitude testing with traditional testing. It is argued that traditional aptitude measures do not assess students' potential, but their manifest level of functioning.

It is hypothesised that the measure of the enriched testing situation after mediation (post-test scores), which is the potential level of functioning, would enhance prediction over and above the traditional measures and provide a fairer and more valid basis for aptitude testing.

HA 2:

Advantaged and disadvantaged students will have different predictors correlating significantly with the criterion of university success.

Traditional measures assess only the manifest level of functioning and apply only to those students who come from an advantaged educational background. These measures, including school marks will not correlate with university success for disadvantaged students. For students who are educationally disadvantaged, the manifest level of functioning will not reflect their academic potential and therefore not predict academic success.

Alternative predictors based on dynamic assessment will not have the same importance for advantaged and disadvantaged students. The measure of learning potential applies more to disadvantaged students who are less predictable on traditional measures.

HA 3:

No significant relationship exists between current ability and learning potential

Conventional ability tests merely assess manifest performance and are based on a static notion of ability. It is hypothesised that ability tests do not measure a student's potential and that ability and learning potential will be independent.

1.6 Clarification of terms

Ability testing - The measurement of competence in performing a particular task at the present moment. It is a student's potential to perform.

Achievement testing - The measurement of the degree to which one has achieved on a standardised educational test.

Adaptability testing - A measure of what students can learn to do and assesses capacity for learning.

Advantaged student - A student who has matriculated under the White Educational authorities.

Aptitude testing - The measurement of a student's potential for performance after being trained up to a specified level of ability.

Deductive reasoning - Reasoning that begins with a specific set of assumptions and attempts to draw conclusions from them. It is a logical operation which proceeds from the general to the particular.

Disadvantaged student - A student who has matriculated under any Black, Coloured or Asian Educational Authority.

Dynamic testing - A testing procedure in which the tester offers assistance as part of the assessment, allowing the students to demonstrate learning effectiveness and modifiability.

Enriched level of functioning - The level of performance in a second testing session indicating what the testee can accomplish after mediation. It reflects the ability to benefit from instruction thereby assessing learning potential.

Inductive reasoning - Reasoning in which general principles are inferred from specific cases. It is a logical operation which proceeds from the particular to the general.

Learning potential - The amount by which a student's performance improves as a result of instruction. It is the difference between the traditional static test score and the subsequent enriched score.

Manifest level of functioning - The level of performance in a first testing session indicating what the testee can accomplish by himself/herself. It reflects both his/her innate capacity level and current knowledge.

Mediation - An intervention by a teacher during a testing process whereby the testee is assisted with difficulties arising from oversights or misunderstandings. Attention is monitored with suitable hints and probes.

Static testing - A testing procedure that is standardised whereby the tester offers no assistance, allowing for the measurement of current or manifest levels of functioning.

1.7 Proposed outline for subsequent chapters

The following chapters will contextualise the need for a dynamic approach to testing. The development of the present test battery evolved out of the shortcomings of traditional methods of formal testing.

Chapter 2 discusses the milieu from which traditional assessment grew into an acceptable practice within the framework of psychometric principles. The concept of intelligence and its subsequent measurement and application into academic prediction will be fully explored. The adaptation, modification and revision of traditional tests in the form of culture-fair tests will be examined, as they serve as a springboard into the analysis of early attempts in dynamic testing.

Chapter 3 carries on the critique of traditional testing, and studies the theoretical foundations of dynamic testing. The two cornerstones of testing for potential will be looked at in depth, Feuerstein and Vygotsky, whose contributions informed alternative approaches to assessment. Their work will be evaluated and contextualised within contemporary models of dynamic testing. Recent research in

the field of dynamic assessment will be examined and serve as the groundwork for the construction of the model of dynamic testing used for the present study.

Chapter 4 explores limitations to current models of dynamic testing and then goes on to situate the key elements of group testing in the context of aptitude testing. This chapter examines the new test battery in detail and outlines the methods of administering the new format. This format will be designated NewTest and for purposes of the present study, NewTest is the name describing the new testing procedure and its administration.

Chapter 5 details the empirical study and clarifies the subject variables, predictor variables and criterion variables. Dynamic and traditional measures will be contrasted and a framework will be developed which will hopefully elucidate the relationship between the testees, the testing materials and the outcomes of testing.

Chapter 6 highlights the actual procedure of testing and the conditions necessary for a dynamic approach to testing. The chosen method of statistics and data collection will be elaborated. This will lead to the analysis of results and an investigation into the hypotheses posited in the present study.

Finally, *chapter 7* explores the implications of dynamic testing and traditional testing for academic prediction, and proposes certain conclusions which emanate from the outcomes of the present study.

Chapter 2

TRADITIONAL TESTING: THEORY AND RESEARCH

The focus of this chapter is to critically examine the theoretical foundations of intellectual testing and the consequent development of culture-free psychometric tests. The relationship and implications of these approaches to tertiary academic prediction will also be discussed.

Traditional psychometric tests of intellectual functioning, such as Intelligence tests and Aptitude Tests, have been widely researched in the context of predicting for academic success. The present study postulates that this research is limited and reflects a weakness in the theoretical assumptions of traditional tests of intellectual functioning. These weaknesses are evidenced in the underlying model and definition of intelligence implicit in the use of the tests, as well as in the consequent attempts at creating culture-fair tests. In order to examine why attempts at relating intelligence to tertiary academic success have not been successful, it is necessary to examine the history of the concept of intelligence. In addition, the present study proposes a new methodological paradigm which is a departure from the above in terms of examining indicators of tertiary success.

2.1 *The context of academic prediction*

Tertiary academic prediction studies have been an important area of interest for psychologists and educationists over a number of decades (McDonnell, 1975). These studies have mostly focused on the use of traditional psychometric procedures which attempt to predict university success with measures of intelligence. The rationale being that there is a relationship between intelligence and academic achievement.

The construct of intelligence as a predictor of academic success has been widely researched. This work can be categorised into three main areas. The first area encompasses the field of psychometric testing including the use of aptitude tests as a means of predicting academic performance. The second area focuses on the cognitive processes underlying studying and learning and the relationship of these processes to academic achievement. The third approach to prediction has as its main concern the assessment of learning potential and the ability to benefit from competent instruction. It is to the latter two approaches that the present study aligns itself.

Academic prediction studies have largely focused on the use of traditional psychometric procedures. At tertiary level, only a modest and inconsistent degree of success has thus far been obtained (Evans & Waites, 1981; and Slack & Porter, 1980). In order to examine why attempts at relating intelligence to tertiary academic success have not been particularly successful, it is necessary to examine those factors that contribute to individual differences in academic achievement.

2.2 Factors in Academic Achievement

In order to accommodate individual differences in testing and in the interpretation of test results, it is important to understand the ways in which testees vary, as well as the factors that contribute to such differences. These differences are decidedly marked when considering both intelligence and socioeconomic status.

2.2.1 Differences in intelligence

Most intelligence measures generate a single index of measurement called the Intelligence Quotient or IQ. IQ tests do not measure a single ability, but rather a combination of abilities. Furthermore, such tests fall into two general categories: Individual tests and Group tests. Individual tests such as the SSAIS, Stanford Binet and Wechsler Scales, generally provide the most reliable and valid results within the limitation of the concept of intelligence quotient. However, these tests cover a wide range of different tasks making it difficult to yield a constant value for IQ. Jensen (1969) attempted to classify the abilities that make up intelligence. Level I abilities include association learning and role memory. Level II abilities include abstract thinking and reasoning. It has been found that Level II skills are less successfully taught than Level I skills. Jensen believes that Level II abilities are largely hereditary in origin. Individuals would differ in their abilities irrespective of teaching.

In fact, when a large number of testees are tested, one can expect to find that the distribution of IQ scores displays a continuous range of variability. Terman and Merrill (1937) found that approximately 64% of all IQ scores fall between 85 and 114, indicating that IQ owes its origin to diverse factors. IQ tests might also favour middle-class whites who are more familiar with test content. Testees who learn English as a second language cannot be tested reliably with IQ tests written in English (Jencks and Crouse, 1982).

IQ is not necessarily a stable fixed value, but changes during childhood and adolescence. Longitudinal studies revealed that IQ scores, on average, change 28.5 points between the age of 2 and 17 (McCall, Applebaum and Hogarty, 1973: 6). Scores of testees of Lower Socioeconomic status tend to drop. Urban disadvantaged children were found to have an average IQ of 95 at age 4, dropping gradually to 80.85 by adulthood (Garcia, 1981: 1178). By contrast, children of high socioeconomic status have an average IQ of 110-115 at age 4, which is maintained into adulthood (Garcia, 1981).

But what does the IQ score really reveal? Is it an infallible measurement which demonstrates a level of performance with important consequences for school and later careers? Psychologists studying intelligence have been preoccupied with a further question 'How can we measure intelligence?' However, this concern is flawed for it has led to the neglect of the more important question 'What is intelligence?'

Because the field of intelligence is presently very different from that which gave rise to the development of intellectual testing, and because the intellectual demands of our present society are in a state of constant change, it is important to examine alternative conceptions of intelligence. We cannot meaningfully discuss issues pertaining to the measurement of intelligence without initially discussing what it is that needs testing.

This section will briefly examine the four main perspectives on the question of intelligence:

- Firstly, the psychometric perspective will be discussed.
- Secondly the Piagetian view will be examined.
- Thirdly, the multiple-intelligences approach will be looked at.
- Fourthly, the information-processing paradigm will be considered.

A later section will look at the underlying differences in a genetic or environmentalist approach to the concept of intelligence.

Presently, we are interested in the implications for testing of the psychometric, Piagetian, multiple-intelligence and information-processing perspectives respectively.

2.2.1.1 The Psychometric Perspective

Psychometricians have sought to understand intelligence by analysis of the increasing ability of children to solve relatively complex problems requiring skills similar to those encountered in daily living. Much use is made of factor analysis which attempts to find common sources of variation among people. Spearman (1927) posited that intelligence comprised a single 'g' factor (general) common to performance on all tests, plus a specific factor (s) involved in performance on each individual test. A later view, that of Thurstone (1938), presented intelligence as a set of 7 primary mental abilities, namely

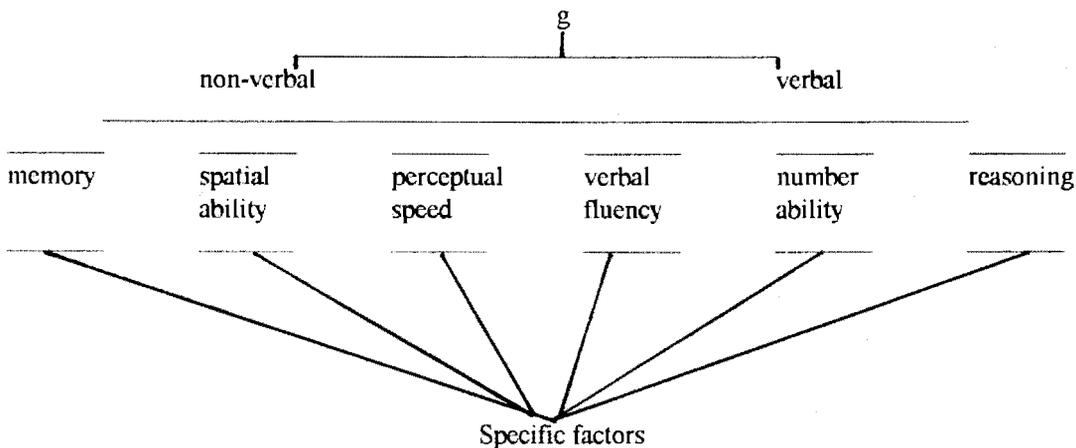
- verbal comprehension
- verbal fluency
- number ability
- spatial visualisation
- perceptual speed
- memory
- reasoning.

A relatively more recent view, that of Guilford (1967), described intelligence as a measure of at least 150 factors, each of which involves an operation, a content and a product. His intellect model is in the shape of a cube, formed by cells comprising the four categories of content, five operations categories and six categories of products. Guilford claimed that out of the 120 factors, 82 had already been identified.

Later developments led to the introduction of hierarchical models of intelligence. Vernon (1979) saw intellectual ability as constituting a general factor at the top with the major group factors, verbal-educational ability and spatial-mechanical ability at the second level. There were minor group factors at the third level and specific factors at the bottom. These theories will also be elaborated on in a later section which looks at the general conception of intelligence. Figure 2 details Vernon's model of aptitude. Its relevance to current conceptions of aptitude is still discernible.

Figure 2

Vernon's hierarchical model of Intelligence



2.2.1.2 The Piagetian Perspective

Piaget concluded through repeated observation that there are coherent logical structures underlying children's thought. He focused his research on outlining the nature of cognitive structures at different stages of development. Intelligence comprised two interrelated aspects; structure and function (Piaget, 1972).

Piaget proposed through repeated observation that the function of intelligence is the assimilation of the environment to one's cognitive structures to encompass new aspects of the environment (Piaget, 1972). The internal organisational structure of intelligence and how intelligence is manifested differ with age. As the child progresses from one stage to the next the cognitive structures of the preceding stage are reorganised and extended, through the child's own adaptive action, to form the underlying structures of the equilibrium characterising the next stage.

There are four factors that interact to bring about the child's development:

- maturation
- experience of the physical environment
- influence of the social environment
- equilibrium.

The latter is an indication of the child's own self-regulatory processes. The child becomes an active participant in the construction of intelligence. This results in the development of an invariant sequence of stages (Piaget, 1972):

- the sensory/motor stage (from birth to 2 years of age, approximately)
- the period of preparation for, and organisation of, concrete operations (including both a pre-operational and concrete-operational stage, lasting from age 2 to 12)
- a formal-operational stage.

The main assertion of this perspective is that there is a single route of intellectual development. Individual differences result from different rates of progression along this route.

2.2.1.3 The Multiple-Intelligences Perspective

Howard Gardner was a committed Piagetian who came to view Piaget's theories as too narrow a notion of intelligence. He formulated a theory of multiple intelligences based on his belief that there is not just one form of cognition which cuts across all human thinking. He proposed that there are multiple intelligences with autonomous intelligence capacities (Gardner, 1983).

According to the theory, there are many ways by which we know, understand, and learn about the world. Most of these ways go beyond those that dominate Western Culture and education. He proposed a schema of seven intelligences. He identified :

- verbal-linguistic intelligence (responsible for the production of language),
- logical-mathematical intelligence (associated with inductive thinking),
- visual-spatial intelligence (the ability to form mental images),
- body-kinesthetic intelligence (the ability to use the body to express emotion),
- musical-rhythmic intelligence (capacity to recognise and use tonal patterns and sensitivity to sounds from the environment),
- interpersonal intelligence (the ability to work cooperatively with others in a group, as well as the ability to communicate), and
- intra-personal intelligence (allows us to be conscious of our consciousness and involves knowledge of the internal aspects of the self).

Gardner maintained that each of us have these intelligences to an extent, not all of them are developed equally. Western education relies heavily on the first two forms of intelligence, that is, verbal and mathematical learning to the exclusion of the other forms of intelligence (Sternberg, 1984).

2.2.1.4 The Information-Processing Perspective

These perspectives of intelligence have in common their view of intelligence as deriving from the ways in which people mentally represent and process information. Information-processing theorists have agreed on the elementary information process as the fundamental unit of behaviour (Newell &

Simon, 1972). The processes are elementary in the sense that they are not further broken down into simpler processes by the theory under construction.

Sternberg (1984) expanded the notion of an elementary information process in a somewhat different way, suggesting that processes can be viewed as being of three basic types; meta components, performance components and knowledge-acquisition components. Meta components are higher order control processes that are used for executive decision-making in problem solving. Performance components are the processes actually involved in executing task performance. Knowledge-acquisition components are processes used in learning new and consequential information.

With this view of intelligence in mind, psychologists have set out to devise new approaches to intellectual assessment that take into account not only static knowledge, but also cognitive processes (Marton and Svensson, 1979). While these approaches still depend on the use of tests and test scores as a measure of mental ability, they also incorporate learning, teaching and clinical observation to determine the individual's cognitive style.

It appears from the foregoing that at best, intelligence and intelligence tests reflect the constructor's personal view of what constitutes intelligent behaviour. Intelligence tests as they currently exist, reflect a belief that innate potential remains fixed throughout an individual's lifetime, and can be measured. It was Vernon (1979) who stated that 'it is indeed curious that we use intelligence tests mainly to predict capacity for learning and yet none of our tests involves any learning, instead they give us a cross-section of what has already been learnt'. Part of the capacity to learn is the influence of the environment within the constraints of inherent ability to profit from teaching. The next two sections will briefly look at the debates within the field of intelligence concerning cultural background and genetic conceptions of intelligence.

2.2.2 Differences in Socioeconomic Status

A student's cultural background is educationally relevant. Stevenson (1978) highlighted the fact that educational level of parents is an important determinant of academic performance. Highly educated parents tend to take a direct interest in the education of their offspring and also become more involved in the activities of the school. Conversely, parents of low socioeconomic status are often not familiar with the school policies and less aware of resources within the school which parents could refer to in times of need. It appears that differences in socioeconomic status are not so much differences in material well-being but, rather, in knowledge and methods of child-rearing (Scarr, 1981).

High socioeconomic status parents tend to provide stimulating cognitive environments in which there are ample opportunities to interact with their children. Such parents answer their offspring's

questions, encourage and support their exploration, and generally provide an appropriate context of meaning so that they can gradually assimilate new experiences on their own terms (Steward and Steward, 1974: 802). They act as models for such activities as reading, effective communication, critical thinking, and community involvement. By contrast, many parents who are disadvantaged socioeconomically have neither the time nor the resources to carry out any of these activities. Their interactions with their children may be intense emotionally, but lack consistency and predictability. This leads to an environment in which activities become sporadic and aimless.

Intelligence and socioeconomic background account for educationally relevant individual differences, and influence testing and the interpretation of psychometric data (Sternberg, 1985). The cultural diversity that has been occurring in tertiary institutions since the 1970's, has intensified the need for more awareness into the concept of intelligence and the relationship between intelligence and academic achievement.

2.3 Intelligence and Individual Differences

Since the inception of intelligence testing, the notion of intelligence has been informed by two major approaches. Essentially, the debate about intelligence has been between the geneticists and environmentalists (the nature/nurture controversy). The present trend seems to be a shift away from polarised positions to a conciliatory stance known as interactionism or interpenetration (Deutsch, 1968).

In terms of the present study it is crucial to examine the debates set forward by these approaches and their consequences for culture-fair testing.

2.3.1 The Genetic Position

Undoubtedly, the man who put the geneticists on the map was Jensen (1969, 1972, 1974, 1980) with his theory in 1969 of the persistent differences in test scores between Black and White Americans on IQ tests. Other theorists such as Eysenck (1971, 1981, 1985) and Vernon (1979) are strong proponents of this position. In essence, their main contention is that there are racial differences in intelligence and that these differences are genetically determined. Spearman proposed a genetically based two factor interactive theory of intelligence, to explain the intercorrelations between group intelligence tests (Sattler, 1982).

Spearman's concept of a general factor 'g' led to an adherence to the notion of intelligence as both a general intellectual factor and a factor specific to the test. These two factors account for performance in IQ tests, and are predominantly biologically determined. Abilities such as verbal fluency, and memory, are functions of a general 'g' loading and another specific factor. The various subtests which make up IQ tests would contain differing levels of 'g' loadings. Sattler (1982) comments that

the specialised factors would cancel each other out when the complete test is administered, revealing a 'g' factor which is a good estimate of intelligence.

Eysenck (1981) argues that 'g' can be measured by means of traditional intelligence tests. Jensen (1980) defines intelligence as the 'g' factor of an indefinitely large and varied battery of mental tests. He later advanced the idea of differential intelligence loadings in intelligence tests. He argued that certain tasks have a higher 'g' loading than others. Tests with low 'g' loadings involve recognition and recall, whereas high loadings incorporate tasks of reasoning.

The proponents of 'g' (Eysenck, 1981; Jensen, 1980; and Vernon, 1979) have further adopted Cattell's (1963) distinction of 'fluid' and 'crystallised' intelligence, arguing that 's' is made up of both. Tests of fluid intelligence are those that require little informational content. Tests of crystallised intelligence draw on acquired knowledge and skill. It is argued that fluid intelligence is the primary determinant of intelligence, and that crystallised intelligence is determined by fluid intelligence. Thus, in the final analysis, the 'g' factor remains as being genetically determined and impervious to environmental influences.

The concept of 'g' has continued to be a major influence on theorists in the field (Brand & Deary, 1982; and Herrnstein, 1973). The main assumptions of this approach are:

- intelligence or 'g' is a recognisable attribute which is responsible for differences among people,
- intelligence or 'g' occurs through a variety of different tasks and can be measured by IQ tests,
- intelligence is essentially innate and biologically determined. It remains stable over time and environmental influences,
- intelligence, being inherently stable, will not respond to compensatory educational programmes.

These assumptions have formed the cornerstone of the traditional intelligence and aptitude tests. Taylor (1985) points out the difference between an intelligence test and an aptitude test is not very significant. Both tests can be differential test batteries, but the aptitude test does not necessarily contain pure intelligence tests.

The implication of the geneticist argument is that intelligence tests predict well with academic performance (Eysenck, 1981). In addition, as IQ is related to scholastic success, it would not make sense to examine the underlying processes involved in learning and the acquisition of knowledge. Intelligence is immutable, and it is unlikely that one can boost scholastic achievement (Jensen, 1980).

Thus, the genetic model of IQ testing is based on a fixed or static concept of intelligence, in which intelligence is reduced to the innate amount of potential ability with which a child is endowed at birth (Burt, 1968).

However, there is a strong school of thought that refutes the concept of genetically determined intelligence, and instead maintains that differences in performance can be explained in terms of environmental advantage.

2.3.2 The Environmentalist Position

Broadly stated, the environmentalist position contends that measures of group or individual performances on IQ tests cannot be separated from social, cultural or economic influences (Bruner, 1975; and Mueller & Mueller, 1953).

If there are differences in IQ, they are due to milieu factors and not intrinsic racial factors as the geneticists would claim, and can be reversed by a change in the environment. In addition, most of the perceived differences in IQ result from cultural bias in testing that discriminates unfairly against minority groups. The argument put forward is that IQ tests create, rather than reflect group differences (Taylor, 1980).

Studies by Levenstein (1970) and Bronfenbrenner (1970), demonstrated that through direct intervention, IQ scores could be increased by up to 20 points. A longitudinal study by Hanson (1975) revealed that environmental variables such as parent-child contact and freedom to explore, were found to be significantly related to intelligence. Further research highlighted that IQ gains can be achieved if compensatory educational programmes start early in life (Scarr & Weinberg, 1976).

In support of the environmentalists' position, Sattler (1981) cites numerous studies demonstrating the effects of birth weight and nutrition, parental harmony, father absence and punishment styles on measures of intelligence.

The implications for the present study are that the environmental milieu can be altered to influence IQ, and that intelligence can be modified by supportive educational contexts (McCall, 1973 and scarr, 1981). However, their contention that IQ is modifiable is also based on a static model of intelligence.

The Geneticist position, as well as the Environmentalist approach do not distinguish between manifest and potential intellectual functioning (Zolezzi, 1992). Scores on ability or IQ tests provide a global picture of present functioning, and cannot be seen as measures of the ability to learn. Ability measured by traditional tests is therefore likely to be relatively independent of learning potential. The concept of adaptability seemed to provide an interesting alternative and a move in the direction of learning potential.

2.3.3 The Adaptability position

Adaptability as proposed by Biesheuvel (1972) and Schafer (1982) allows for a conceptualisation of intelligence that is in line with the explicit assumptions of the environmentalists. Biesheuvel (1972) argued that it is the ability to adapt to the cultural environment that defines intelligence. The concept of adaptability has advantages over intelligence as a basis for cross-cultural testing as it is broad enough to allow interpretations that include genetic, as well as cultural influences. Biesheuvel (1972) further suggested that adaptability has a far greater affinity to culture and is a measure of what people can learn to do.

Traditional measures of ability and IQ are only reflections of past adaptations and acquired skills. There is no assessment of the capacity for learning. The measure of adaptability hoped to redress this shortcoming by embodying a test-coach-retest testing procedure.

A South African study carried out by Lloyd and Pidgeon (1961) compared the performance of testees from different racial groups on standardised tests. Half the children in each group were subsequently coached on items similar to the test items. Finally, all testees were retested. Their findings suggested that disadvantaged testees made much greater gains in test performance than advantaged testees. The implication was that it is meaningless to compare traditional test scores of students from diverse cultures, even after a period of familiarisation.

Vernon (1979) contended that standardised tests should contain material that is likely to have been available to all members of a certain cultural group, so that differences between individuals may, in part, be attributed to general intelligence. Proponents of the adaptability position were looking for ways to make psychometric comparisons between cultural groups more equitable. In so doing, adaptability measures merely reflected the inequality of the milieu and were still culturally-biased, in that the re-standardising of the tests for different cultures relied upon a static concept of intelligence. It is these latter two criticisms, that of cultural-bias in testing, and that of standardisation of samples, that led to the anti-test movement, and subsequent attempts at culture-fair testing.

2.4 The Anti-test Movement

From the late 1960's there was a growing anti-test movement. The movement argued that IQ and ability tests discriminated against minority groups. Evans and Waite (1981) pointed out that the movement criticised standardised tests as being racially and culturally biased. The validity and reliability of intelligence tests for use in different racial or cultural groups was seriously questioned.

The issue of cultural bias became particularly acute in relation to predictive validity and the use of such tests for selection. Evans and Waite (1981) cite a major test case conducted in California in 1969 on the issue of using tests to place children in special classes: 'Defendants have utilised standardised intelligence tests that are racially and culturally biased, have discriminatory impact against Black children, and have not been validated for the purpose of essentially permanent placements of black children into educationally dead-end, isolated, and stigmatising classes'.

There have been a number of landmark court decisions cited by Jensen (1980) that have severely restricted the use of IQ tests for scholastic prediction. These include Marxist arguments against testing (Simon, 1979).

Evans and Waite (1981) argue that traditional tests consist of test items which discriminate against children along class lines. Simply at face value, some of the subtests require a certain familiarity and exposure that will severely disadvantage certain socio-economic groups and favour those more familiar with test content. This specifically disadvantages testees on the verbal subtests.

In addition, motivational factors are considered to affect test-taking behaviour. Biesheuvel (1972) argues that the test-taking behaviour of Blacks in South Africa is either over-cautious or too impulsive. This is a result of test anxiety which emanates from lack of familiarity with the testing process, and an anxiety due to differences in race between examiner and examinee. Furthermore, the results of testing favour the advantaged groups because invariably the test has been normed on this group.

Anastasi (1982) argues that most IQ tests have been standardised on White middle-class samples and have generally excluded minority groups. Accepting the principal of cultural bias which manifests in test content and inappropriate norms, a number of efforts aimed at producing culture-fair intelligence tests were attempted.

2.5 Culture-fair testing

Attempts at culture-fair testing have been concerned primarily with making IQ and ability tests more appropriate to different socio-cultural groups. The modifications have mainly been in test content and interpretation of results through adaptive procedures, such as item and language changes, and statistical manipulations such as re-standardisation (Anastasi, 1982).

Non-verbal tests were considered better and preferable to verbal tests (Anastasi, 1982: 289). The visual modality involved in tests such as Raven's Progressive Matrices, was believed to be more universal than the verbal or linguistic modality. This assumption has been vigorously disputed by

Blum (1978). It is now agreed that cross-cultural adaptations of tests involves much more than simple modification or translation of test items into the language of diverse cultures (Anastasi, 1982: 296).

Sattler (1982) argued that non-verbal tasks involving pictorial, spatial or figural content have generally been unsuccessful. Anastasi (1982) states that a test such as the 'Draw-a-Person-Test', which ostensibly involves a universal symbol, is highly influenced by environmental and cultural factors.

The Human Sciences Research Council (HSRC) have attempted to overcome the problem of lack of familiarity with test items by developing local tests validated against local criteria. Use is made of symbols and materials that are intrinsic to a particular culture. Anastasi (1982) argues that such attempts still try to predict performance within a western-world view and are inappropriate. For example, test items are based on modern conceptions of technology, largely ignoring the world views of alternative cultures.

A major problem in the design of culture-fair tests has been their validation in correlations with recognised IQ tests such as Wechsler. Inherent biases in the original tests are simply replicated in the new tests. Other attempts at culture-fair testing involved statistical manipulations such as the creation of special norms by restandardising the tests with diverse cultures. Again, by simply altering the norms, the conventional test is still kept very much intact. The only modification is the ranking given to a particular raw score, based on the differential performance of the population on which it is normed. Anastasi (1982) further argued that reliability and validity coefficients established on one population could not simply be adapted to other populations.

A further misgiving with culture-fair tests is that they all implicitly invoke a static concept of intelligence as a measurable and stable construct. The idea of a static 'g' has not been relinquished (Shochet, 1986: 86). Thus, unwittingly, the environmentalists who created culture-fair testing, return to the same position as the geneticists in that it is the end product (knowledge) that is examined, not the ability to learn or the underlying cognitive processes involved in the acquisition of knowledge. Thus culture-fair testing falls into the same mould as traditional academic prediction studies, in that it is the end product of knowledge or 'g' that is correlated with measures of university success.

2.6 Comparison and evaluation of the different approaches to intelligence

The concept of intelligence has been broadly examined in the light of either a genetic or environmental approach. Various perspectives have been espoused which lie at different spectrums of this continuum. It would be logical to conclude that the psychometric and multiple-intelligence

perspectives border closer to the genetic position. The Piagetian and information-processing models would be closely associated with the environmental position.

The similarities and differences among the four predominant models to defining intelligence can perhaps best be pointed out by comparing how they would account for performance on a single type of problem. Analogies have been found to be among the best single indicators of overall intelligence (Spearman, 1927, and Sternberg, 1984) and so provide a good example.

Adherents of the psychometric perspective would attempt to understand performance on the analogy by examining the underlying factors of intelligence that contribute to individual differences in performance. The analysis of intellectual behaviour employs a structural model which concentrates on variation among individuals. Furthermore, standard IQ tests are used which assume that performance on this specific task is a function of a set of underlying abilities expressed as factors.

A Piagetian would attempt to explain performance on this task by understanding the logical operations underlying analogy solution, and by identifying stages leading up to satisfactory analogy solution. The analysis of intellectual behaviour employs a model of the development of schemes for problem-solving and concentrates on what is common to individuals of a given age, but not common to individuals of different ages. In addition, observation is used to assess intelligence which assumes that performance on the given task can be understood in terms of the availability of logical functions for problem-solving.

The multiple-intelligences perspective would attempt to understand performance on the analogy by examining it within the framework of verbal-linguistic reasoning. Within this specific intelligence the researcher would proceed to examine how one comes to know, understand and employ verbal-linguistic intelligence and apply it to solving the tasks. The analysis of intellectual behaviour employs a structural model of different intelligences which differs amongst individuals. A portfolio of tasks is utilised in assessing the degree of development of each intelligence.

An information-processing researcher would try to examine performance on this task by looking at the processes that contribute to performance, and that make some analogies more difficult than others. The analysis of intellectual behaviour makes use of a process model which focuses on variation in item difficulties. It breaks down tasks that are found on standard IQ tests and assumes that performance on a given task can be understood in terms of a set of component processes.

In sum, each perspective seems to be dealing with different but overlapping aspects of intelligence. The question then arises as to whether there are aspects of intelligence or its functioning that are neglected by each perspective.

All the above approaches use intelligence in a form that does not allow for assessment of potential, and are therefore static, and treat IQ tests as if they were assessing the substance of intelligence. They fail to draw a critical distinction between current levels of intellectual functioning and potential levels of intellectual functioning.

The geneticist, environmental, adaptability and culture-fair models, as well as the four perspectives, have been unable to provide an adequate theoretical basis of intelligence testing. In the main, intelligence tests based on these models have proved poor predictors of academic success (Dalton, 1976; Houston, 1983; and Slack & Porter, 1980). In response to the poor performance of such tests, aptitude tests were developed. As aptitude testing has mainly replaced traditional IQ tests in prediction of academic success (Breland, 1979), it is important to look at the relationship between intelligence, aptitude and academic prediction.

2.7 Intelligence, aptitude and academic prediction

Jencks and Crouse (1982) point out that the idea that aptitude tests were developed to select students on the basis of future potential is incorrect. Aptitude tests grew out of the general intelligence testing movement (Anastasi, 1976). As such, aptitude tests, merely assess current levels of performance across domains and are, in reality, achievement tests.

Despite the above shortcomings, aptitude tests were seen as a positive development as they were not reliant on a single global measure such as 'g', but on a profile of measures which reflected a testee's strengths and weaknesses.

Aptitude testing has been informed by Vernon's hierarchical model which incorporates the hierarchical organisation of abilities (Vernon, 1979). Spearman's 'g' factor was the major factor with second-order factors included such as verbal, number and spatial abilities. This laid the foundation for subsequent attempts at factorial research which identified further factors of cognitive ability. Factorial-based aptitude tests informed the development of aptitude tests used in the selection of students, as well as aptitude tests used as aids in school guidance.

The most widely used aptitude test in career counselling in South Africa is the Senior Aptitude Test (SAT) (Taylor, 1989). It was compiled for measuring a number of aptitudes of pupils in Standards 8, 9 and 10, and adults. The SAT consists of 12 tests which generate an aptitude profile based on 6 aptitude fields. Thus measures are obtained for verbal ability, numerical ability, visual-spatial reasoning, clerical aptitude, memory and motor-skill.

The relationship between the SAT scores and achievement in an occupation has not yet been determined (Taylor, 1985). Furthermore, the SAT is prone to a lack of predictive validity and cultural bias (Taylor, 1989). Anastasi (1976) puts forth a number of reasons why multiple-factor aptitude tests such as SAT have poor predictive validity: 'it is possible that differences in performance in specific courses depend principally on interests, motivation, and emotional factors'. He concluded that multifactorial batteries have fallen short of their original promise.

This chapter has examined issues surrounding the nature of intelligence, intelligence testing, culture-fair testing, aptitude testing and academic prediction. This was done as the vast majority of research into predictors of academic success has concentrated efforts on the relationship between IQ and academic performance. It has been argued that attempts at academic prediction within the paradigm of traditional testing (whether it be from a geneticist, environmental, adaptability, culture-free or aptitude position) is confined to a static view of intelligence, and that this restriction might explain why the research in this area has produced such poor findings. The model of testing based on modifying IQ and assessing learning potential seems to provide an interesting alternative to the traditional approaches.

Chapter Three

Dynamic Testing: Theory and Research

3.1 Introduction

The search for new approaches to testing can be traced to the growing disenchantment with conventional testing on a number of fronts: inadequacy of both the underlying assumptions and the practical outcome of psychometric tests, their method of administration, and the resulting interpretations.

This dissatisfaction has increased considerably with the expansion of psychometric practice and its application to large groups of pupils and students with distinctly different backgrounds. For purposes of the present study, the terms traditional, conventional and standardised testing all refer to static models and methods of psychometric testing. Thus any test which is administered in the normal pen-and-paper manner, falls within the ambit of traditional psychometric testing. South African tests such as the Senior Aptitude Test (SAT), the Senior South African Intelligence Scale (SSAIS) and the Mental Alertness Test are examples of conventional, standardised psychometric tests.

As has been explained in the previous chapter, these tests rely heavily on norm-referencing and tend to focus on differences between individuals.

Norm-referenced testing compares the results of a testee to the results obtained by previous testees on the same test. The testee is the primary focus of assessment, and a profile is most often drawn up analysing relative strengths and weaknesses of the individual. The peaks and troughs are placed in perspective, by evaluating the degree of divergence from the norm. For example, a typical subtest used in most tests, is that of arithmetic which purports to measure numerical ability and ability to focus on a task. A high score compared to the norm would suggest good number ability and a reasonable interpretation would be that the testee has the ability to succeed at similar tasks in educational settings.

However, with the gradual democratisation of the educational system, comes the inclusion of populations previously considered ineligible for or inaccessible to education (Marcum, 1982). For these populations, test instruments have never been developed or norms established. Traditional tests have emerged from within a First World culture with norms relating to those educated within western schooling systems (Anastasi, 1982). These changes manifest as multi-cultural challenges which increasingly call for a shift in the focus of testing. No longer is it adequate to hone in solely to the learner and his/her intrapsychic profile of intellectual functioning. It is necessary to contextualise this profiling of ability within the instructional environment (Zolezzi, 1992). This is an important shift of focus in that results are compared to ability to change or improve scores, depending on the degree of

support or encouragement emanating from the testing situation. This shift to sources outside the individual is a fairly recent phenomenon (Heller, Holtzman & Mestick, 1982; and Kameenui & Simmons, 1990).

In the past few years, a consensus has been established that the traditional quantitative testing approach faces a serious challenge (Culverwell, 1989; Shochet, 1986). This section will attempt to synthesise the emerging trends of testing for potential, given the shortcomings which are increasingly becoming evident in contemporary approaches to testing.

Firstly, criticisms of traditional testing will be discussed. This leads to the exploration of alternative testing models and the origins of dynamic testing. Vygotsky (1962, 1978) was the first to criticise the traditional intelligence and aptitude tests. His theory of the zone of potential development laid the foundation for the development of a family of new approaches to assessment, generally referred to as dynamic testing. These approaches will be explored within a framework distinguishing the various efforts according to differences in the testing context and testing content.

Secondly, the merits of using the principles of dynamic testing in a multicultural context will be evaluated. The present researcher believes that dynamic testing needs to be contextualised in terms of the testees capacity to learn. Accordingly, the writer rejects the notion that certain cultures are deficient. It is this conceptual break with the past that suggests that the tester becomes a participant in the testing procedure that provides the impetus for the formation of the testing battery in the present study.

3.2 Shortcomings of Traditional Approaches to Testing

The previous sections have reiterated the continued use and proliferation of traditional tests. One has only to look at the testing catalogues of the Human Sciences Research Council (HSRC) to see the ongoing application of traditional (conventional/standardised) tests for a variety of purposes such as: education, selection or placement of students. It is true that most test-developers are attempting to address issues of multi-culturalism and educational disadvantage within the testing situation (Boeyens, 1989; Murray, 1988)

However, many of these attempts have failed to respond to the very need that brought them into existence because they have almost fully preserved the assumption of intelligence as a fixed entity, and to a very large extent have made no changes in the nature or presentation of the tasks. In addition, intelligence is always formulated as an ability. Thus criticism of traditional tests can be proposed on two fronts:

- Shortcomings in underlying assumptions which include manifest functioning, homogenous testing, product-based evaluation, and the assumption of fixed ability;
- Shortcomings in methodology and administration of traditional tests which include lack of responsiveness to instruction, lack of motivational factors and insensitivity to diverse background of testees.

The following section will examine both these areas of shortcoming regarding conventional testing.

Traditional tests analyse current levels of functioning, thereby only providing a partial view of the testee's status. These tests yield no direct evidence about the processes that underlie competence or academic success. Vygotsky (1978) made the point that static test scores do not provide information about those functions that are in the process of maturation. This leads to his notion of a testing environment, incorporating some form of social support, that will create a zone of proximal development, in which testee's will be able to demonstrate those latent skills not tapped by static test procedures.

Standardised tests rely heavily on the assumption that all testees have had comparable backgrounds and opportunities to acquire the information within the tests. Particularly liable to be compromised are educationally disadvantaged students whose abilities are likely to be underestimated (Shochet, 1986).

Although traditional tests are product based, it is nonetheless the case that they are frequently interpreted in terms of general abilities. The abilities are presumed to operate in many, if not all, academic domains. While domain-general skills may exist, it is clear that there are important domain-specific capabilities that underlie successful performance in different academic domains.

Another concern with traditional tests stems from the conclusions that tend to be drawn. There is an assumption that results reflect academic ability which is regarded as fixed and unlikely to change over long periods of time (Jensen, 1980). The ability is further presumed to be a permanent characteristic of the testee in all situations and under all circumstances.

By way of summary, several consequences of the traditional testing assumptions can be pointed out. There is a reliance on static, product-based evaluations, inappropriate levels of description and a decontextualised testing situation.

From a methodological viewpoint, traditional testing measures are not designed to evaluate instructional strategies which could improve the learning capability of the testee. Instead, these testing procedures consider learning to be best assessed unaided in an objective, neutral environment. The opportunity to directly influence learning is overlooked within the context of conventional testing.

Recognition is not given to the testee's potential to succeed with adequate environmental support. As noted by Biesheuvel (cited in Feuerstein, 1979: 35) 'our efforts should be directed towards the construction of tests to measure potentiality to meet educational, vocational, and social demands, and to study the factors that influence modifiability of behaviour'. Biesheuvel also noted that inherent to the view of modifiability of knowledge and skills is the need to generate tests that include a learning component. The fact that the testee is not given the opportunity to learn during the testing process certainly inhibits motivation for undergoing testing from the outset. There is a lack of variation in test administration which produces a sterile test-taking situation. Haywood (1970) argues that: 'individuals may make poor scores on product oriented tests, not necessarily because they lacked or lack the aptitude for academic pursuits, but frequently for two other reasons ; opportunities to learn the associations and skills demanded by tests have not been uniformly present, and the tests do not measure adequately the fine-trained skills and strategies required even for academic learning.' However, in cases where there is a mix of testees from diverse socio-educational backgrounds, there would be a variety of learning styles and ways of learning, invariably implying that many testees not conversant with the middle class bias evident in most traditional tests, are compromised.

Testees from disadvantaged backgrounds disproportionately score at below-average levels on tests that purport to measure aptitude and intelligence (Shochet, 1986). It became increasingly clear that culture and educational background influence performance on cognitive tests. It was the pragmatic nature of most African research that forced the awareness of culture as a powerful moderator of intellectual test performance. The investigation of abilities and aptitude in an African context owes its impetus to the rapid industrial expansion after the Second World War, as well as the movement toward decolonisation (Irvine, 1966; and Silvey, 1963). The period since the mid-1960's witnessed the appearance of various non-psychometric approaches in ability testing (Greenfield, 1966; Miller & Meltzer, 1978; and Murray, 1961). these included attempts to devise alternative instruments or modify existing ones.

The various efforts to modify psychometric practice can be categorised into five general types of approaches:

1. Conservation of the conventional structure and contents, while creating separate norms for different cultural groups.
2. Constructing separate tests for specified populations.
3. Maintain the conventional structure but alter some tasks in a way that allows consideration of individual functioning within a cultural and developmental context.
4. Incorporate pictorial and non-verbal modes of presentation.
5. Modification of individual functioning wherever necessary to facilitate testing of true capacity above and beyond current levels of functioning.

The first four approaches have been examined in chapter two. It was pointed out that these modifications failed to do justice to the assessment of diverse cultural groups, because these groups did not show a higher level of functioning when confronted with the modified testing context. Even when they succeeded in responding to the tasks, the success proved to be irrelevant to their adaptation to the requirements of the dominant culture into which they needed to integrate.

Changes in the testing context were meaningless as long as static goals were preserved. Feuerstein (1980) concludes that any change in the task or norms reflects a belief that socio-economically disadvantaged individuals intelligence differs not only quantitatively, but also qualitatively from the intelligence of the middle-class child, and that, in order to measure it, it was necessary to appeal to the functions or modality that best characterised this differential functioning.

The fifth approach, that of modifying the individual's functioning responds to the need to assess culturally different or disadvantaged populations by attempting to change the individuals confronted with the psychometric task. The failure of the individual to respond to the task is then dealt with by the intervention of the examiner. This form of testing is dynamic in that the aim of testing is to prepare the individual to cope with the exposure to the task and assess potential to increase learning (Feuerstein, 1979, 1980).

Because potential is centrally concerned with what could be, it is inextricably linked to the possibility of change. Change is reflected in new abilities in the real world.

3.2.2 Potential, intelligence and testing

For too long we have lumped potential and intelligence together (Gardner, 1983). Potential has been subsumed into intelligence. If you are intelligent, then by implication you must have potential. However, intelligence scores in the high ranges, as revealed by traditional testing, does not necessarily lead to success, academically, or in the world or work. 'Studies have shown that the most successful persons in everyday life are those with moderately, but not exceptionally high IQ's' (Sternberg, 1984 : 308). Current notions of intelligence acknowledge man's need to change and grow. 'Every intelligent system adds to it's own fund of knowledge and repertoire of skills' (Butterfield, 1988: 45). This fund of knowledge is increased wherever a person faces a problem for which he or she does not already have an effective strategy. It is exactly at this point that the role of the examiner or mediator is important, offering a method for sharing the required cognitive competence while affirming the person through a belief in their potential.

These newer formulations which incorporate potential into the notion of intelligence represent a fundamental shift in the way intelligence is assessed. It was Vygotsky (1962, 1978, 1979) who provided the basis for the paradigm shift to learning potential assessment. His emphasis on the need to determine the testee's ability to learn by recording the effect of cues incorporated into the testing situation stimulated much research into the area of dynamic testing.

3.3 Foundations of Dynamic Testing: The Zone of Proximal Development

Vygotsky (1978) perceived intelligence as a dynamic process that changes with development and learning. As a testee interacts in a testing situation, individual learning stimulates the development of cognitive functions. Vygotsky's point was not that 'children differ in how efficiently they learn' (Campione, 1989), but that children differ in their current state of development in ways that cannot be assessed by techniques that are limited to analysing children's performance when they are working alone.

As cognitive development proceeds, a 'Zone of proximal development' can be ascertained to reflect the gap between the testee's actual development, and developmental potential. This potential enables the tester to facilitate the testee's capacity for learning. In this sense, assessment is dynamic and helpful.

According to Vygotsky (1978) any attempt to determine a testee's learning potential must take cognisance of two distinct developmental levels. The first is the actual developmental level which reflects the acquired problem-solving skills that the testee has at his disposal at a given time. The second developmental level is the level of problem-solving efficiency which the testee can reach when assisted by capable instructors. The difference between the actual developmental level and the potential developmental level is the zone of proximal development (ZPD). The size of this zone is determined by using traditional aptitude tests in a test-teach-test format.

A testee is first given a test (or part of it) to determine which items she can perform correctly and which items present difficulty. After this initial performance, the tester provides help in completing the difficult items, by appropriate prompting until competence is achieved. Finally, similar items are administered again to determine the degree to which learning has helped the testee to perform better. The degree of aid needed before a testee reaches a solution is taken as an indication of the width of the potential zone (Vygotsky, 1978).

An individual who has received fewer prompts and who is able to solve many problems of a similar nature has achieved high transfer and, by implication, has higher learning potential. The ZPD is

regarded by many theorists (Brown & Ferrara, 1985; Brown & French, 1979; and Rogoff & Wertsch, 1984) as a measure of the ability to benefit from instruction and denotes the capacity of the learner for change when placed in an optimum environment of mediated learning.

It is in this context, testing children from different educational backgrounds in a supportive environment, that Budoff (1987) Feuerstein (1979) and Brown and Ferrara (1985) did their early work. The common feature of this later research in dynamic testing is the emphasis on potential for change within a context of assisted learning. However, the methods developed vary considerably and reflect different goals.

In fact, there are numerous models of dynamic assessment described in the research literature (Embretson, 1987; and Ferrara, 1987). The salient feature characterising all dynamic assessment approaches is the use of guided learning to determine a learner's potential for change (Campion, 1989; and Meyers, 1987).

The following section will examine the different models of dynamic testing which have developed from the earlier concept of the ZPD. The present study aligns itself most closely with the fifth model of test-train-test and this will be subsequently discussed in the ensuing section.

3.4 Models of Dynamic Testing

Five distinct models of testing in a dynamic context have been identified in the research literature:

1. mediational assessment
2. testing-the-limits testing
3. graduated prompting testing
4. mediated and graduated prompting testing
5. test-train-test assessment.

The latter model has formed the main theoretical basis of the present study and the variations of testing within the model will be looked at in a later section.

3.4.1 Mediational assessment

This model is based on a theory of cognitive functioning, in which a lack of mediated learning experiences results in cognitive deficiencies. Mediated learning experiences are those interactional contexts whereby an adult teacher/mediator explains reality to the child learner so that he/she can internalise the understanding and hopefully transfer this knowledge to other situations.

It was Feuerstein (1979) who first linked assessment procedures with intervention which was based on specific principles of mediation. Such testing aimed to assess the nature and extent of an individual's

deficiencies, as well as the amount and type of mediated learning needed for him/her to profit from direct learning. Feuerstein uses specific feedback to that the individual learns to adapt and apply knowledge to increasingly complex and unfamiliar situations.

An important element of this model is the analysis of tasks which is guided by a 'cognitive map' that is used to identify, clarify and modify a learner's deficiencies. The map gives the mediator a framework in which to observe whether failure is due to :

- content unfamiliarity
- preference for verbal, pictorial, figural or numerical modality of presentation
- deficiencies in the input, elaboration, or output phase of a mental activity
- inadequate cognitive functions or mental operations
- task complexity
- level of task abstractness, or
- deficient or underdeveloped efficiency in spite of prerequisite skills knowledge.

All tasks are analysed within these seven parameters of the cognitive map (Feuerstein, Rand, Hoffman, Egozi & Shachar-Segev, 1991).

The individual's deficient functions must be considered within the context of the three phases of the mental act: input, elaboration, and output. Feuerstein utilises a mediational period during testing whereby the parameters of the cognitive map are systematically varied. This period of mediating is learner-centred and focuses heavily on using the individual's cognitive strengths to bring out new strategies when confronted with difficult tasks.

Because this procedure of Feuerstein's involves a systematic approach to mediated testing it will be further discussed within the test-train-test model.

3.4.2 Testing-the-limits Testing

This model is based on the premise that intellectual and personality factors account for differences amongst individuals in processing information. The testing situation involves specific interventions which can be eliminated at various stages of the assessment process. The idea is to assess for the effects of training on a transfer test so as to gain an understanding of the testee's specific ability to pick up on the cues given by the tester (Carlson & Wiedl, 1979).

The limits of the testee's abilities are assessed by incorporating various procedures that lead to higher levels of performance. Amongst the procedures used are :

1. prompts given to the testee to verbalise during and after solution, while at the same time providing an explanation of the principles needed to complete the task,

2. prompts that aid the testee to verbalise how he or she solved the problem,
3. prompts which assist the testee to verbalise while solving the problem,
4. providing feedback, and
5. providing elaborated feedback that explains the principles involved in reaching successful task completion.

The testing-the-limits model does not require changes in the general structure or content of conventional tests. Rather, use is made of general measures of cognitive ability which are modified within the testing situation. Modifications come in the form of encouraging verbalisation before and after solution or after solution only (Carlson, 1983). For example, the Raven's Coloured Progressive Matrices are often used and during testing the tester might incorporate simple feedback, elaborated feedback or feedback plus verbalisation during and after solution.

Studies using the testing-the-limits model found that the testing procedure of verbalisation and elaborated feedback led to higher levels of performance than the standard testing condition which did not incorporate assistance (Bethge, Carlson & Wiedl, 1982; and Carlson, 1983).

3.4.3 Graduated Prompting Testing

This model of dynamic testing has been greatly influenced by Vygotsky's (1978) notion of a zone of proximal development (ZPD), as elaborated earlier in this chapter. The graduated prompting process of assessment utilises the ZPD to predict the testee's readiness to learn and benefit from assistance during testing. Testees who have broad zones of proximal development are seen to profit greatly from intervention. This means that there is a considerable gap between the level that the testee can initially reach unassisted, and the level that can be attained when assistance is provided. Conversely, it is unlikely that children with narrow ZPD's will go much beyond their starting levels of unassisted performance.

An important feature of this model is that assessment of a testee's readiness or ZPD within a specific content area of testing must be continuous. Emphasis is placed on assessing the amount of assistance needed in allowing for effective transfer learning. There is a sequential set of prompting procedures which facilitate measurement of the amount of assistance needed to perform the task. The graduated prompting procedure provides mediation in the form of predetermined prompts that are sequenced from the most general to the most specific.

Graduated prompting testing uses a pretest to determine the beginning level of performance (Brown & French, 1979; and Campione Brown & Ferrara, 1982). The pretest also assesses the testee's general intellectual ability. After the pretest, there is a training phase consisting of a series of progressive

prompts which are based on an analysis of the tasks involved. However, the prompting procedure, unlike the mediational procedure of Feuerstein, is standardised so as to produce quantitative data. Prompts are introduced starting with those that are general and abstract to more explicit, specific and concrete. In addition, the prompts are also based on the information generated by the testee. Thus this procedure does not rely on making high-level inferences, such as used by Feuerstein in mediational testing, but allows for a measurement of the minimum amount of assistance necessary to solve a given problem.

If the testee produces accurate information, some or all of the prompts may be discarded. The number of prompts needed for problem solution is seen as inversely related to learning and transfer ability. This means that if a testee requires a high level of assistance through prompting then it is most likely that the testee will have difficulty in transfer of learning. Improvement in performance by the testee is tested by the administration of a post-test similar to the pretest (Brown and French, 1979).

3.4.4 Mediated and Graduated Prompting Testing

This model (Bransford, Delclos, Vye, Burns & Hasselbring, 1987; and Burns, Haywood, Delclos & Seward, 1987) incorporated the method of Feuerstein's mediation with Campione and Brown's procedure of graduated prompting. The contribution of mediational assessment is evidenced in the direct teaching of metacognitive skills such as planning and monitoring. However, it deviates from the LPAD model in that modifications of the mediated assessment result in a brief, scripted instructional procedure. In fact, Burns (1985) and Tzurriel and Klein (1987) have standardised the mediation by developing mediated testing scripts.

The mediated assessment component allows for the testee to become familiar with the test content and the cognitive functions required. Furthermore, specific rules are taught and feedback given based on performance. Once the testee has mastered the rules, practice on assessment items is provided.

At the end of each task, the testee is given elaborated feedback that explains the rules involved in the task. This phase of testing then incorporates much of the graduated prompting procedures described in the previous section. Thus, initially there is mediational assessment, where the nature of prompts provided is contingent upon the performance of the testee. After a period of testing where greater familiarisation of test items takes place, graduated prompting takes place. These prompts are predetermined, based on task analysis (Burns, 1985).

The model of mediated and graduated prompting testing usually involves the initial administration of some form of static measure (a test without assistance). This is then followed by graduated prompting arranged in terms of degree of explicitness (from general and abstract, to specific and concrete).

Testees' who do not perform well in this phase are provided mediated assessment. Results indicate that when a static assessment is followed directly by graduated prompting, testees' independent task performance increases on tasks already taught (Vye, Burns, Delclos & Bransford, 1987). The same study suggests that there is generalisation to a transfer task with the graduated prompting phase. However, the mediation phase appears to lead to greater generalisation.

In sum, the previous four models of testing attempt to link assessment and instruction. Furthermore, they are seen as attempts to improve the predictive and prescriptive features of traditional testing by generating more in-depth descriptions of an individual's strengths and weaknesses. However, these four models have focused on one-to-one testing situations.

The present study is an attempt to translate these advantages to a group testing situation. It is for the reason that the writer placed the new testing procedure within the ambit of the fifth model which is test-train-test assessment.

3.5 Test-Train-Test Testing

The rationale for this model is that a period of training during testing would equalise differences in backgrounds of testees (Zolezzi, 1992). This model uses a brief procedure which starts off with pretesting. This is followed by training testees in understanding the nature of the tasks and culminates in a post-test. However, most of the proponents of the aforementioned four models incorporate some element of test-train-test in their procedures. It is merely that this fifth model is a more deliberate and systematic attempt to simplify and adapt the procedures to a group situation with testees of diverse educational backgrounds. It would be useful to reframe those attempts at test-train-test within the other models to see in which ways they can contribute to synthesising a procedure tailor-made for group testing.

With the above aim in mind, it becomes clear that the models should be differentiated in terms of their contribution to elucidating a new model for group testing.

The competing ways in which test-train-test attempts at dynamic testing contribute to group testing can be clarified by distinguishing attempts within two broad dimensions. Firstly, approaches can be evaluated in terms of test process. This specifies the degree of interaction between tester and testee within the test situation. In designing the interaction between examiner and student, the proponents of a clinical approach use an unstructured clinical interview in which the examiner is given considerable latitude during mediation (Brown, Feuerstein and Vygotsky). Alternatively, there are those who wish to standardise the procedure of interaction hoping to generate a consistent and objective mediation experience (Budoff and Ferrara).

Secondly the assessment can be either evaluation of relatively general or domain-specific skills and processes. Adherents of the first approach have concentrated on general skills and deficient cognitive functions (Budoff, Feuerstein and Vygotsky). Others have been more concerned with test contents that are situated within a particular academic domain (Brown and Ferrara).

Table 2 outlines the theoretical framework as well as the major theorists within each group. We will discuss each group briefly and then evaluate why the writer chose to contextualise the present test battery within the standardised domain-specific area of assessment.

Table 2

Classification of current approaches in Test-Train-Test assessment

Test Content	Test Process	
	General Skills	Clinical Standardised
	Domain-specific Skills	<p>Vygotsky & Feuerstein</p> <p>Brown Ferrara</p>

3.5.1 Clinical Interaction/General Skills

The major aim of this approach is to focus on underlying cognitive processes which provide information about testee's current level of functioning. Assessment is carried out in a clinical manner that combines evaluation and instruction. The stated goal is to assess the testee's ability to profit from instruction.

Vygotsky (1978) and his ZPD, as well as Feuerstein (1979) would be placed in this category. The Learning Potential Assessment Device (LPAD) of Feuerstein was developed to modify intellectual ability and even introduce new cognitive structures.

This approach argues for a flexible, individualised, and highly interactive format. The tester is responsive to the testee, giving and requiring information, selecting relevant examples, and summarising learning. The cognitive processes evaluated are presumed to be general and modifiable. The relation between assessment and instruction is emphasised. The criterion against which the mediated assessment is evaluated is the testee's performance both on the type of items practiced during the testing session and on transfer items.

Previous studies, both in South Africa (Skuy & Shmukler, 1987) and elsewhere (Feuerstein, Miller & Jensen 1981; Feuerstein, Rand, Hoffman, Egozi & Shachar-Segev, 1991; and Skuy, Kaniel & Tzuriel, 1988) have suggested the usefulness of the LPAD in assessing the potential for cognitive modification in disadvantaged/low socioeconomic status (SES) populations, both at the top and bottom ends of the academic spectrum. There have been some less successful attempts in improving academic performance (Bransford, Stein, Smith & Vye, 1985).

3.5.2 Clinical interaction/domain-specific skills

This approach also attempts to integrate assessment and instruction. However, the cognitive processes that are targeted are chosen in reference to specific academic domains. The assessment embodies some of the features of Feuerstein's LPAD. An environment is constructed where testees are observed as they engage in specific activities or problems. The tester acts both as an evaluator and a clinician, capable of discovering strengths and weaknesses and responding to testees by providing feedback, practice and support as needed.

The major difference is that the activities and problems are always modelled and practiced in context. As the activities are practiced in a specific context, for example, reading, there is little concern whether learning is transferred to other domains. If mediation and assessment is successful, improvements are obtained directly on important school tasks rather than on processing skills that are assumed to be related to performance on those tasks.

Brown (1974) is the main proponent of this approach. He argues for a reciprocal teaching approach in a cooperative learning group. A teacher and a group of students take turns leading a discussion concerning a specific academic text that they are jointly trying to understand. The dialogues are organised around comprehension-monitoring activities which include questioning, summarising, predicting and clarifying.

The objective of this approach is to assist testee's to become independent learners through joint construction of meaning. Learning strategies are always modelled and practised in an appropriate context, rather than as decontextualised isolated subskills. It is the social support provided by the mediator and the rest of the group that allows for instruction geared to the level of students at the appropriate time. There is constant diagnosis and monitoring where the mediator increases the demands of the task where necessary, forcing the student to function at a more advanced level.

The advantage of this procedure is that it can be incorporated into the classroom as a regular component of daily activities. Palincsar and Brown (1984) have demonstrated that reciprocal teaching of reading and listening comprehension can be an effective means for dealing with poorly

achieving students in the early to middle school years. Brown and Campione (1986) have attempted to extend this approach to learning in the areas of Algebra and Natural Sciences.

3.5.3 Standardised instruction/General Skills

Efforts in this category are concerned primarily with devising methods to increase the predictive validity of the assessment process. The test contents tend to tap general abilities. The goal is to assess a general learning potential by disadvantaged students that was not tapped by standard static tests.

The main issue concerns the extent to which improvement in scores provides useful diagnostic and predictive information. Interventions are designed to facilitate performance. Pre-post designs are generally used which are interspersed with a period of standardised instruction. For example, groups of testees may be given the Raven Progressive Matrices (a test of completing patterns using inductive reasoning) in the standard administration (pre-test, which is unaided), or they may be required to verbalise the solution choice before seeing the alternatives or after making their choice, or they may simply be given feedback about the correctness of each choice. These modifications result in higher levels of performance on the Raven, increases that are seen to reflect changes in testees understanding of the task as well as their greater comfort in the testing situation.

Carlson & Weidl (1979) have found that the post test scores in their dynamic testing procedure to be more predictive than pretest scores. Embretson (1987) makes use of a standardised instructional component which takes place between pretest and post test. The test content consisted of items which assess spatial ability. After a period of training in three-dimensional thinking (tasks similar to the Raven, using induction), the test was re-administered. She found that testees improved from first to second administration, and the score on the latter administration provided a better predictor of performance on a number of criterion measures than the pretest performance.

Campione & Brown (1987) researched the role of learning and transfer processes in students varying in academic performance. Testees were given a series of static tests of general ability. They were then subject to instruction in inductive reasoning. This instruction involved hints that facilitated learning rules for solving problems by inferring general principles from specific rules, for example, as in solving non-verbal tasks by looking for an all inclusive or pervasive principle. However, their method employs both a learning score and transfer score. The former score is assessed by how much instruction is needed to learn in order to use a set of rules independently. The latter score is derived by how much instruction is needed before the aforementioned rules could be applied in related, but novel situations. They found that transfer performance is highly related to academic performance. It appeared that the appropriate and flexible use of a rule or principle leads to understanding, which in turn, predicts for future success in learning.

The major drawback to these approaches is that testing is not situated within any particular academic domain (Campione, 1989). Therefore, the learning potential scores cannot be related to potential within a particular sphere of study. We have come to know enough about the basic academic subjects and cognitive skills, to develop procedures designed to assess domain specific skills (Ferrara, 1982).

3.4.4 Standardised Instruction/Domain-specific skills

In more recent studies of dynamic testing, it has been concluded that, in a variety of problem-solving situations, those testees who had difficulty learning new information were unlikely to use that information flexibly in new problem situations (Campione & Brown, 1987; and Campione, Brown & Ferrara, 1982). This problem can be overcome if testing takes place in a domain in which rules and principles can be learned and applied to novel types of problems. In terms of predicting for academic success it further becomes necessary to choose a domain that is known to be related to university success. Researchers who work within this framework make use of structured intervention within a specific field of ability (Shochet, 1986; Zolezzi, 1992).

The initial period of mediation is fairly general becoming progressively more specific. The prompts or hints used are based on a detailed task analysis of the skills necessary for both task performance and task transfer to novel problems. The hints are given in a fixed sequence, independent of the testee's responses. The procedure is more task, rather than child, orientated. Such an approach produced quantitative data with good psychometric properties as test administration is standardised.

Campione, Brown, Ferrara, Jones and Steinberg (1985), used a variant of the Raven's Progressives Matrices, followed by an instructional phase involving three rules: rotation, imposition and subtraction. This specific mediation makes explicit inductive rules. In the next session, novel examples of the same type were presented in a random order. The testing also included a transfer session which included the same problem types interspersed with a set of transfer problems: such as comparing patterns according to degree of positioning in space, degree of being covered by another object and degree of portions missing respectively. These required the use of combinations of the original rules. Thus patterns had to be compared in terms of position, shape and size.

Group differences were apparent during the different phases of testing. It was found that the greater the need for flexibility in applying the learned rules, the larger were the differences between low intellectual functioning and average intellectual functioning testees.

Ferrara, Brown, Campione (1986) included an inductive reasoning task in their dynamic test procedure. This task gives the testee an opportunity to infer specific principles from general rules, for

example, as in solving verbal tasks by analogy. This study also affirmed the finding that groups of testees of contrasting ability do differ in terms of learning, and particularly, transfer performance. Less able children tend to need more help to solve sets of original learning problems, and then continue to be at a disadvantage when they are required to make flexible use of the principles or rules they have been taught. Furthermore, these differences discriminate between which students are likely to be successful at scholastic studies. Brown and French (1979) found that learning tests specific to certain school subjects are better predictors of academic success of first-year students than a conventional intelligence test.

Test-train-test approaches addressed the need to look at the implications of mediation and prompting within a group context. These approaches can be contrasted with those attempts within the other models to help identify the reasons why the test-train-test model is most appropriate to the needs of the present study.

3.6 Comparison of dynamic testing models

Significant differences exist among the five models of dynamic testing. Table 3 sets out the dimensions in which the models differ in their theoretical orientation, purpose of assessment, type of skills assessed, type of tasks employed, type of instruction employed, and empirical support associated with each model of testing.

Table 3

Models of Dynamic Testing

	Test-train-test	Mediated assessment	Testing-the limits	Graduated Prompting	Mediated & Graduated
Theoretical Orientation	Intelligence is trainable	Mediated learning for cognitive development	Intra individual differences in processing information	Sociocultural cognitive development	Learning is contingent on direct experience
Purpose of testing	Identify students who can profit from optimal instruction	Identify deficient cognitive functions	Provide an index of general intellectual ability	Identify students at risk for academic failure	Examine effects of different instructional procedures
Tasks used	<p>General</p> <p>Non-verbal tasks</p> <p>Specific</p> <p>Inductive and deductive academic tasks (reasoning)</p>	Visual-motor and memory tasks	Matching figures and search tasks	<p>Inductive reasoning (letter series)</p> <p>Mathematics and reading curricula</p>	<p>Perceptual tasks</p> <p>Reading comprehension and word problem-solving</p>
Instructions used	Standardised verbalisations	Non-standardised clinical	Standardised with feedback	Standardised hints and prompts	Non-standardised with standardised graduated prompts
Empirical Support	Lower SES children found to be high in post-tests	Difficulties at input and output phases accounted for low functioning performers' deficient functioning	Reduction in test anxiety and performance due to feedback	More accurate performance estimates of learning and transfer	Greater transfer of learning from mediated testing than from graduated prompting

It is the first column and it's associated studies which provided the springboard for the development of the present study. In order for the present study to be both predictive and psychometrically defensible, it was imperative to operate from a standardised, domain-specific procedure within the test-train-test model. The writer also believed that this procedure would be enriched by combining the works of Feuerstein, Budoff and Ferrara. Chapter Four discusses the meshing of the aforementioned studies into a comprehensive group aptitude testing format.

A further contention of the writer is the necessity of situating the testing procedure in a multicultural context. The influence of culture, environment and learning opportunities of the testee should be taken into account (Feuerstein, 1979, 1980).

3.7 *Dynamic testing in a Multicultural context*

An important motivation to introduce the new testing procedure in the Counselling and Careers Unit at the University of the Witwatersrand was the writer's belief in a fair and equitable assessment opportunity for all students especially where there is an increasingly heterogeneous intake of prospective students.

There are certain handicaps which disadvantaged students bring to the testing situation. They are often fearful of the testing process, expect to do poorly, are often insensitive to speed requirements, are unfamiliar with the problem contents, and do not develop spontaneously the most effective strategies to solve the problems (Hartshorne, 1984; and Taylor 1989).

Conventional tests assess the degree to which testees have spontaneously acquired from their natural environment, the skills and knowledge which cumulatively predict academic success. There is a tacit assumption that a testee who learned informally prior to entering formal schooling will continue to learn - formally and informally in and out of school. Testees from disadvantaged educational backgrounds do not have a frequent and equal access to school-preparatory experiences and pre-academic skills-building (Muray, 1980). Yet, many of these students are competent problem-solvers in their non-school environment, having mastered the skills, knowledge and strategies necessary to make a successful adjustment. They do learn and profit from relevant experiences more successfully than their conventional ability scores and school achievements indicate (Zolezzi, 1992).

In a changing era in South Africa, where the human rights of each individual is gaining increasing importance, a fair and equitable assessment of human potential is of the highest priority.

Assessment procedures in the South African context should reflect the concept of equality and equality of education for a just society, taking into account the following sources which Irvine (1966) found to be important influences on test scores :

1. the content of the test
2. the form and style of the test
3. the transfer that takes place between practice items and actual test times especially when the material is unfamiliar
4. the particular cultural or educational bias of the test items

5. the motivational influence of strange testers who tend mostly to be Europeans.

The above-mentioned sources of potential bias are addressed by focusing on the testee's modifiability and potential to learn, that is, the ability to improve performance on reasoning problems following a systematic learning experience. Reasoning is viewed as the critical ability where the reasoning tasks are administered in a test-teach-test sequence, which allows the testee to understand how to solve the problems when the contents of the problems may be strange and the appropriate strategies are not readily accessible (Ferrara, Brown & Campione, 1986).

The period of mediation or teaching helps the testee to narrow the cognitive gap between his previously learned problem-solving strategies and those implicit to the problems he must ordinarily solve on the current test battery. The dynamic testing procedure minimises the superficiality of the test situation. The repeated contacts with the test items in a context of support and teaching allows the testee to develop a sense of competence. Furthermore, the writer ensured that there always was either a tester or test assistant present at each session who was also from the same disadvantaged background as that of the testees. This form of testing allows for the assessment of a post-test measure which reflects the testee's ability under optimised conditions in which all testees are familiar with the tasks and its demands, and also have had success in solving problems similar to those on the test. In addition, they will have had the opportunity to learn and apply relevant strategies. The following chapter describes in more detail the contents and procedure instituted in the development of the current dynamic test battery.

The Dynamic Test Battery: Contents and Procedure

4.1 Introduction

The previous chapter discussed the development of dynamic testing as an alternative to traditional approaches to assessment. This represents a fundamental shift in paradigm toward aptitude and prediction for academic success. At the same time, dynamic testing addresses educationally disadvantaged communities by stressing the ability to learn.

The various approaches to dynamic testing were explored within the framework of degree of support in testing and degree of contextualisation during testing. Accordingly, different forms of dynamic testing were distinguished. The main thrust of this chapter is to critically evaluate these attempts to operationalise learning potential within the context of aptitude testing.

The practical problems encountered in developing a learning potential aptitude test battery specifically for groups, laid the foundation for the construction of the present dynamic test battery (Newtest). The researcher will discuss why the two tests were chosen and modified as a response to the shortcomings of contemporary learning potential instruments. The process of standardising the testing situation will then be discussed. The next important step was to operationalise the new constructs used in the Newtest battery. Finally the researcher will discuss the changes in the testing situation in terms of the shift in relationship from examiner/examinee to that of trainer/trainee.

4.2 Limitations of current approaches to Dynamic Testing

Chapter 3 explored the increasing accumulation of literature on the use of a learning-orientated approach to testing. This section will concentrate on problems with the implementation of dynamic approaches in a group aptitude testing situation. These criticisms will then serve as a springboard to the discussion of the formulation of an appropriate strategy to counter the shortcomings mentioned.

4.2.1 Non-Standardised mediation

Most dynamic approaches place emphasis on good rapport between tester and testee. The problem of biased intervention becomes a possibility (Embretson, 1987). The problem can be further exacerbated if testees are evaluated by different testers. Each tester would develop a unique testing relationship, applying different standards in the mediation process. A major goal of clinical approaches to dynamic testing is the assessment of cognitive deficits. This is done through a carefully structured mediation

process. Brown and Ferrara (1985: 280) criticised individual-oriented mediation as lacking a description of the assistance and prompts given to the testee.

The lack of standardisation may favour certain testees who pick up certain cues more easily. There is always the temptation of the tester to devote more time and attention to specific testees. In addition, the method of mediation may only favour certain testees. In these cases, testees who profit from more visually-oriented assistance may be excluded if mediation is primarily auditory. A further criticism is that clinical mediation often utilises strategies at a level which would benefit only low-scoring testees (Boeyens, 1989). Students who initially score at a high level on a pre-test would require higher-level intervention which is often lacking from a clinical approach.

4.2.2 Based on a deficit model

Although dynamic testing has offered an alternative to traditional testing and static views of ability, it is based on a deficit model of human cognitive skills (Shochet, 1986). The format of dynamic assessment is predicated on a lack of appropriate cognitive skills which are diagnosed during testing. The assessment of learning potential is attributed to the capacity in acquiring the skills lacking during initial testing. The implication of such an approach is that there is no certainty that the skills diagnosed and mediated relate to skills needed for academic success. For dynamic testing to contribute more meaningfully to academic prediction, there is a need to examine and understand the processes underlying the acquisition of knowledge.

4.2.3 Test items are non-standard

Conventional testing is typically not guided by any formal theory. Therefore, the difficulty of test items can only be determined through practice and observation. Such tests are constructed outside a theoretical framework. The majority of dynamic tests make use of traditional measuring instruments during the process of assessment. The fact that no initial item standardisation has been performed for the target testing group limits the usefulness of test results. The task of accurately assessing the improvement of an individual testee is confounded. Too many cognitive skills are inherent in test items and conclusions about improvement in particular skills cannot be made with confidence.

4.2.4 Pre-test and Post-test ceiling effect

Initial attempts at assessing learning potential encountered problems in finding the suitable level of complexity of test items. This difficulty arises because the second administration of the test should allow for meaningful improvement. However, the Counselling and Careers Unit (CCU) at Wits University found that many students initially scored high in many of their traditional tests. This was

particularly the case with the Raven's Progressive Matrices. Only the last three items appeared to discriminate between successful and unsuccessful students.

Most traditional tests are constructed and normed with the objective of making the test difficult for most testees. It is only the top percentile of students who will have any chance of solving all the items. This negates the possibility of good students showing improvement after mediation thus nullifying the rationale for a second administration.

A further observation of the use of tests like Raven's Matrices in a dynamic format is the higher learning potential scores of disadvantaged students as compared to advantaged students (Babad & Budoff, 1974: 442). The latter group are generally more familiar with the tests and stand more chance of obtaining the ceiling effect. The fact that disadvantaged students scored higher scores in learning potential indicates that the complexity of the test might have been more appropriate to this group of students.

The problem of pitching a pre-test at an inappropriate level is that it has a demotivating effect on high-scoring students. If they already have mastered the skills necessary for solving test items, the mediation period becomes superfluous and in some cases counter-productive.

4.2.5 Unreliability of improvement scores

The reliability of difference scores used in dynamic testing can present a problem. Lord (1963) pointed out that large individual differences in improvement are particularly likely when the pre-test and post-test have large measurement errors. Many tests used in dynamic testing contain items which are heterogeneous causing the internal reliability of the test to be low. The lower the internal reliability of the test, the higher its error of measurement. McNemar (1969: 850) found that even when there is no average change in score levels, the low scorers tend to gain while the high scorers tend to lose. This phenomenon arises because the improvement scores move toward the mean. This confounds the interpretation of improvement scores and points to the necessity of developing tests which ensure large difference scores between pre and post-test administrations.

4.2.6 Time and labour intensive

Most of the initial attempts at dynamic assessment were done within a clinical framework. The testing is done in a one-to-one situation involving intense mediation with graded prompts and detailed intervention. This involves a great deal of time and requires well-trained mediators. Feuerstein (1980) argues that effective mediation and testing per testee necessitates a tester/testee relationship of approximately twenty-five hours. The rationale of lengthy intervention is that the tester constantly monitors the testing relationship and grades the level of hints accordingly. If the testee can solve a

problem with minimal or no mediation, then a more difficult item is presented. The reduction in the number of hints the testee requires to solve each problem is used as an index of the child's learning speed.

In response to extended mediation, the degree of learning potential was described as the reduction in the number of hints the testee requires (Campione, Brown & Bryant, 1985: 110). However, it was found that disadvantaged learners required extensive prompting and often were unable to transfer learning to other similar items.

The problem of time and training of testers is even more pertinent in aptitude testing where group assessments take place. In such a situation it is essential that the testees are exposed to the same testing conditions. A major objective of aptitude testing is to predict for academic success, given the opportunity to benefit from good instruction in the domains prescribed for various courses of study. This means that the testing situation should simulate as far as possible the learning situation in academic institutions.

4.2.7 Difficulty in grading mediation

It is much easier to grade the difficulty of items in tests than it is to grade the merits of hints used in the mediation process. Many approaches to dynamic testing make inter-individual comparisons of testees in terms of the number of hints and prompts required by the testees (Burns, 1985). This places much emphasis on the ability of the mediator and can only be beneficial when there is much interaction between tester and testee.

This approach is useful when differentiating between children with specific cognitive deficits, however, it does not appear to be either suitable or practical for assessing differences in learning potential amongst the average school-going population.

4.2.8 Generalisability of learning across task domains

Most studies in dynamic testing have used tasks which involve some form of reasoning, generally either inductive or deductive. These tasks are far removed from classroom tasks or any academic domain. Some studies involving graduated prompting procedures have investigated dynamic assessment in the context of domain-specific skills (Carney & Cioffi, 1990; and Kletzien & Bednar, 1990). In most cases it has been found that the generalisability of results from such tasks is limited (Slonimsky and Turton, 1985). It might be true that these studies have succeeded in identifying the specific cognitive processes pertaining to a specific domain. However, the results are restricted to the repertoire of skills tapped within the focus of that particular area of testing.

A major concern in utilising dynamic testing tasks is the lack of evidence suggesting that the cognitive skills being tested are readily transferable to academic tasks. It has been argued that the focus on cognitive skills is not the same thing as the acquisition of knowledge in academic disciplines (Slonimsky & Turton, 1985: 62). Ferrara, Brown & Campione (1986) conclude that the effects of dynamic testing across different academic domains remain unexplored.

4.2.9 Generalisability to normal student populations

Most dynamic testing procedures have been used with low performing and special education students (Campione & Brown, 1987; Carlson & Wiedl, 1980; and Feuerstein, 1979). Dynamic testing has also been extended to students with limited English-speaking ability and students from different racial backgrounds (Budoff, 1987). Students with learning problems have been the focus of many studies using the methods of dynamic testing (Budoff, 1987; Carlson, 1983; and Ferrara et al, 1986). Feuerstein, in particular, has targeted disadvantaged populations (Feuerstein, Miller & Jensen, 1981; and Feuerstein, Rand, Hoffman & Miller, 1980). Inroads have been made into dynamic testing of the deaf, (Katz & Bucholz, 1984) and in the disadvantaged gifted (Skuy, Kaniel & Tzuriel, 1987). However, no studies have successfully documented the procedures of dynamic testing as applied to groups of students who fall within the average range of intellectual functioning.

4.3 Theoretical basis of the Construction of the Group Dynamic Test Battery (Newtest)

The previous section accumulated sufficient evidence in contemporary approaches to dynamic testing to justify serious misgivings with the implementation of any one approach to group aptitude testing. This reservation is even more marked when the assessment context is at tertiary level dealing with students of average to superior levels of manifest intellectual functioning.

In fact there has been a paucity of research done in assessing the merits of dynamic testing at tertiary level. Shochet (1986) made some preliminary inroads into the aforementioned problem areas. The domain of group aptitude testing using dynamic testing principles appears to be a completely new area of exploration.

The author has conducted research into alternative selection procedures at university level (Zolezzi, 1992) and concluded that educationally disadvantaged students were modifiable and could be predicted for academic success based on a learning potential testing procedure. However, in order to overcome the misgivings pronounced earlier and modify the testing approach, it was necessary to incorporate the work of three main theorists into a comprehensive framework specifically relating to aptitude testing at university level.

Accordingly, the work of Budoff in the area of standardised dynamic testing will be explored. Thereafter, the contribution of Ferrara regarding domain-specific dynamic testing will be evaluated. Finally, the Feuersteinian approach to the testing situation will be discussed. The confluence of the work done by the aforementioned theorists provides the basis for the construction of the Newtest.

4.3.1 Budoff and Standardised Dynamic Testing

Budoff developed learning potential assessment embedded in a test-train-retest sequence. The approach used involves a pre-post design with a standardised instructional component interspersed. The testee initially attempts reasoning problems in a traditional format. Subsequently, either in a group or alone, the testee is given assistance through problem-relevant training. The testee is re-tested thereby revealing a learning potential measure defined by the pre-to-post gain score.

Budoff originally distinguished between gainers and non-gainers. The former group showed substantial pre-to-post test gain, while the latter group improved very little. However, more recent work of Budoff (1987) has refined the interpretation of improved scores. The pretraining scores reflect the present functioning ability of the child, and the scores correlate with verbal and non-verbal intellectual quotients. Thus, depending on the assessment instrument, a measure is obtained of current numerical reasoning, for instance, when an Arithmetical Reasoning test is used in its traditional form.

The post-training score reflects the effect of training. Following suitable training, many children with initially low current intellectual functioning, function at a level similar to the child from more advantaged circumstances (Corman & Budoff, 1973). This post-training score, regardless of the pretraining level, represents the testee's optimal level of performance following a period of training.

The relevance of Budoff to the present study is the employment of a standardised instructional component, and the modification of the traditional testing context. The emphasis is on facilitating performance by verbalising the solution choice after testees' make a choice so as to enhance understanding.

The post-training score is hypothesised to be related to performance on tasks that permit the testee to operate in areas of conceptual strength, as opposed to areas of weakness such as the verbal-conceptual domain to which traditional intellectual measures relate.

A drawback to this approach within the context of predicting for academic success, is the reliance on assessing general skills. The tests use content-independent processes. It is an important assertion of the writer that aptitude testing should be situated in the context of the major university areas such as

scientific and verbal reasoning. The testing and instruction should be more domain-specific so as to assess with more confidence the skills necessary for success in various domains. The work of Ferrara is particularly apt in this regard.

4.3.2 Ferrara and Domain-specific skills

Ferrara (1987) extended the work of Budoff by incorporating learning transfer in the mediation phase of testing. When the testee encountered problems during mediation, the tester provided a sequence of hints or suggestions about how to proceed.

Following this, Ferrara presented a variety of transfer problems in the same interactive, assisted format. The testee is required to apply the procedures learnt originally to a variety of problems that differed in systematic ways from those worked on initially. The assistance given to testees is structured to facilitate transfer of learning from earlier items to more difficult items later encountered in testing.

The inclusion of a transfer component in mediation distinguishes students who can use only what they were taught originally from those who because they understand principles, can go beyond the specific problem types they have practised.

In her PhD thesis, Ferrara (1987) administered a post-test after the learning and transfer phase. The aim was to determine how much the testee has learned during the assistance period. The finding was that the dynamic scores, measured as the gain from pre-to-post test, were better predictors of gain than were the static knowledge and ability scores. Further, in a hierarchical regression analysis, although the static scores, when extracted, first did account for 22.2% of the variance in gain scores, addition of the dynamic scores accounted for an additional 33.7% of the variance, with transfer performance accounting for 32% of the variance.

The contribution of Ferrara to the present study is the importance of structuring the mediation phase to facilitate learning of principles which leads to understanding and flexible thinking.

By implication, the tests used in dynamic testing should be constructed in such a way that previous experience relates to subsequent experience. It is to Feuerstein whom we now turn for input on the testing situation, given the context of a group administration using standardised assistance in domain-specific skills.

4.3.3 Feuerstein and the modification of the test situation

While both Budoff and Ferrara informed the present study of the need to standardise mediation in a systematic format, further work was required to modify both the instrumentation and test situation in order to accomplish the goal of creating a new aptitude test procedure.

Feuerstein believed that assessment should be a dynamic 'assessment of modifiability through focused learning' (1979), hence his concept of the Learning Potential Assessment Device (LPAD). In service of this goal, Feuerstein developed a 'Cognitive Map', an 'LPAD model' and a number of criteria involved in the provision of mediation during dynamic assessment. Although alluded to in a previous section, this section will elaborate on his ideas and their application to group testing.

4.3.3.1 The Cognitive Map

The present study used Feuerstein's cognitive map (Appendix 4) as a model from which to operationalise the testing procedures. The map consists of a number of parameters which dictate the development of the prerequisite cognitive structures that would be necessary for academic success.

The parameters are: content, modality, operation, levels of complexity, levels of abstraction, level of efficiency and phase. The latter refers to a functional location within a mental act comprising an input, elaboration and output phase (Appendix 26). Failure to perform adequately on a particular task may be attributed to a deficiency that predominates in a particular phase.

The cognitive functions are in service of the basic cognitive operations such as classification, reasoning by analogy, syllogistic reasoning, etc. Feuerstein (1979, 1980) also recognised that problem-solving tasks are presented in a variety of modes, such as verbal, pictorial, numerical and figural, or a combination thereof. Any task presented in a particular modality, consisting of a particular operation, can vary according to its level of complexity predicated on the units of information involved. Additional factors in the cognitive map are the level of abstraction and level of efficiency which describe the distance between the given mental act and the object upon which it operates. Finally, the content of testing must be carefully assessed in terms of familiarity so as to focus on the cognitive operations that are the target of testing.

4.3.3.2 The LPAD Model

Based on an understanding of the cognitive map, the LPAD approach involves changes in the construction of tasks and in the administration in the testing situation. Appendix 24 outlines the possibilities of presenting tasks in terms of the parameters of the cognitive map. Feuerstein points out that to achieve the goals of dynamic assessment requires changes in the examiner-examinee

relationship, as well as the introduction of a training process as an integral part of the LPAD system. The tester is required to be neutral and present standardised instructions. In addition, the tester sums up experiences and creates reflective insightful thinking in the testee (Feuerstein, 1980).

This interactive testing context increases the examinee's motivation by developing a positive approach to problem-solving. There is an increased mastery of tasks, especially when the sequence of tasks follows the LPAD model of progressively increasing difficulty. This shift in motivation, achieved by assigning meaningfulness, will not alone suffice to make the testee's problem-solving behaviour the most efficient possible. It is also necessary to train the testee through mediation to select appropriate behaviour necessary for success (Feuerstein, 1980).

Feuerstein (1979) isolates five areas involved in the training processes:

1. Regulation of behaviour through inhibition and control of impulsivity.
2. Improvement of deficient cognitive functions.
3. Enrichment of the repertoire of operations.
4. Enrichment of content.
5. Creation of reflective, insightful thought processes.

The mediation phase is further refined by adopting further criteria in the training process (Appendix 25).

The Feuersteinian principles have important implications for the present study. Firstly, they inform the sequencing and structuring of test materials. Secondly, the important factors in mediation are spelled out, calling for appropriate use of visual aids.

4.4 Choosing the tests

Within the aforementioned theoretical framework, a new dynamic group testing battery was developed which adhered to the following guiding principles:

1. The tests should be time and cost efficient.
2. The tests should each measure the same basic operations within the same modalities. This will enable the mediation to have an influence on retesting.
3. Learning acquired through earlier items should facilitate the testee's capacity to solve subsequent items.
4. All testees should be presented with equivalent opportunities to demonstrate learning potential.
5. There should be separate testing and training phases in which to assess the degree of improvement resulting from mediation.

6. The training phase should be standardised so as to afford equal opportunity to all testees to benefit from instruction.
7. The tests should be at an appropriate level of complexity normed on university students for the purposes of the present study.
8. The tests should be shown to be reliable to as to demonstrate that increases in scores arising from training are not explained by random fluctuations.
9. The tests should be valid predictors of university success. Each test should assess the prerequisite skills necessary for success within the various academic domains.

The two tests chosen to constitute the Newtest Battery were the Deductive Reasoning Test and the Pattern Relations Test, both developed by the Human Sciences Research Council. They both appear to adhere to the principles outlined above. Furthermore, the writer had reported promising results using the tests for selection at university across the spectrum of disadvantaged and advantaged students (Zolezzi, 1992).

4.4.1 The Deductive Reasoning Test

The Deductive Reasoning Test is fully described in Chapter 5. Feuerstein (1980) considers syllogistic reasoning to be an important operation and a pre-requisite for academic success.

In terms of the Cognitive Map (Appendix 24), this test is internally consistent using the verbal modality. The operation used is syllogistic reasoning. Success in the Human Sciences requires the ability to reason deductively using the verbal modality.

The reliability of this test is 0.919 (Verster, 1973) using the KR21 formula. Furthermore, it appears to be at the appropriate level of complexity, normed on advantaged graduate students.

4.4.2 The Pattern Relations Test

This test is also discussed in the following chapter. Feuerstein (1979) regards inductive reasoning as operationalised in Raven's Matrices as an important constituent of academic success. The Pattern Relations Test is similar to the Raven's, but is more complex.

An analysis of this test in terms of the cognitive map suggests that it is internally consistent utilising the figural modality. The operation used is inductive thinking. According to Sternberg and Gardner (1982) inductive reasoning scores intercorrelate highly. Rutherford and Watson (1991) found inductive reasoning to be a useful measure of success in the Natural Sciences.

The Pattern Relations Test appears at the appropriate level of complexity, normed on First Year advantaged students. The reliability of the test is 0.812 (Shochet, 1986), using the KR21 formula.

The tests are both easy to administer in a group and are reliable complex tests which will not produce a ceiling effect after the first administration. Furthermore, each test uses a consistent modality and operation which facilitates learning of earlier items to be transferred to later items (Zolezzi, 1992).

Finally both tests appear to measure the pre-requisite skills necessary for success in the various academic domains.

4.5 Standardising the Mediation

Given that the two tests appeared to satisfy the guiding principles previously mentioned, it became imperative to carry this consistency through to the training situation. It has been mentioned that the primary guideline for mediating is the standardisation of the process so as to avoid subjective influences arising from the tester-testee relationship. Feuerstein's (1980) criteria for mediation (Appendix 26) were useful in laying the foundation for effective mediation:

1. there must be *intention* to mediate.
2. mediation must *transcend* the testing situation and facilitate broader learning.
3. there should be mediation of *meaning* in the stimuli presented.
4. mediation must attempt to *regulate the behaviour* of testees by inhibiting impulsivity.
5. there should be an attempt to transmit a sense of *competence* to the students.
6. mediation should encourage the testee to *challenge* new tasks with confidence.

These criteria were incorporated into the mediation process and consistently used throughout. However, the writer found it necessary to standardise mediation more effectively by using visual transparencies outlining the principles clearly in a logical format. This is fully in line with the Feuersteinian guidelines to mediation for the following reasons:

1. it provided all students with repeated experiences of certain operations.
2. it encouraged reflective insight by summing up earlier learning and inhibiting impulsive thinking.
3. the mediator modelled appropriate problem-solving behaviour.

The writer identified the key cognitive operations required for success in each test (Appendices 5 & 6), and systematically laid down the rules pertaining to each test.

After administration of the traditional form of each test there was a short break followed by mediation. This period was preceded by a short explanation outlining the new testing situation. This is fully explained in Chapter 6. Each testee received a written copy of the mediation process (Appendices 10 & 11). Thus the whole process was standardised while at the same time allowing for effective tester-testee interaction according to Feuersteinian principles.

Most mediators found that the mediation process required 15 to 20 minutes. This satisfied the principle of being cost and time efficient. Each mediator was trained to be objective by sticking to the transcripts and avoiding discussion. The mediation process was followed by a readministration of the test so as to be in a position to assess improvement in learning.

4.6 Operationalising Learning Potential

The Feuersteinian model was adopted to distinguish between current levels of functioning and potential functioning.

The present study distinguishes more specifically the current levels of functioning in the areas of deductive and inductive reasoning. The Deductive Reasoning Test in its traditional form, measures current deductive reasoning, and the Pattern Relations Traditional Form assesses current inductive reasoning.

On the second attempt (following mediation), the same tests would provide a measure of potential functioning in their respective domains. Thus, for purposes of the present study, potential functioning is operationally defined as the testee's raw score on the second administration after the period of mediation.

Learning potential then becomes the difference between the initial raw score on the first attempt, and the raw score on the second attempt. Again, to be more specific, the second score in the Deductive Reasoning Test is a measure of potential functioning in Deductive Reasoning. By extension, the difference between the score and the initial score is the learning potential in Deductive Reasoning. Likewise, this operationalisation applies to learning potential in Inductive reasoning.

4.7 Modifying the Tests

It was necessary to modify the second administration of the Pattern Relations Test to facilitate meaningful mediation.

Items were reclustered to allow for transfer of learning. Items with similar methods of solution were grouped together. This regrouping aided mediation of rules ensuring generalisation of principles learnt to later items. The number of items remained the same, but the format was altered accordingly (Appendix 22). This modification was not required for the Deductive Reasoning Test which appeared to have an inherent consistency in item grouping.

The actual procedure followed using these two tests will be fully discussed in the following chapters. Chapter Five will deal with the actual empirical study and the variables of interest. Chapter six will outline the testing procedure and the concomitant testing conditions.

Chapter Five

Description of the Empirical Study

5.1 Introduction

The present study is aimed at the prediction of academic success. However, it departs from previous studies in that it compares traditional test measures with dynamic measures using a novel approach to testing. The predictor variables in the dynamic measures are based on a learning potential paradigm. This perspective as discussed in Chapters 3 and 4 represents a shift in the way aptitude testing is carried out. This approach focuses on the distinction between manifest or current ability functioning and potential ability functioning. Another key distinction is the assessment of students from different educational backgrounds.

This chapter therefore is devoted to a discussion of the research design, the sample, subject variables, the predictor variables and the criterion variables in accordance with dynamic principles of testing.

As argued earlier, the dynamic approach used in the present study attempts to combine the best features of a standardised (quantitative data) and clinical (qualitative descriptions) assessment procedures in a single package. The primary concern is to increase the predictive validity of the assessment process by working within the context of specific abilities. The assumption is that testing conducted at this level will provide information about different student populations across a number of situations.

For purposes of the present study, student refers to a prospective university level student who is currently completing the Matriculation year of schooling.

5.2 The Design

The design will involve testing two different groups of subjects using two contrasting methods of assessment. Subjects will be tested on a number of predictor variables which will then be analysed in terms of the relationship of these variables with academic success (criterion variables). Criterion measures of success (University results) will be obtained after one year of study. Furthermore, the two groups will each be composed of students coming from various levels of educational background. The level of educational disadvantage will constitute the subject variable for purposes of the study. The subjects, subject variables, predictor variables and criterion variables will each be discussed in later sections.

The fundamental aim of the present study is to determine the relationship between two different methods of testing and subsequent performance in university examinations. This is a nomothetic approach in that it will use a number of predictor variables which are isolated in terms of the study. The relationship between these predictor variables and the variables measuring the criterion of achievement will form the main part of research. It is then an aim of the study to demonstrate that there is a stronger relationship between dynamic test scores and academic achievement at university, than between traditional test scores and university results. Nomothetic inquiry also suggests that the unique meaning-constructs of the subjects in question be forfeited for the sake of the generality of the concepts. Thus the methodology of this research study focuses on groups of students within an objective testing situation. This is in contrast to an idiographic approach which would make use of extensive inquiry into the multitude of factors which might contribute to academic success of a single student. The nomothetic approach is the method of choice because the researcher will focus on groups of students, isolating and comparing two different ways of testing students.

The researcher acknowledges the fact that non-cognitive factors such as personality, attitudes, motivation and study habits are involved in performance at university. However, it is beyond the scope of the present study to examine the vast literature and empirical data which have correlated non-cognitive predictor variables with academic success.

5.3 The Sample

The sample of the present study consists of 50 matriculation students who will be designated 'students', and who then subsequently registered for first year university studies in their Faculty of choice. These students come from different educational backgrounds and the categorisation of students into two distinct groups will be discussed in the following section.

The study will take place over a period of three years. During Year One 18 students (the Traditional Testing Group) will undergo the conventional testing procedure. During Year Two, this group will be monitored at first-year university level and year-end marks obtained. Concurrently, Year Two will also involve another group of 32 students (The Dynamic Testing Group) who will undergo the dynamic testing procedure. Year Three will see them into their first year university studies and the ultimate collection of data in the form of Year-end results.

Most of the students attended the testing sessions voluntarily. It stands to reason that the group of students would be fairly motivated to achieve at university, seeing that they take the time and expense to seek assessments for study choice. Entwistle (1977: 232) has alerted researchers to the problems in obtaining a representative sample for tertiary academic prediction studies. The major drawback being that most often the sample is self-selected because it relies on volunteers, who are generally

more motivated than most students to achieve at university. The present study attempts to redress this imbalance by allowing for a proportion of students who were non-volunteers. Allowance was made for students from certain geographic areas to be incorporated into the whole experimental sample, irrespective of whether they wanted to go to University, or not, or whether they attained the prerequisite university Points Entrance or not. Certain schools were given a quota of students to send for testing who did not meet the entry level for University based on their Standard Nine marks. This group of students representing roughly 15% of the sample were thus compelled to undergo the testing procedures. The remainder of the sample constituted of volunteer subjects.

The subjects thus consist of a sample of N=50 students from different educational backgrounds. They are all registered for the first time in various faculties at the University of the Witwatersrand. *Table 4* shows the Faculty distribution for the sample.

Table 4

Distribution of sample by Faculty

Faculty	N = 50	%
Arts (BA)	18	36
Commerce (BComm)	13	26
Science (BSc)	19	38

Table 5 shows the distribution of sample by sex, and *Table 6* clarifies the age distribution of the sample. As neither age nor sex is taken into account in selection decisions at the University of the Witwatersrand, neither of these variables are included as predictor variables in the present study.

Table 5

Distribution of sample by Sex

Female		Male	
N=	%	N=	%
28	56	22	44

This table indicates that there are slightly more females than males in the sample. This is, however, in keeping with the general sex distribution in the overall population of students in the Faculties covered by the study.

Table 6

Distribution of Sample by Age

Age	N=	%
16	12	24
17	18	36
18	15	30
19	4	8
20	1	2

The age distribution reveals that the majority of students fall in the 17 and 18 year range. Again, this approximates the overall distributions in the Faculties concerned.

The sample is also distributed across different educational backgrounds. However, for specific purposes of the present study, this categorisation of the sample will form a variable which will be correlated with university success.

5.4 The Subject Variables

As has been mentioned, the present study compares two different methods of testing across a population of students. The study will make use of two contrasting testing procedures because it is the main contention of this research that students from different educational backgrounds should be given an opportunity during the testing process to perform to their true potential, given the necessary assistance to make up for disadvantages in educational experiences (Murray, 1988; Shochet, 1986; and Zolezzi 1992). Accordingly, an alternative testing procedure is introduced, incorporating enrichment for all students. Thus it is significant to differentiate amongst the sample, those students from disadvantaged backgrounds who purportedly might benefit most from the introduction of an element of teaching into the testing procedure. The students will be categorised into two levels of educational disadvantage, namely advantaged (ADV), and disadvantaged (DISADV).

For purposes of the present study the disadvantaged students will be categorised as those who are schooled under the Black education authorities. The per capita expenditure on DISADV is far less than that for students educated under white education authorities or private schools. Advantaged students will be categorised into the latter group. Table 7 differentiates the subject variables according to faculty and sex.

Table 7*Distribution of subject variables by Faculty and Sex.*

	ADV		DISADV	
	Female	Male	Female	Male
Art	7	5	5	1
Commerce	5	5	2	1
Science	4	8	5	2
	16	18	12	4

over both years

It is an important contention of the present study that the categorisation of students according to level of educational advantage leads to differences in prediction of academic success.

The DISADV are disadvantaged in that they received an inferior schooling when compared to students who are schooled under the White authorities. Between the educational systems, there are gross inequalities in financial provision for the different groups. The racial inequalities are illustrated in Table 8 below (Survey of Race Relations in South Africa, 1990).

Table 8*Comparative Education Statistics 1990*

	White Education	African Education (DET)	Coloured Education	Indian Education
Std 10 pass rate	96%	40%	72%	93%
Per capita expenditure	R3082	R764	R1359	R2227
Underqualified teachers (less than matric plus a 3-year qualification)	0%	52%	45%	2%
Pupil-teacher ratios	17:1	38:1	23:1	20:1

For the DISADV groups the teaching process tends to emphasise child compliance and requires passive recall of information rather than application of knowledge or analytical and creative problem-solving (Donald & Hlongwane, 1989). Furthermore, curricula in all schools reflect the views of the South African minority group. The imposition of educational and cultural ideals is seen by many as social engineering (Csapo, 1986).

The concept of DISADV is relative in that the advantaged students are not all white students. This is because a black student who attended a private school falls into the ADV category. Table 9 outlines the two different groups according to the categorisation of level of disadvantage.

Table 9

Summary of subjects according to categorisation of disadvantage

	Total	ADV	%	DISADV	%
1992					
Traditional group	n=18	n=12	67	n=6	33
1993					
Newtest Group	n=32	n=22	69	n=10	31
	n=50	n=34	68	n=16	32

The subjects thus consist of a sample of n=50 students who were in Matric and sought testing at the CCU. The first group of subjects (1992, traditional) then enrolled at the University of the Witwatersrand at the beginning of 1993. Likewise, the second group (1993, Dynamic) registered in 1994 at the University of the Witwatersrand. These two groups will then be compared according to the different predictor variables adopted for the study.

5.5 The Predictor Variables : Traditional

The 1992 traditional group will undergo a battery of traditional tests which will include the High Level Battery (B/75) sub-tests Mental Alertness and Reading Comprehension, Standard Level Arithmetic Reasoning Test (A/131) and the Raven's Matrices (1958). In addition, school results will form part of the traditional measures. Each of these measures will now be discussed in turn.

It is important to keep in mind the fact that the above measures will all administered in the traditional format without assistance. The testees will be required to complete the tests within the prescribed time allocations under strict examination conditions.

5.5.1 School results

The admissions criteria employed by many tertiary institutions generally includes school marks. Thus it was crucial to include this variable in the present study, as it is considered by many universities to be a good predictor of academic success. Furthermore, this measure becomes pertinent to the study in that it proposes that school marks are not useful predictors of success for DISADV students.

For the purposes of this study, it was decided to be consistent with university policy and to use the Matric rating scale used at the University of the Witwatersrand. The school results are converted using the symbols obtained by each student. The rating scale at the University of the Witwatersrand is calculated as follows:

Table 10
Matric rating conversion scale

Symbol	Value	
	Higher Grade	Standard Grade
A	8	6
B	7	5
C	6	4
D	4	2
E	3	1
F	2	-
G	1	-

To obtain the school mark rating of each student the values are summed up. The marks are based on the Standard 9 Final results.

5.5.2 Mental alertness B/75

In accordance with traditional approaches to aptitude testing (Chapter 2), the present study will include two sub-tests of a traditional aptitude test within the group of traditional predictor variables. The test to be used is the High Level Battery developed by the NIPR. The High Level Battery is intended for persons with matriculation, an equivalent qualification or a higher qualification. It comprises the following six multiple-choice paper-and-pencil tests: mental alertness, arithmetical problems, English vocabulary, English reading comprehension, Afrikaans reading comprehension, and Afrikaans vocabulary.

As separate norms have been developed for the sub-tests, each test can be administered independently of the others. The Mental Alertness sub-test is described as a measure of general intelligence (Wilcocks, 1973). Thus this test allows for the assessment of intelligence using norms based on vocational guidance students who are mostly in standard 10. The test comprises verbal analogies, classification of abstract concepts, numerical and letter series, etc. The test items are of the multiple-choice type and uses 42 items with a time limit of 45 minutes.

The raw scores will be used in the present study.

5.5.3 Reading Comprehension

The Reading Comprehension sub-test of the High Level Battery will be used to assess the verbal ability of students, whereas the Mental Alertness sub-test taps the g factor of intelligence (Chapter 2), this sub-test would lead to a measure of verbal ability according to Vernon (Chapter 2).

The content of the test is based on four English passages, each of which is followed by five questions relating to the passage. The time limit is 20 minutes. The test is appropriate as academic success at the University of the Witwatersrand requires an appropriate level of proficiency in the English language.

This test is widely used in aptitude testing and is regarded as a measure of verbal ability (Wilcocks, 1973).

5.5.4 Arithmetic reasoning

According to traditional intelligence theory (Chapter 2), arithmetical reasoning has been seen as an important group factor of intelligence. Thus the standard level Arithmetic Reasoning Test (A/131) will be used to tap this ability.

This is a test of the ability to reason in a numerical domain. Although the test presumes the testee to have existing knowledge of fundamental arithmetic rules, he/she does not have to be highly skilful in performing large computations accurately and quickly. The test comprises 30 items requiring a completion time of 35 minutes.

The test has been used to select Black students for Science and Engineering courses at University level (Rutherford & Watson, 1991). It has also been used successfully in predicting the performance of White students in a number of technical subjects such as Computer Science and Mathematics at Technikon level (Ord, 1972).

5.5.5 Raven's matrices

This test was developed and validated by Raven as a measure of non-verbal reasoning. It is frequently used as a measure of inductive reasoning and non-verbal ability (Feuerstein, 1979; and Shochet, 1986).

The test consists of 36 items from each of which a part is omitted. The subject is required to choose the missing part from eight given figures. The test has a time limit of 20 minutes.

5.6 The Predictor Variables : Dynamic Test Battery (Newtest)

The format of the Dynamic Test Battery (Newtest) was fully discussed in Chapter 4. However, for purposes of the present study the first administrations of each of the chosen tests are considered traditional measures. Both the Deductive Reasoning and Pattern relations are initially administered under traditional testing conditions. They therefore form part of the traditional predictor variables. Each of these two tests will now be discussed in their traditional forms (no assistance given during testing).

5.6.1 Deductive Reasoning

The Deductive Reasoning Test (B/112) developed by Dr J M Verster (1973) is based on the principles of formal logic. According to Verster (1973) the test examines the relationship between premises and conclusions of a valid argument.

The test is based on verbal nonsense syllogisms in which the testee has deduced the correct answer from five possibilities. The process of deduction is described by Evans (1982) as the reasoning from the general to the particular. An example is listed below:

- ITEM: No bookkeepers are searchlights
 Some chimneypots are searchlights
- Therefore: A No chimneypots are bookkeepers
 B Not all searchlights are chimneypots
 C No bookkeepers are chimneypots
 D Some chimneypots are not bookkeepers
 E Some bookkeepers are not chimneypots.

See appendices 17,18 and 19 for the instructions of the test in its traditional form, for samples of items of the Deductive Reasoning Test, and the blank answer sheet given to testees in both the traditional and dynamic forms.

5.6.2 Pattern relations

The Pattern Relations test is similar in structure to the Raven's Progressive Matrices. It is a test of inductive reasoning. This process is contrasted with deduction. Evans and Waites (1981) elaborate that inductive reasoning leads from the particular to the general. Whereas Deductive Reasoning is syllogistic reasoning, inductive reasoning is reasoning by analogy.

The Pattern Relations test consists of 30 items containing a matrix governed by a particular set of rules.

The last figure of the matrix is left blank. The testee is required to select from six alternatives what the appropriate figure should be. This figure should logically complete the pattern and be consistent with the rule governing the particular matrix. The format of the test introduces easier items to very complex items toward the end of the test.

Appendices 20, 21 and 22 give details of test instruction, sample items and the answer sheet used in the traditional administration of the Pattern Relations test.

For purposes of clarity it might be useful to summarise the traditional predictor variables. Table 11 outlines the construct (explained in Chapter 4) and relates it to the predictor variable.

Table 11

Summary of predictor variables : Traditional

Predictor Variable	Construct
1. School Marks (MAT)	Current scholastic ability
2. Mental Alertness (MA)	Current intellectual ability
3. Reading Comprehension (RC)	Current verbal ability
4. Arithmetical Reasoning (AR)	Current numerical reasoning ability
5. Raven's Matrices (RM)	Current non-verbal ability
6. Deductive Reasoning Traditional (DR/T)	Current deductive reasoning ability
7. Pattern Relations Traditional (PR/T)	Current inductive reasoning ability

The traditional contention in aptitude testing has been that school marks show a relationship with success at university (Entwhistle, 1984; and McDonnell 1975). More specifically, Mental Alertness scores also show a relationship with academic achievement at University (Zolezzi, 1990). For purposes of selection into the Science and Commerce Faculties, traditional scores in Arithmetical Reasoning, Raven's Matrices, and Pattern Relations might demonstrate a relationship with scores in those Faculties. Deductive Reasoning scores and Reading Comprehension might show correlations with success in the Arts and Education Faculties. The aforementioned tenets have provided the underlying rationale for continued use of traditional aptitude tests.

Thus the traditional assumption in using conventional aptitude testing is that the single administration of the chosen tests, albeit, intellectual or aptitude, is sufficient to predict success at University level. As has been vociferously argued in the present study, this assumption is unfounded and needs to be replaced with a proposition that suggests that double administrations be used which utilise a period of teaching. The latter scores would be dynamic measures and show a stronger relationship than traditional measures to results at the University level.

5.6.3 Dynamic measures

Chapter 4 fully outlines the dynamic tests and the features which modify the testing procedure so as to bring about a measure of potential ability. Thus, the predictor variables will also include two measures of dynamic testing: Deductive Reasoning Enriched (DR/E) and the Pattern Relations Enriched (PR/E). For purposes of completeness, Table 12 outlines the dynamic measures and their related constructs.

Table 12

Summary of Predictor variables : Dynamic

Predictor Variable	Construct
1. Deductive Reasoning Enriched (DR/E)	Potential deductive reasoning ability
2. Pattern Relations Enriched (PR/E)	Potential inductive reasoning ability

The present study proposes that the measures of potential ability show a higher correlation to university success for Disadvantaged students than do measures of traditional testing.

5.7 The Criterion Variables

The criterion measures for university success in this study are based on the University of the Witwatersrand evaluation procedures. The Year-End Examination results will be used for each group of students. The rationale being that a year of exposure to good academic teaching should elicit the true potential functioning of all students. Thus, all students, including the DISADV students will have had long enough time to assimilate the benefits of good mediation. Each student will therefore obtain a year-end mark which will be the average obtained in the Final Examinations.

The study is fundamentally an examination of academic success within the framework of vocational counselling. The implication is that different cognitive skills correlate with different courses. Previous studies (Culverwell, 1989; Rutherford & Watson, 1991; and Shochet, 1986) suggest that cognitive skills necessary for success in the Sciences are different to those required for success in the Arts courses.

In view of the above, criterion measures will be obtained after 12 months (when students write their year-end exams). The measures will be separated by Faculty: Arts, Commerce and Science. Chapter 2 described how traditional aptitude testing implies a correlation between certain traditional measures and success within certain faculties. For example, the assumption that high scores in current non-

verbal ability will lead to success in the Sciences. Therefore, it is necessary to compare the traditional and dynamic groups on the basis of success in the aforementioned courses of study. Table 13 summarises the criterion variables.

Table 13

Summary of criterion variables

Criterion variable (November Exam)	Construct
B Sc Subject marks (Bsc)	Scientific ability
B Com Subject marks (Bcom)	Commercial ability
B A Subject marks (BA)	Social science ability

A proposal suggested in the present study is that those subjects which require scientific ability will show a relationship with the PR/E scores and those subjects requiring social science ability will show a relationship with DR/E scores. Moreover, this relationship will be stronger than that indicated by traditional measures. Commercial subjects will show a combination of scientific and social science abilities. The PR/E and DR/E measures will enhance the predictive validity of the traditional formats of the tests by incorporating an element of skills training.

We have thus far moved from a discussion of subjects, subject variables and predictor variables to a discussion of criterion measures which will be used in the present study. Table 14 is a summary of the empirical study. Chapter 6 will further elucidate how the researcher conducted the actual study and will describe the testing sequence and testing conditions as well as the data collection and ensuing results of testing.

Table 14*Summary of the Empirical study*

Experimental Group	Subject Variables	Predictor Variables	Criterion Variables
1992 Traditional Group (N=18)	Advantaged students (N=12)	School marks (MAT) Mental Alertness (MA) Reading Comprehension (RC) Arithmetical Reasoning (AR)	1993 BSc year-end marks 1993 BCom year-end marks 1993 BA year-end marks
	Disadvantaged students (N=6)	Raven's Matrices (RM) Deductive Reasoning Traditional (DR/T) Inductive Reasoning Traditional (PR/T)	
1993 Dynamic Group (N=32)	Advantaged students (N=22)	Deductive Reasoning Enriched (DR/E) Inductive Reasoning Enriched (PR/E)	1994 BSc year-end marks 1994 BCom year-end marks 1994 BA year-end marks
	Disadvantaged students (N=10)		

Chapter 6

The Empirical Testing Procedure and Results

The present study is primarily a predictive approach involving testing subjects (who are distinguished by a subject variable) on a number of predictor variables, then assessing the relationship of these variables with academic success at university (criterion variables). The subjects, predictor variables and criterion variables were fully discussed in the previous chapter.

This chapter is devoted to an overview of the testing procedure and testing sequence, as well as the materials used in each phase of testing. The testing condition will then be discussed. In addition, a restatement of the hypotheses will be given, leading to an examination of the results pertaining to these hypotheses.

6.1 The Testing Procedures

In this section, a general overview of aptitude testing in the Counselling and Careers Unit (CCU) at the University of the Witwatersrand (Wits) will be discussed. The overview will include the training of mediators. A large part of the detailed procedures, especially in relation to the dynamic testing condition, have already been discussed in Chapter 4.

6.1.1 Aptitude testing in the CCU: Traditional Approach

Traditional aptitude testing was carried out during 1992. Prospective University of Witwatersrand students applied for the programme. Generally, these students came from traditional feeder areas and consisted of current matric pupils. On application, the prospective students were sent a Biographical Questionnaire and committed themselves to a 3 hour Saturday morning testing session. The training of administrators for these sessions presented no problem as all the CCU testing staff were all highly trained in psychometric testing. The information from these testing sessions as well as that from the Biographical Questionnaire were fed back to each prospective student at a follow-up one-to-one interview.

6.1.2 Aptitude Testing in the CCU: Dynamic Approach (Newtest)

Dynamic testing was carried out during 1993. A concerted attempt was made to recruit more prospective students from educationally disadvantaged backgrounds. With this purpose in mind, a workshop was organised at the CCU to explain the new testing programme to Guidance teachers and Career Counsellors within educationally disadvantaged communities. Appendices 7,8 and 9 outline

the handouts used during this workshop. As a result of the workshop, there was an increase in the number of applicants wanting to make use of the new testing programme.

It was necessary to retrain the CCU staff in the new testing procedure. The writer had to convince the CCU staff of the need for alternative testing. Accordingly, proposals had to be submitted outlining proposed modifications to the existing programme (Appendix 1) as well as an intended period of training for existing testers (Appendix 2). These proposals were favourably received by all CCU staff and the way was set for the introduction of dynamic testing in 1994.

Six members of the CCU staff attended the training workshop outlined in Appendix 14. The workshop covered the rationale of dynamic testing and addressed the theoretical underpinnings of mediated testing. A major part of training involved using the traditional tests dynamically. Each mediator was given an opportunity to do the appropriate test in its traditional form. A period of mediation led by the writer followed. Allowance was given for hint-taking and appropriate prompting. Thereafter, each mediator completed the enriched test. The objective of this exercise was for each mediator to experience first-hand the changes in testing condition, and be given the opportunity to look at the various cognitive skills assessed in the relevant tests. In addition, the interpretation of the dynamic tests required a module of training time (Appendix 13).

A Pilot group of 10 students were recruited from a local High School to undergo the first testing session in the dynamic format. The writer conducted this session which was attended by all the CCU staff. At the conclusion of testing, all the testees were given an evaluation questionnaire (Appendix 15). This will be discussed in the results section which follows in chapter 7.

6.2 The testing Sequence and Materials

The testing sessions each extended over a period of a year. The traditional measures were administered to the subjects at 5 different testing sessions. The testing group generally comprised 7 or 8 students. This traditional testing took place throughout 1992 at monthly testing occasions between March and July.

The Traditional Testing sessions lasted 2 hours 10 minutes. The testing sequence was as follows:

- | | |
|---|-----------------------|
| • Mental Alertness Sub-test (High Level Battery) | Duration : 45 minutes |
| • Reading Comprehension Sub-test (High Level Battery) | Duration : 20 minutes |
| • Break | Duration : 20 minutes |
| • Arithmetic Reasoning Test (Standard Level I) | Duration : 35 minutes |
| • Raven's Standard Progressive Matrices | Duration : 30 minutes |

Total testing time 130 minutes.

The Dynamic Test (Newtest) measures took place throughout 1993 at fortnightly testing sessions between April and September. These groups were smaller in size, comprising 5 or 6 students.

The Newtest sessions were 3 hours 45 minutes in duration. The format is outlined in Appendix 7. It is important to note that the dynamic testing was always preceded by a short explanation to the testees of the rationale underlying the new approach in testing. This preface to testing generally took the following form :

'First of all I would like to thank you for participating in our testing programme. You are going to be involved in a new approach to aptitude testing. This approach only involves two different types of tests. However, we will be using these tests in such a way that you are given the best opportunity in showing your true potential for each test. The tests will first be completed by you on your own without any assistance. Thereafter, we will have a period of coaching and learning which will assist you in solving the types of problems within each test. You will then complete the same tests. We believe that this procedure makes allowance for bringing out your learning potential and is essential in giving us additional information in your career choice. It is also important for you to realise that this testing session becomes a learning experience wherein we all attempt to become better problem-solvers.'

The testing administrator/mediator had the following materials:

Verbatim transcript of the Newtest enriched conditions (Appendices 10 and 11).

Overhead projector and screen.

Overhead projector transparencies of the appropriate graphics accompanying the Newtest.

The mediator then went through the enriched testing conditions as outlined in Appendix 8 and outlined in Chapter 4. The mediators for the Newtest were either the writer or trained graduate counsellors in psychology.

6.3 Testing Conditions

In order to control for extraneous testing interference a number of precautions were undertaken to ensure objective and uniform conditions in the test situation.

6.3.1 Ensuring consistency in the different testing groups

The study necessitated the testing of several small groups over a period of 2 years. It was imperative that all testees undergo testing with the same procedures in the same time sequence. The period of

mediation was standardised and a verbatim transcript utilised at each session (Appendices 10 and 11). Furthermore, the wall chart summarising rules (Appendix 16) was used to reinforce learning at the same testing session. All mediators followed the same forms of explanation in order to control for possible effects of different teaching styles. In addition, questioning was restricted to obviate different inputs of information.

6.3.2 Clarity of vision and hearing

During the period of mediation the students moved closer to the front in order to explore the visuals. They were seated in a half-circle ensuring clarity of vision and hearing. This was easily achieved as each testing group was very small in number.

6.3.3 Ensuring no copying or cheating during enriched testing

Students were placed in alternate rows in alternate seats during testing, thereby minimising the possibility of cheating. Clear and consistent instructions were given and the presence of an extra invigilator also acted as a deterrent. After mediation, all visuals were removed and transcripts collected so as to ensure that the enriched testing remain objective.

6.4 Statistics

The present study is a predictive study and the statistics of choice are that of correlation analyses. To investigate the relationships of both traditional measures and dynamic measure with academic success, Pearson Product Moment correlations will be computed, as both variables are continuous.

All significance levels in the study are set below the 0.05 level and based on 2-tailed assumptions.

6.5 Data Collection

During the 1992 academic year, all traditional tests were administered. The scoring of these tests was simple and in accordance with the testing manuals, no rating was required and the scoring was completely objective.

The test administrator's manual for all tests used, provided answers to items which were simply tallied. The raw scores of the tests were used in the traditional and enriched testing conditions.

In the dynamic format, the learning potential measure was simply the difference between the traditional score and enriched score in each of the dynamic tests.

To avoid mechanical errors in the scoring, each answer sheet was scored twice by different scorers within the Counselling and Careers Unit.

6.6 Results

6.6.1 Introduction

In this chapter a restatement of the major hypotheses will be given. The section begins by investigating Hypothesis I. The postulation that enriched scores which incorporate learning potential enhance prediction of academic success will be tested.

Hypothesis II is then considered. The relationship between traditional measures, dynamic measures and academic success is investigated by distinguishing students on the level of educational advantage or disadvantage.

Finally, the relationship between current ability tests and learning potential will be tested.

6.6.2 Investigation of Hypothesis I

HAI:

It can be expected that prediction of university success will be significantly enhanced through a dynamic testing situation as operationalised for the purpose of the present study.

This hypothesis will be investigated for the full group of students without differentiating educational background. Traditional aptitude measures will be compared with dynamic aptitude measures. These results will be correlated with the criterion measures at the year-end. The reason for using only the year-end results is not to confound the effect of the academic context and academic support.

November was enough time to derive benefit from University instruction through normal teaching programmes, but not long enough to fully assimilate the benefits of supplemental academic support.

The traditional measures will be tested firstly. This will then lead to an investigation of the dynamic measures for the whole group of students in each case. The operationalisation of learning potential was discussed in Chapter 4.

For purposes of the present study, results will be reported initially for the full group of students correlating the predictor variables with the criterion variable (November exam results) irrespective of faculty. Thereafter, results will be investigated on the basis of Faculty. In cases where there were

fewer than 6 students in a faculty, the results were not included as this did not constitute enough subjects for the sample to be statistically representative.

Table 15 gives the Mean and Standard Deviation of scores on the traditional measures and the November examinations.

Table 15

Mean scores and Standard Deviation of scores of the traditional tests and the November results per faculty (1992/93) group).

Traditional Measures	Mean	Std Dev
Matric	65.2	11.6
MA	27.3	6.1
RC	12.0	3.6
AR	16.2	8.7
RM	33.1	3.2
Nov Exam	58.1	8.9
BA	55.7	9.9
BCom	54.4	3.9
BSc	64.0	8.8

Table 16 reveals the correlations between the traditional test measures and the November Exam results irrespective of Faculty. These results will be contrasted with Table 16 which shows correlations for the dynamic Newtest measures for the Full group of students.

Table 16

Correlations between traditional measures and November Examinations 1992/93 group ($p < 0.05$)

Traditional Predictor Measures	Nov Exam
Matric	0.70
MA	0.26
RC	0.41
AR	-0.20
RM	0.09

These results indicate that the Matric marks are the only measure showing a significant relationship with University results for this group of students. None of the other traditional measures show a significant relationship with the November results.

Table 17

Correlations between the dynamic Newest measures, Traditional measures and November examinations -1993/94 group (p < 0.05)

Dynamic measures	Traditional measures	Nov Results
	MAT	0.69
	DR/T	0.16
	PR/T	0.06
DR/E		0.36
PR/E		0.14
LP/DR		0.21
LP/PR		0.04

Again, the only significant relationship is between the Matric marks and the University results. However, because the study is primarily addressing the relationship between test results in an aptitude testing context, it is essential to discern the relationship between predictor test measures and the results differentiated by Faculty. Note that traditional measures are contrasted with dynamic measures between groups as well as within the same group (1993/94 group). This is because the initial attempts of the DR/T and PR/T are considered traditional measures as no assistance is given during these administrations.

It is important to note that the Deductive Reasoning Enriched measure shows a slight correlation with University success (0.36). This is a considerable improvement on the initial administration (DR/T is at 0.16). Likewise, there is improvement in correlation between pre-test PR (0.06) and post-test PR (0.14). Thus, it can be seen from this group of results that the introduction of a dynamic testing format has enhanced the prediction of academic success, although not at a significant level.

Furthermore, the results do reveal that the dynamic tests are able to discern a measure of learning potential for all students. In fact, many students showed considerable improvement between pre and post-training measures. Table 18 delineates the means and standard deviations for all the dynamic test predictor variables including learning potential.

Table 18

Mean scores and Standard Deviations of scores of the dynamic and traditional measures, as well as November results (1993/94 group)

Dynamic Measures	Traditional Measures	Mean	Std Dev
	MAT	69.25	9.8
	DR/T	22.9	5.1
	PR/T	15.6	5.3
DR/E		25.8	5.5
PR/E		22.7	2.9
LP/DR		2.9	5.4
LP/PR		7.1	3.4
	Nov exam	64.0	8.9
	BA	64.7	6.9
	B Com	58.0	9.0
	B Sc	67.0	8.9

At face value, it appears that for the Full Group of students across both traditional and dynamic tests, Matric marks are the only measures which show a significant relationship with the November examinations irrespective of Faculty. However, if we look closely at the changes that occur between pre and post-training measures in the dynamic testing context, we can discern a significant pattern in terms of enhancing predicability of academic success for different groups of students.

Firstly, it can be deduced that all students showed an increase in score from the pre-training measure to the post-training measure. Table 19 demonstrates the learning potential of all the testees across both the dynamic tests.

Table 19

Learning potential scores for the full group of students in the Dynamic tests as operationalised by DR/E less DR/T and PR/E less PR/T. (Highest LP to lowest LP)

Subject Number	Learning Potential			
	Deductive Reasoning (DR)		Pattern Relations (PR)	
	Subject Variable			
	ADV	DISADV	ADV	DISADV
1	15		7	
2		12		6
3	10		2	
4		10		5
5		9		6
6		8		10
7		8		8
8		6		11
9	6		15	
10	6		12	
11	6		9	
12		5		2
13	5		9	
14		4		10
15	3		3	
16	2		7	
17	2		5	
18		1		5
19	1		7	
20	1		7	
21	1		4	
22		0		10
23	0			
24	0			
25	-1		14	
26	-1		7	
27	-1		3	
28	-2		11	
29	-2		11	
30	-5		10	
31	-5		6	
32	-11		6	
Mean	1.3	6.3	7.0	7.3
Std Dev	5.4	3.8	3.7	2.9

The results in Table 19 suggest that each student had improved their score either in the enriched DR/E or PR/E or both together. Furthermore, it is the Disadvantaged students who showed the

greatest improvements in score between pre and post-training measures. This increase in score was more evident in the Deductive reasoning test. It appears that for this group of students who show gains in post-tests, that the introduction of a dynamic format greatly enhances the prediction of academic success. The comparisons between the advantaged and disadvantaged students will be discussed in a later section.

The traditional measures are unable to predict or discern students who might benefit and respond positively to mediation.

The predicability of the traditional test formats (PR/T and DR/T) are enhanced through dynamic testing, albeit not at a significant level. Deductive Reasoning correlations increase from 0.16 to 0.36 and Pattern Relations from 0.06 to 0.14.

In order to clarify the relative differences between the two methods of testing, it is also necessary to analyse the relationships between predictor variables and results in the various Faculties. Table 20 clarifies the results for the Traditional measures and Table 20 for Dynamic measures.

Table 20

Correlations between the Traditional measures and November Examinations for the Full group (1992/93) in the Faculty of Arts. ($p < 0.05$)

Traditional Measures	BA Nov Exams
MAT	0.76
MA	-0.01
RC	0.21
AR	-0.13
RM	0.09

Table 21

Correlations between the Dynamic Test measures and the November Examinations for the full group (1993/94) in the Faculty of Arts ($p < 0.05$)

Dynamic Measures	Traditional Measures	BA Nov Exams
	MAT	0.48
	DR/T	-0.16
	PR/T	-0.23
DR/E		-0.19
PR/E		-0.32
LP/DR		-0.01
LP/PR		-0.15

These results confirm that the only significant predictor of success for the Full group of students, irrespective of method of testing, is the Matric marks. Again, it is important to observe that these results are unable to discern between different types of students. It is only when the results are contrasted using the degree of improvement of learning that a picture emerges which suggests stark differences in learning potential between students. Section 6.6.5 will elaborate on this observation.

The sample sizes were too small to realise a reliable correlation for the Traditional measures in the Faculties of Science and Commerce. Table 22 highlights the correlations in these Faculties for the Dynamic measures.

Table 22

Correlations between the Dynamic Test Measures and the November Examinations for the Full group (1993/94) in the Faculty of Commerce and Science. ($p < 0.05$)

Dynamic measures	Traditional measures	B Sc Nov exams	B Com Nov exams
	MAT	0.88	0.70
	DR/T	0.18	-0.03
	PR/T	-0.02	0.13
DR/E		0.43	0.26
PR/E		0.14	0.32
LP/DR		0.26	0.24
LP/PR		0.26	0.09

This table suggests that the dynamic measures enhanced the predictability of the traditional measures and improved the relationship between the pre-test and post-test measures for both types of test. The

DR/E measure shows a relationship with the B SC Exam results (0.46) and is a significant increase on the pre-test measure (0.18).

In summary, when we contrast the two forms of testing using the full group of students without differentiating subject variable (ADV or DISADV), the only significant predictor of university success is the Matric results. However, the dynamic measures have allowed the results to be interpreted more qualitatively and suggest that all students, irrespective of educational background, are able to improve on pre-test scores and show a measure of learning potential after a short period of mediation. A deeper analysis of the learning potential scores points to the possibility of using entirely different predictors for different groups of students.

This will be explored in the following section. In terms of qualitative interpretation, the evaluation comments from the testees who undertook the dynamic testing format, might be encouraging for changing the mindset of students towards aptitude testing. Appendix 15 outlines the questionnaire used for the evaluation process. An analysis of the evaluations reveals that the new format is much more relaxing and enjoyable than traditional testing. Students felt more motivated to do the tests, mainly because the process of testing and its implementation had been clearly explained to them before testing. Students also commented that the atmosphere was more collaborative and less formal and therefore reduced test anxiety. Thus from a qualitative viewpoint, the new format definitely enhanced the opportunity of testees to performing at their best possible level. Therefore, from a psychological-educational interpretation, it appears that the dynamic test procedure satisfies the criteria of active involvement, relevant meaning and positive experience. However, it is the ability of the new testing format to discern between high and low learning potential students, that its real significance and contribution comes into play.

6.6.4 Investigation of Hypothesis II

HAI:

Advantaged and disadvantaged students will have different predictors correlating with the criterion of University success.

If the full group of students for both testing formats are differentiated by educational background into educationally Advantaged and Disadvantaged students, then the results might reveal differences in the ability of each test to tap into latent academic potential within each student.

The Traditional Testing group will be differentiated into the two groups (Tables 22 and 24) and these results will be contrasted with the results for Advantaged and Disadvantaged students in the Dynamic testing group (Tables 23 and 25 respectively).

Table 23

Correlations for Advantaged students in the Traditional Test Group (1992/93).

Traditional measures and November Examinations. ($p < 0.05$)

Traditional measures	November Exams
MAT	0.47
MA	0.21
RC	0.33
AR	-0.34
RM	0.29

Table 24

Correlations between Dynamic Test Measures and the November Exams for the Advantaged Students in the 1993/94 group. ($p < 0.05$)

Dynamic Measures	Traditional Measures	November Exams
	MAT	0.64
	DR/T	0.09
	PR/T	-0.06
DR/E		0.27
PR/E		-0.04
LP/DR		0.21
LP/PR		0.04

These tables demonstrate that the Matric results are the only significant indicator and predictor of university success for the Advantaged students. For this group of students the DR/E enhanced the predictability of the traditional DR/T measure. The DR/E showing a stronger relationship to university success, albeit not at a significant level. It will be informative to analyse the learning potential scores for the advantaged students and contrast these with the disadvantaged students (Table 27).

Table 25

Correlations between the Traditional measures and the November Exams for the Disadvantaged students in the 1992/93 group.

Traditional measures	November exams
MAT	0.76
MA	0.24
RC	0.39
AR	-0.64
RM	-0.15

N = 6

Table 26

Correlations between the Dynamic measures and the November Exams for the disadvantaged students in the 1993/94 group. ($p < 0.05$)

Dynamic measures	Traditional measures	November exams
	MAT	0.86
	DR/T	0.50
	PR/T	0.38
DR/E		0.66
PR/E		0.61
LP/DR		0.23
LP/PR		0.04

*(Academic results)
3 Faculties
BA Hon BSc*

The results from Table 25 indicate that the matric marks are the only significant predictor of university success for the Disadvantaged students. It is interesting to note that both the Arithmetic Reasoning test and Ravens Matrices correlate negatively with the November results. These tests are still widely used in Aptitude testing programs and yet they demonstrate no relationship at all with academic success.

The results emanating from Table 26 are indeed encouraging for enhancing prediction for Disadvantaged students using the Newest format. Matric marks are still a significant measure, but the Deductive Reasoning Enriched Test as well as the Pattern Relations Enriched, both show significant relationships with academic results (0.66 and 0.61 respectively). In addition, both these tests show marked improvements from pre to post-test measures (DR from 0.50 to 0.66, and PR 0.38 to 0.61).

When both methods of testing are contrasted, it definitely appears that the Newtest format reveals two very reliable indicators of university success in addition to the Matric marks. Furthermore, disadvantaged and advantaged students certainly do have different predictors of success in terms of the tests used in the respective formats. It is only the DR/E and PR/E which are able to predict for academic success for the Disadvantaged students (given that matric marks are not a test, but a determined result from outside the testing situation).

These results can be further elucidated by breaking down the results for the respective groups into the various Faculties (Advantaged students in Table 28 and Disadvantaged students in Table 29).

But before this contrast is investigated, mention has been made of the ability of the dynamic Tests to discern a pattern of high learning potential in the group of Disadvantaged students.

Table 27

The Mean and Standard Deviation measures for the disadvantaged and advantaged students in the 1993/94 group. ($p < 0.05$)

Dynamic measures	N = 22 Advantaged students		N = 10 Disadvantaged students	
	Mean	Std Dev	Mean	Std Dev
DR/E	25.0	5.9	27.7	4.0
PR/E	22.2	3.6	23.9	3.3
LP/DR	1.3	5.4	6.3	3.8
LP/PR	7.0	3.7	7.3	2.9

N = 32

Thus, on all four measures of dynamic assessment, the Disadvantaged students showed higher scores as well as lower standard deviations. This group of students benefited significantly from the new testing format. In fact, if we go back to Table 19, we can see that 8 out of the top 10 students in higher learning potential, are from the Disadvantaged group. These high learning potential increases are more evident in the Deductive Reasoning Tests, suggesting that this group of students benefits enormously from exposure to strategy teaching and test-taking cues. The fact that the increases were not as significant for the Pattern Relations might indicate that the mediation was not as meaningful for the group in the non-verbal format.

It was mentioned that extra information might be collated if the group results are reflected according to Faculty results.

Table 28

Correlations between the Traditional and Dynamic measures for the Advantaged students in the 1993/94 group as per Faculty. ($p < 0.05$)

Traditional measures (93/94)	Dynamic measures	BA <i>N=12</i>	B Sc <i>N=12</i>
MAT		0.52	0.86
DR/T		-0.26	0.13
PR/T		-0.25	-0.38
	DR/E	-0.21	0.33
	PR/E	-0.27	-0.08
	LP/DR	0.09	0.22
	LP/PR	0.19	0.54

Table 29

Correlations between the dynamic measures and the November exams for the Disadvantaged students in the 1993/94 group in the Faculty of Science. ($p < 0.05$)

Dynamic measures	November exams
DR/E	0.75
PR/E	0.66
LP/DR	0.22
LP/PR	-0.11

These two tables show more specifically that the new testing format provides better predictors of success than the traditional measures for specific fields of study. Interestingly, the Deductive Reasoning measure is a better predictor of success in the sciences, than the Pattern Relations, suggesting that deductive reasoning skills show a strong relationship with skills needed in scientific subjects. The other Faculties are not reflected as there were not enough students registered to constitute a reliable sample size.

A final interpretation to contrast the two groups of students, is to differentiate students according to high learning potential and low learning potential for each dynamic test. The mean score for the learning potential in the DR/E test is 1.3 and the PR/E is 7.0. Therefore, students who score above these scores are classified as high learning potential students and those scoring below are low learning potential students. Tables 30 and 31 show the correlations for the high potential and low potential groups respectively.

*Disadvantaged students
DR/E mean 1.3
PR/E 7.0*

Table 30

Correlations between the Dynamic Measures and November Exams for the High potential students in the 1993/94 group. ($p < 0.05$)

Dynamic measures	November exams
DR/E	0.58
PR/E	0.54
LP/DR	0.13
LP/PR	-0.65

Table 31

Correlations between the Dynamic measures and the November Exams for the Low potential students in the 1993/94 group. ($p < 0.05$)

Dynamic measures	November exams
DR/E	0.22
PR/E	-0.01
LP/DR	0.22
LP/PR	0.30

The results suggest that the dynamic tests do discern between high and low learning potential students, and that the former group does show a significant correlation with university success for both tests. The High Learning potential students include both ADV (N=4) and DISADV (N=8) students for whom the Newtest battery correlates significantly with university success.

In summary, the results confirm the hypothesis that advantaged and disadvantaged students have different predictors for university success. In fact, the only significant predictor for both groups of students is the Matric mark. However, this measure does not allow for differences in educational background and because it is a static measure, is unable to discern between high and low learning potential students. The only two tests which show a significant relationship with academic success for the Disadvantaged students are the Newtests, DR/E and PR/E. There are no significant indicators of success emanating from the traditional measures for either advantaged or disadvantaged students.

Again, from a psychological-educational viewpoint, the dynamic measures show a reliable relationship with university success. Testees have more faith in testing situations where the process of testing parallels closely with the demands of the academic context. They become more motivated for the mediation process highlights the meanings between high and low thinking skills. The learning

potential is improved irrespective of low performance in initial tests. The fact that traditional measures only assess current aptitude, and that this bears no relationship to learning potential will be investigated in the next section.

6.6.5 Investigation of Hypothesis III

HA III:

No significant relationship exists between current ability and learning potential.

The traditional measures of aptitude, merely reflect current levels of ability. In contrast, dynamic measures reflect potential levels of ability. The relationship between the traditional ability measures (DR/T and PR/T) and learning potential is outlined in Table 32. Traditional measures are static predictors in that they are unable to discern whether a student can improve on this score given a period of mediation. On the other hand, dynamic measures incorporate mediation, thereby allowing for measurements of improved performance. These measures assess potential levels of functioning and facilitate prediction of academic success after allowing for exposure to good teaching. In order to investigate this hypothesis it is necessary to correlate the learning potential scores for each student with their scores in each traditional format of the test. Table 32 demonstrates the correlations between learning potential and traditional ability for the full group of students.

Table 32

Correlations between learning potential measures and the traditional ability measures for the full group of students -1993/94 group. ($p < 0.05$)

Learning Potential Measures	Traditional Ability Measures	Correlations
LP/DR	DR/T	-0.46
LP/PR	PR/T	-0.75

This result shows a negative relationship between learning potential and measures of current ability, confirming the hypothesis. Learning potential is independent of current levels of functioning and can be elicited and modified through a process of instruction and assistance.

6.6.6 Summary of Results

Table 33 summarises the predictors of academic success across the whole study within the parameters of each hypothesis with a short conclusion which will help lead into the final chapter which deals with the implications of the results.

Table 33*Correlations between predictor measures and criteria measures for the whole study (Summary).*

		Hypothesis I			
		Traditional measures 1992/93	Dynamic measures 1993/94	Nov exams	B Sc exams
Full Group	MAT			0.70	
			MAT	0.69	
			DR/E		0.43
			DR/E(DR/T 0.16)	0.36	
			PR/E(PR/T 0.06)	0.14	

Dynamic tests enhance prediction in that DR/E shows a relationship with success in the Sciences, traditional correlations are improved through a dynamic format but not at a significant level. Matric marks show a significant correlation to academic success.

Conclusion: H_A I is confirmed.

		Hypothesis II			
		Traditional measures	Dynamic measures	Nov exams	B Sc exams
ADV students	MAT (92/93)			0.47	
	MAT (93/94)			0.64	
DISADV students	MAT (92/93)			0.76	
	MAT (93/94)			0.86	
			DR/E	0.66	0.75
			PR/E	0.61	0.66

The significant indicators for success are both DR/E and PR/E tests for DISADV only. Entirely different predictor results for each group. Matric results show a significant relationship to academic success for both Advantaged and Disadvantaged students.

Conclusion: HA II is confirmed.

Hypothesis III

Ability test	Learning potential	Correlation
DR/T	LP/DR	-0.46
PR/T	LP/PR	-0.75

No relationship at all between current level of ability and learning potential.

Conclusion: HA III is confirmed.

Discussion and Conclusions

7.1 Introduction

This section will discuss the important findings of the present study in terms of a number of issues raised in the introductory chapters. The confirmation found for the three hypotheses in the investigation, and the way in which they have been supported, has many implications for the ways in which the findings fit in with the research and theory alluded to in the opening sections. The implications will be discussed under the following headings:

1. Discussion of results
2. Implications for the objective of the present study
3. Implications for aptitude testing and academic prediction
4. Implications for disadvantaged students
5. Implications for current research trends in academic prediction
6. Limitations of present study and future research
7. Summary and conclusions

7.2 Discussion of Results

The three hypotheses have been supported by the results of the study. The major finding of the present study was that the Disadvantaged students are predictable for academic success using the Dynamic Test Battery. For this group of students, the Newtest format enhances the ability of testers to make reliable interpretations regarding possible success in University studies. In contrast, none of the traditional tests are able to predict for academic success for either Disadvantaged or Advantaged students. The fact that the Dynamic tests correlate significantly with the November results for Disadvantaged students suggests that this testing procedure is appropriate as a new form of aptitude assessment in the South African context. The results add weight to the continuing disillusionment with traditional testing measures and points to a new paradigm in aptitude testing. This is in line with the literature which espouses a testing format which incorporates a learning dimension. The major finding also highlights the fact that all Disadvantaged students showed considerable improvements in their post-training scores and it is these scores which are the reliable indicators of later success, not the pre-test scores.

Current approaches which rely on static measures (only one administration of a particular test), are unable to assess learning potential and therefore exclude any possibility of allowing for students to demonstrate ability to benefit from good instruction. This is what university studies are about, good instruction. It is only the Newtest Battery, which simulates university conditions during testing, that

an opportunity is given to all students to express their potential levels of achievement. The positive results emerging from the study in this regard, add convincing support for the growing body of literature arguing for testing to be more aligned with real-life learning situations (Lidz, 1991).

Supplemental to the major finding is the consistent reliability of Matric marks as a predictor of academic success for all students. The results do not confirm the findings of studies that accord a weak relationship between school results and university success (Cowley, 1977; and Shochet, 1986). Rather, the results are in agreement with the international literature (Entwhistle, 1984) that attributes school results to be the single best predictor of academic performance. However, school results do not discern levels of educational disadvantage. Matric marks merely reflect results at a particular point in time without discriminating among the crucial group of students in the lower ranges who have potential to succeed at university. Nisbet and Welsch (1966: 475) found that students with minimum entry qualifications do in fact, achieve at university if given the opportunity. The present study confirms this observation particularly for the Disadvantaged students who generally have lower Matric scores than Advantaged students. Thus, if we were to advise students solely on the basis of school performance, then a large group of students would be compromised and limited in terms of career choices. But if these marks are supplemented by Learning Potential measures then whole new avenues of possibilities are opened up.

The major finding rejects traditional test measures as reliable indicators of university success. They do not predict achievement for both Advantaged and Disadvantaged students. In fact, the traditional non-verbal tests, such as Raven's Matrices and Arithmetic Reasoning are the poorest predictors of University success. In addition, these tests do not predict for success in those areas that they purport to predict for, which is success in the Sciences. An interesting finding is that it is the Verbal tests, Reading Comprehension to a slight degree, and Deductive Reasoning Enriched which come out as the best indicators of university success. This finding might suggest that verbal conceptual understanding is an important component of first-year university work. The single best test for predicting academic success is the Deductive Reasoning Dynamic Test. The Disadvantaged students showed significant increases in this test between pre and post-training scores. This huge increase can be explained by the positive learning experience arising from the mediative process. The change in the testing format also transformed the testing situation into a learning environment thereby reducing test anxiety. The qualitative evaluations from testees attests to the fact that dynamic tests are enjoyable, meaningful and relevant.

The finding that the new format satisfies the criteria of the psychological-educational categories points to its relevance in a context where students enter tertiary education from varying educational backgrounds. The Newtest format successfully discriminates students who have high and low learning potential irrespective of school marks. The second significant finding is that the Newtests

firmly demonstrate that Disadvantaged students benefit the most from mediation and the Advantaged students the least. Thus the more the students show ability to increase scores during testing, the less reliable do traditional indicators become as predictors of performance. The students who predicted significantly on the Newtests did not predict as well on the traditional measures. Conversely, students who showed only slight gains in post-test scores were not predictable on any measures other than Matric marks.

It is interesting to note that it is mainly the Advantaged students who fall into the Low Potential increase group suggesting that they benefited the least from the mediation. Some students actually did worse in the post-test, showing a negative learning experience from mediation. This phenomenon might be worthy of further research. An observation worth noting, is that the Disadvantaged students as a whole seemed to be more receptive and motivated to undergo the new testing procedure.

A further finding was that there was no relationship at all between learning potential and the traditional ability measures. In fact, on both counts, for each test, the relationship was negative. The two measures are independent, and learning potential is a more reliable predictor of academic success and this has nothing to do with the current level of ability. This finding further rejects notions of traditional ability measures as indicators of learning potential.

The major and minor findings support the deeply held assumptions of both Feuerstein and Vygotsky who hold that individuals can improve on initial levels of testing given environmental support. This was the underlying rationale behind the present study, to create an appropriate testing situation wherein all testees can be given an opportunity to reveal learning potential. This rationale formed the basis of the objective of the present study. This will be discussed in the following section.

7.3 Implications for the objective of the present study

The preceding section outlined the major finding of presenting reliable predictors of university success, irrespective of educational background. This led to the supportive finding of demonstrating that all students can improve on present levels of functioning given a short period of training. Finally, the supplemental finding emerged that the increase in learning potential is independent of the current level of functioning. These three findings which were presented as the three hypotheses fulfil the underlying objective of the present study.

The objective of the present study was to develop an aptitude testing battery appropriate to the South African context. The earlier sections of the study detailed the need to find alternative predictors of academic success, given the heterogeneous background of students entering tertiary education. It was argued that the new procedure should be capable of identifying students who have the potential to succeed at university. In addition, the alternative testing methodology should satisfy practical criteria

Altogether functioning close to optimal level!

= difference scores!

✓ to be expected!

in order to achieve predictive validity. The previous section summarised the results in terms of identifying students who have high levels of potential functioning and who are highly predictive for later university success. In this sense, the study seems to satisfy an important dimension and objective of the present study.

It was contested in the earlier sections that traditional tests are no longer appropriate to the present university context where students from varying entry level backgrounds compete for places in different fields of study. Students who undergo traditional testing are given no opportunity to show how they might perform in the different contexts which the university environment might demand from them. It is this very reason that accounts for the more recent conceptions of intelligence. According to multiple-intelligence theory (Gardner, 1982), students should be allowed to demonstrate their potential intelligences in any learning context. The Newtest Battery is a step in this direction, in that the interactive format draws out potential strengths in verbal-linguistic and visual-spatial reasoning, as well as mathematical-logical reasoning. Sternberg (1984) also expressed his concern that traditional testing formats did not allow for analysing cognitive skills necessary for actual academic success. The present study demonstrated that it had identified specific cognitive skills necessary for success at university, and that these skills could be taught to students so that they might benefit from using a problem-solving strategy. Thus, there is convincing evidence to conclude that the study satisfied the objective of presenting an alternative method which was more relevant to the composition of the student population and concomitantly in line with current developments in intelligence assessment.

However, a very important corollary to this objective was to find a reliable battery of tests which also was practical and psychometrically defensible. In terms of practicality and simplicity, the Newtests required less administration, less scoring and less time as a whole. The battery involved only two tests which could be scored between test administrations. Thus there was less need to read out instructions and hand out sheets, as was required in the traditional format. The tester becomes an active part of the testing situation in the Newtest context, and therefore is also able to make qualitative observations regarding student responses, verbally and numerically. This dimension warrants further research, as it appears a fruitful area to explore interactions during testing from an interpersonal intelligence viewpoint. The new format is standardised and can be effective in large groups. In fact, the results suggest that perhaps the procedure can be streamlined to incorporate only the Deductive Reasoning Tests. The Newtest Battery counters the misgivings in the literature, that attributes lengthy clinical-type procedures to dynamic tests. The present study shows that dynamic tests can be conducted in an efficient and practical manner.

The Newtest Battery allows all students to have equivalent opportunities to demonstrate potential. They all experienced the same process of mediation and were tested under the same conditions in

terms of time, instructions and examples provided. Both Newtests demonstrated that they were appropriate to prospective university students, in that there were no ceiling effects or floor effects. The contents were at a level which allowed for improvement in scores in a subsequent administration. Each test measured the prerequisite skills necessary for success in university study. The results however, do suggest that some of the skills attributed to Inductive Reasoning are not necessarily prerequisites for scientific academic success. Conversely, some Deductive Reasoning skills seem to be necessary for success in most fields of study at university.

The Dynamic test measures show low standard deviations validating them as reliable measures. The post-training scores have proved to be reliable predictors of academic success as they involve the same items in the pre-test measures which have been found to be high in reliability. Thus, the introduction of a short and simple mediation process has transformed the testing context into a learning environment which not only satisfies the psychometric criteria laid out in the objectives of the study, but also satisfies the psychological-educational categories which underpin the study.

The fact that both Newtests have been normed on university students gives credibility to the interpretation of the tests. Credibility in testing allows for testees to approach problems with meaning, involvement and positive experience. The new format allows for an enhanced process of identity formation. For the first time in testing, the testee is able to receive feedback on performance and is given direction to improve performance. Again, the psychological-educational categories are strengthened through introducing the possibility of increasing one's score while being better prepared.

The foregoing discussion presents evidence that the objective of the study has been achieved along the dimensions of satisfying both the theoretical underpinnings, as well as the practical criteria of psychometric defensibility. The study further asserts that because it is found to be relevant and appropriate to South African Aptitude testing, it is no longer defensible to rely upon traditional measures in aptitude testing.

7.4 Implications for Aptitude Testing and Academic Prediction

The results of this study lend empirical support to critiques of traditional measures of aptitude testing and academic prediction. In the review of the literature on traditional testing it was emphasised that these formats utilised a static view of intelligence and aptitudes. The findings of the study did not support the geneticist and environmental conceptions that there exists a relationship between static measures of intellectual functioning and university success. Geneticists argue that intelligence tests assess an immutable measure defined as general intelligence. However, the present study has demonstrated that this measure is not immutable, but modifiable and can be significantly altered for all groups of students. The Mental Alertness Test purports to measure general intelligence, and has not predicted for academic success in the present study. Thus, the traditional concept of general

intelligence has been found to be neither stable nor a meaningful predictor of future academic performance.

The present study demonstrates that the geneticist viewpoint which informs traditional testing is based on false premises. This premise excludes the ability to learn from experience and instruction. The Disadvantaged students demonstrated vast improvements in intellectual functioning between test administrations, and these measures cannot be attributed to initial differences in intelligence or ability, as they have shown to be independent of current levels of functioning. The overwhelming evidence is that traditional tests of aptitude are not particularly useful in predicting university performance (Entwhistle, 1984; and Shochet, 1986).

The present study is in accord with the environmentalists who claim that intelligence can be altered through manipulation of the environment. However, the agreement ends when environmentalists attempt to adapt and modify the static measures in an effort to produce parity between groups of students of diverse educational backgrounds. The present study was not an attempt to manipulate the norms so as to create different norms for different groups. Neither was it an attempt to adapt the language or modality of the tests so as to create better familiarity of test items for diverse groups. An important objective of the present study was to create a learning environment based on firm psychometric principles using tests that adhere to the requirements of psychometric theory. The selected instruments were kept in tact, and not tampered with (only in the PR/E were some test items re-clustered). The tests had good reliability coefficients, appropriate levels of complexity and modality, were normed on university students, based on the language medium used at the university and had face validity in terms of the perceived relationship between its constructs and university academic success. The present study has argued that it is indefensible to manipulate these principles if the underlying assumption is still based on a static notion of intelligence. Statistical manipulations may attempt to create parity in test scores between populations, but do not create an environment of parity in learning opportunities for capacity to change.

It is suggested that the present study, by arguing that intelligence can be changed, represents a fundamentally new approach to aptitude testing. An approach that rejects both geneticist and environmental conceptions of intelligence and intelligence testing. Aptitude testing becomes part of an evaluative process wherein each testee continually checks out current levels of ability in terms of skills needed in the future. The present study draws out the cognitive skills which are necessary for academic success and equips students with an opportunity to test out potential ability in the required skills. Testees are given first-hand experience of the learning environment in which they are likely to find themselves. They are given real-life opportunities to adapt and learn.

The major implication for aptitude testing arising from the results is that traditional measures should never be used for academic prediction if they do not incorporate a learning dimension. The present study does not disqualify traditional tests as invalid and unreliable instruments. It only negates their usefulness in an aptitude testing context when used in a static manner. Traditional tests might become useful if they are readministered in the format described in the study and after they are investigated in terms of prerequisite skills and the concomitant mediation. The corollary of this implication is more qualitative; Dynamic Aptitude tests become more enjoyable, and transform the procedures of aptitude testing into a process of self-exploration, feedback and identity formation. Testees come away from the testing programme with new strategies for learning and clear information of skills needed for academic success. Testers are no longer perceived as threatening and distant, but become facilitators in the process of self-exploration by presenting hints and cues.

The Newtest format becomes a transition learning experience, particularly for Disadvantaged students who can rectify and try out strategies without being penalised or prejudiced against a single administration of any test. Testers can get a grasp for their underlying difficulties during mediation and this can inform the teaching process. Thus there is a reciprocal benefit arising from the dynamic format in that mediators can see which strategies are more effective and which hints and cues assist the process of learning. This format informs the university of support programs which might build upon the cognitive skills identified in testing.

Disadvantaged students are given opportunity to extend their learning in the early days of university academic studies. It is this group of students who increasingly make up the composition of new university enrolments that have the most to gain from the Newtest format.

7.5 Implications for Disadvantaged students

The process of dynamic testing does not locate poor academic performance as an inherent deficiency of the testee. Rather, the Newtest format redirects attention to the immediate environmental determinants on educational performance, as well as the broader socio-political context. It would be useful to return to the Mediated Learning Experience (MLE) espoused by Feuerstein in earlier sections and detailed in Appendix 3. The process of mediation is an attempt to redress the contributory factors leading to educational disadvantage. The mediator guides the disadvantaged student to adequate levels of cognitive development despite the restrictive influences of disadvantage; which might manifest as poverty of stimuli, low parental level of education, and inadequate schooling. The Newtest format argues for a dialectical relationship between testing methods and the socio-political milieu in which it is contextualised. A consideration of the wider societal system allows for an exploration of the political and social inequality which impinge on each prospective student presenting for aptitude test programmes. If the testing format excludes recognition of debilitating

factors, then it merely perpetuates the cycle of disadvantage and discriminates against those students who have the potential to succeed after benefiting from an equitable and just educational process.

The Newtest format shifts testing from an evaluative context to a learning context. There is a shift from individual capability to institutional capability. No longer must the disadvantaged student be the sole agent to change in order to improve, but rather, the question emerges of how can the learning institutions improve learning. At the present time of writing, the socio-political dispensation of apartheid has been dismantled. However, the damage which this policy has caused will take a great deal of time and effort to erase. Education reflects the apartheid policy and its effects more strikingly than any other social institution. The present study has shown that students from educationally disadvantaged backgrounds respond positively to dynamic testing despite abysmal educational backgrounds. Yet traditional measures of aptitude are continually being used to predict for academic success. Disadvantaged students are therefore given information based on current levels of functioning, which have been shown to be unreliable predictors of future academic performance.

The fact that disadvantaged students evidence high levels of learning potential forces the question of how appropriate educational experiences can fulfil this potential. Learning can be described as a qualitative change in how the learner interprets subject content. Ramsden (1988: 25) argues that student achievement measured purely quantitatively in terms of implementing procedures leads to the adoption of strategies at variance with teachers' aims. This is precisely what happens in a traditional testing format wherein the tester and testee have no interaction and no mutual understanding of what the tests measure, or what strategies might be beneficial in solving test items. The situation is merely imposed on the testees and reflects a form of institutional aridity in which no responsibility emerges to address those barriers that adversely affect the assessment opportunities of students from diverse backgrounds.

An enlightened implication of the present research, is that it emerges as a positive attempt to confront the issues of different students within testing situations, whether the difference be due to race, culture, ethnicity or language. The study has challenged the assumptions of traditional testing, and in fact any testing situation, which does not take cognisance of the restrictive practices discriminating against disadvantaged or minority students. The study has attempted to reflect the concept of equality of education by taking into account cultural variations and diverse capacities. It has placed testing into a broader and more appropriate educational context to include how testing relates to and reflects instruction, and acknowledges the interactional nature of the process of testing.

The whole context of traditional testing has been contested and brought into accountability in terms of equality of testing opportunity along many fronts:

- the tendency to maintain the status quo because of implications of change, such as expense in changing test instruments.
- passivity regarding changed beliefs and mindsets of traditional testers.
- underutilisation of the students home language, culture and background.
- faulty notions of what tests really measure, and misconceptions of the information that tests do actually yield.

Samuda (1987) elaborates further on the practices which he terms the 'psychometric abuses in placing minority students'. He outlines the following current forms of test abuse:

- monolingual/ethnocentric tests and testers.
- inadequate and inaccurate knowledge of tests, testing and minority students.
- lack of a well-defined policy regarding assessment and discrepancies between policy and practice.
- insufficient knowledge and awareness on the part of testers concerning the unique and different individual and cultural learning styles.
- inadequate training and sensitivity to the problems and needs of disadvantaged students by testing personnel.
- unconscious stereotyping and prejudice on the part of testers that reflect patterns of interaction and expectation within the broader community.
- a mindset that achievement difficulties in students are unalterable.
- interpretations of aptitude tests as indicators of expectations for student performance rather than as indicators of educational intervention.

It is perhaps too strong to term the above factors as a form of psychometric abuse. Nevertheless, it highlights the need to be sensitive and aware of the biased practices still predominant in many testing institutions. The present study has been an attempt to move to nonbiased assessment and in the process raise awareness to the many forms of test discrimination. The Newtest format can be seen to be part of an emerging paradigm of equal and fair testing which formulates specific guidelines to address the needs of all student populations. It has attempted to do this by making explicit the principles of unbiased assessment:

- multilingual testers as well as diversity of cultures
- full knowledge of tests and testing
- acknowledgment of diverse learning styles
- training of testers in terms of needs of minority groups
- mindset of modifiability of student performance, and
- test interpretations seen as indicators of educational objectives.

By satisfying these criteria and at the same time demonstrating psychometric defensibility, the Newtest format is in a position to inform current research in academic prediction.

7.6 Implications for current research in academic prediction and aptitude testing

The results of this study have questioned the appropriateness of conventional aptitude and intelligence testing for students from disparate educational backgrounds. The inappropriateness of traditional forms of testing is brought into disrepute on both theoretical and methodological grounds. The response of current research efforts has been to modify and adapt the traditional measures so as to introduce an element of culture-fair or culture-free testing. Culture-fair approaches tend to manipulation of statistical methods, while culture-free tests tend towards manipulation of content and test items. These forms derive from the paradigm that intelligence can only be defined in terms of its manifestations within a cultural milieu. Adaptability enables a much enlightened conceptualisation of intelligence and aptitude, compared to the static models of aptitude testing. This newer conceptualisation allows for interpretations that include genetic, as well as cultural influences, without demanding a quantitative measure to be assigned to either point of view. The implication is that it does not make sense to assign significance to a testee's performance on one cognitive skill, if ability in another skill has been important for educational success in the past.

Current research trends have tried to take into consideration this tenuous dichotomy in testing, which isolates general cognitive skills which are relatively uninfluenced by background factors, from more specific skills which are shaped by the environment. More emphasis has been placed on the latter skills, and recognition is accorded to learning within a cultural context. However, these approaches are found to be problematic in two respects, from an aptitude-testing perspective.

The main difficulty is in deriving a static measure of aptitude which is uninfluenced by background and educational factors, as test performance in the traditional format invariably involves the application of background skills. Thus, those current attempts which propose to introduce increasingly abstract measures of aptitude which are uninfluenced by variances in environmental factors, are not in fact testing for learning potential. They are still only testing for what the testee currently knows. Static measures are always influenced by background and educational factors.

A second area which is problematic with current attempts at culture-free adaptation of tests is that the more abstract the measure, the less it will predict performance, as the measure must inevitably move away from specific skill areas to general areas of cognitive processing whose expression in real life is constrained by the limits of the test. If we apply these observations to the Newtest Battery, it can be argued that the Pattern Relations Test is closer to the general skills area and Deductive Reasoning to

the specific skills domain. The rationale being that the deductive reasoning skills required are more specific than the broader prerequisites in inductive reasoning. The modality is verbal and the contents are not at the abstract level of the Pattern Relations Test.

The results of the present study suggest that the ravages of disadvantage are most marked at the specific skills level of cognitive ability. These are abilities and skills that are developed as a result of experience with relevant stimuli, experiences which disadvantaged students have not had in their educational upbringing. Evidence in favour of this observation are to be found in the vast increases in learning demonstrated in the Deductive Reasoning Test. By nature, most traditional measures fall into the category of general skills testing and from the perspective of the disadvantaged testee, are abstract.

The present study vehemently argues against the fairness of using such tests at this point in South Africa's history, when innovative attempts are being made to redress the sins of apartheid and the disadvantage it has caused for many of its people. Both traditional attempts and adaptability approaches are restricted to the static and unalterable notion of aptitude performance. This restriction leads to the paradoxical position that if such tests are to be fair to disadvantaged groups, then these tests must become less predictive of performance and hence defeat the very purpose of why they were initially created. Current adaptability approaches face a paradigm constraint surrounding the predictors that are chosen. The present study provides a direction towards the introduction of a new paradigm.

Dynamic aptitude testing using groups is indeed a new area of research in South Africa. To the researcher's knowledge there has been no similar form of research conducted thus far. This fact has alerted the author to the limitations of the present study and given urgency to extend the new paradigm further into testing practices in South Africa.

7.7 Limitations of the present study and future research

Although the results obtained during this investigation seem to suggest that learning potential can be successfully operationalised psychometrically in a group aptitude testing context, the conclusions which can be drawn are limited by the small sample size, which makes generalisation invidious, and confidence in the reliability and applicability of the Newtest Battery would certainly be boosted if tried out on larger groups of subjects. Moreover, the present sample size precluded the possibility of a regression analysis which, for the Advantaged students, would have provided a better and more streamlined outcome with regard to the relative weighting of the different significant predictors in the prediction process.

The use of the Pattern Relations Test as a learning potential predictor of academic success appears to be testing cognitive skills not necessary for first-year university success. Thus the present study relies heavily on the skills elicited from the Deductive Reasoning Tests which are more verbal. This result corroborates the author's previous research into alternative selection procedures which found verbal tests to be a good predictor of academic performance at first-year level (Zolezzi, 1992). Perhaps the initial period of tertiary education relies on verbal understanding and then advances to the level of abstract reasoning by the final undergraduate years.

The period of mediation used in the present study was limited to the auditory and visual modalities of presentation, thereby excluding kinesthetic, or doing, learners from full benefits of assistance. Interaction during this phase was also restricted and discounted qualitative assessments of each individual's style of learning. A small subgroup of learners did not benefit very much from the mediation, suggesting that this format was not appropriate to their learning style.

These restrictions arising from a shortened period of mediation limited the study in terms of analysing processes of thinking. Again, the author's previous research found that a promising measure of academic prediction to be Learning Process Styles (Zolezzi, 1992). A further example of work which has attempted to address process factors in university learning in Science faculties, is that of West and Pines (1985). The process measures direct educational researchers to examine the process by which learners acquire knowledge through conceptual relations and also the way in which they think about their own problem solving.

Future research into aptitude testing and academic prediction should progress to assessing learning potential over a number of different measures and after a more intensive period of mediation. Attempts should be made to evaluate dynamic measures across many more faculties and across many more educational institutions. There is a real need for educational researchers to analyse prerequisite cognitive skills in the various domains of study or work, and then search out appropriate measures which can be used as dynamic measures.

Finally, it is argued that future research should try to explore the processes of the testee's thinking to a greater extent than was possible in the present study. West and Pines (1985) observation that the testee is in the process of learning is pertinent and emphasizes qualitative interpretation of how each student approaches a coherent body of knowledge. This methodological shift contrasts with that of the present study which concentrates on specific skills. In an aptitude testing context, it would be fruitful to attain a profile of each testee's relative processes of learning and how they respond to different types of mediation. Such a profile might include a learning style profile incorporating preferred modalities of learning, which then could subsequently inform the format for mediation. Such a profile might be generated before testing through interviews and questionnaires. It is not

inconceivable that this area of research will lead to group aptitude tests which are administered to suit the characteristics of the testee, and an advanced computerised analysis used to make study and career decisions based on the variables collected for each testee.

These fertile areas of future research will attempt to bring prediction and education into alignment. The present study has demonstrated that learning potential can be operationalised from traditional measures, and reliably used for academic prediction. The onus of fulfilling the learning potential falls into the hands of educators who can provide innovative and appropriate educational learning experiences.

7.8 Summary and Conclusions

This study has successfully extended the learning potential paradigm into aptitude testing by establishing a significant relationship between dynamic measures and academic performance. The rationale which has been justified in the present study was that it is invalid to use traditional measures for students from educationally disadvantaged backgrounds. These measures only reflect current levels of functioning and are unable to distinguish between the individuals' manifest performance and their future potential functioning.

The findings of the present study clearly demonstrated that all students can improve on test performance through mediation, and that the post-mediation performance enhances the ability of testers to predict for later academic success.

The validity of traditional test measures has been brought into question by the findings of this study. It was argued that this was because these approaches have been explicitly and implicitly predicated on the static and immutable conceptions of ability and aptitude. This conception has confined research in aptitude testing into a limited paradigm which excludes the assessment of learning potential and specific cognitive skill development. In addition, it was argued that these tests and testing procedures are ethnocentric and discriminate against students from diverse and disadvantaged backgrounds.

The present study has been an attempt to redress these inequalities and shortcomings without compromise in quality of performance and psychometric standards. It has achieved this objective through:

1. identifying and operationalising measures which focus on potential rather than on measures which reflect immutable competencies.
2. identifying a specific measure (DR/E) which elucidates key cognitive skills necessary for university success.
3. clarifying the need to introduce a more equitable testing procedure which is non-discriminatory, and

4. clarifying issues which require that the learning potential of students be facilitated by appropriate educational instructions.

The study has therefore been a culmination of investigating harder quantitative data, as well as softer qualitative data. It has been an attempt to confront the inadequacies of an inappropriate traditional testing paradigm and point the way forward to a more equitable and relevant aptitude testing procedure. South Africa has moved from being a draconian dictatorship to becoming one of the world's most liberated and fluid societies. There is a commonality of culture and a vast reservoir of goodwill which necessitates new ways of looking at education and testing in general, if we are to develop the potential of all our students. But change in education carries an element of risk and always runs against entrenched interests: there will always be those who perceive that equal opportunity reduces their own power. In South Africa, many groups have experienced discrimination and do not commence education with the hypothetical 'level playing field'.

A central thesis of the present study is that complacency in testing will not do. Neither will culture-free or culture-fair modifications substitute for equal treatment. The implication of this study is that equal treatment in testing will also not do, for equal treatment under conditions of disequity serves to magnify disequities. The study argues for equalising treatment and a positive testing procedure of searching for potential. It further argues for the need of clear, directive policies in aptitude testing and psychometric testing in general. The qualitative results of the present study suggest that the testing format used was appropriate and a step in the direction of equalising the testing process. It is also an urge to a fairer system of testing along the lines of the Public Law 94/142 in the United States, which now requires that tests and evaluation materials must be provided and administered in the student's own language, that tests must be validated for the purpose for which they are used, be administered by trained personnel preferably familiar with the cultural and linguistic backgrounds of the students upon whom the tests are being used, and be tailored to areas of specific educational need. Unfortunately such policies have not been implemented in the South African testing context and many testing institutions fail to recognise that the problem of bias in testing is multifaceted.

The present study argues that it is imperative that we recognise that our educational institutions are expressions of the same culture that gives rise to the testing procedures. The study is a call to affirmative action in testing. A proactive step which involves training; training is a modification, and in this context, modification is a form of acculturation. This is the precise reason why tests of learning potential, which may be equated with modifiability, represent the future of psychometrics in South Africa.

In summary, at a quantitative level, it appears that a promising approach to group aptitude testing is combining the Deductive Reasoning Dynamic Test measure, with Matric marks to generate a reliable

indicator of later academic success. No traditional test measures fit either the criterion of predictability or the criterion of relevancy. It is however, at the qualitative level that the implications of the present study are most provocative. It is a plea to educators and testing personnel to re-evaluate their paradigms regarding assessment and recognise that educational institutions, like our assessments, are not culture free. The more we divorce our predictors (in the form of psychometric tests) from the broader socio-political context, the more unreliable and unfair they become. It is crucial to eliminate as many forms of bias and unfairness as possible in the testing process. It is felt that the Newtest format has contributed to the process of equalising the testing context, and opens up opportunities to restructure our educational environments.

Appendix 1:

CCU Proposal for Modification of Traditional Testing Programme

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

COUNSELLING AND CAREERS UNIT

PROPOSED MODIFICATION OF THE CAREER DEVELOPMENT PROGRAMME FOR 1993

1. Background:

The validity of the present ability testing battery has been questioned as a predictor of success at university. These indicators are static measures which merely reflect manifest levels of intellectual functioning and are limited to the extent that learning potential is not assessed. It is proposed that a dynamic approach which incorporates learning potential would be a better measure of ability to succeed at testing level irrespective of educational background.

2. The Instruments:

Previous research at tertiary level (Shochet 1986, Boeyens 1989, Rutherford and Watson 1991) suggests that deductive reasoning and inductive reasoning skills are valid predictors of success in the humanities and scientific fields respectively. Two instruments which effectively tap these skills at post-school level are the deductive reasoning test (DRT) and the pattern relations test (PRT) of the HSRC. These two tests do not have a ceiling effect, are culture fair in terms of not requiring high level English skills for comprehension or instructions. Furthermore they are easily adaptable to a test-teach-test situation thereby facilitating assessment of learning potential.

3. Method:

These two tests can be administered in their traditional forms (DRT 45 min and PRT 50 min) to yield a manifest score of functioning designated DRT/T and PRT/T respectively. Traditional scores yield a baseline measure to aid assessment of learning potential. Mediation then takes place where the DRT/T and PRT/T items are re-arranged into clusters to give the mediation condition a systematic framework. The subsequent scores yield an enriched measurements (DRT/E and PRT/E). A learning potential measure is also generated by DRT/E minus DRT/T and PRT/E less PRT/T.

4. Interpretation:

Six different measures are generated through the two instruments which can be used to explore possible study directions. Furthermore, an analysis of the enriched scores reveals particular cognitive strengths according to clusters, i.e. ability to categorize information. Possible avenues of further exploration could be suggested by the stanine scores in all four administrations of the KISS. Examples of interpretation are:

High PRT/T & PRT/E with low DRT/T & DRT/E = strong scientific, investigative where stanine 7-9 is high, 4-6 medium and 1-3 low.

High DRT/T & DRT/E with low PRT/T & E = strong social and humanities, medium DRT/T & E = strong commercial

High PRT/T & E and low/medium PRT/T and high PRT/E point to predominantly humanities direction.

Thus the difference in T and E scores is also an indicator of motivation and enthusiasm in the area concerned, i.e. high learning potential (LP) in DRT opposed to low LP in PRT points not only to good ability in verbal reasoning and openness to benefit from enriched instruction.

In cases where all scores are deflated the higher LP score could be a good indicator of the more appropriate direction.

5. Procedure:

Group administrations of up to 30 in number are very manageable.

The application of the testing would involve one four and a half hour session comprising:

- a) DRT/T 45 minutes
- b) PRT/T 50 minutes
break 10 minutes
- c) DRT/E 80 minutes
- d) PRT/E 85 minutes

Mediation time involves 35 minutes for each test and requires instruction through overheads and reflection on previous answers. Thus invigilators are required to ensure that students do not change previous answers. The enriched forms involve a re-arrangement of items according to reasoning rules to facilitate mediation.

6. Training:

Administration of the procedure entails a high level of knowledge in both deductive and inductive reasoning as well as mediation skills. Mediators need to do all four administrations to obtain an understanding of the process. Mediation requires good teaching skills such as clear explanations and linking of concepts. Mediation can either take the form of clustering in items and explaining followed by another clustering etc. or by an intensive 20 minute period between sessions covering all relevant information. The latter would cut testing time to four hours in total.

Steve Zolezzi
14 September 1992

Appendix 2:

CCU Proposal for Training of Testers

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

COUNSELLING AND CAREERS UNIT

Proposed Format and Conditions of Staff Training for Administration, Scoring and Interpretation of New Aptitude Testing Programme.

1. Training and Administration:

A step-by-step approach is essential in acquiring proficiency in the two new instruments:

Module 1: Acquaintance with each Test and types of cognitive skills tapped.

Module 2: Administration of traditional forms of both tests and scoring.

Module 3: Mediation for Deductive reasoning.

Module 4: Mediation for Pattern Relating.

Module 5: Interpretation of both tests.

Each module would require an hour of training time. In addition, it could be useful to observe the enriched condition of testing as part of the training programme.

2. Conditions for Training:

I propose to package this testing format in the form of booklets for each module and copyright modules 3, 4 and 5 which form the backbone of this non-static assessment approach. The traditional tests are available from the HSRC. However enriched answer sheets can be photocopied. I would ask for a royalty to be negotiated for each test administered to individual students.

The training period would require 5 hours of active training and observation of mediation and testing at an actual testing session. Again, a fee for training can be negotiated. However, due to inflexible work conditions next year the only training day possible is a Saturday.

Steve Zolezzi
20 November 1992.

PROCEDURE FOR NEW APTITUDE TESTING PROGRAMME

- STEP 1 Explanation of procedure.
(2 administrations of 2 different types of Test without help followed by discussion and teaching and then a readministration of the same kits. The aim of this type of testing is to see if you have the ability to benefit from university instruction and improve your first score.)
- STEP 2 Administer Deductive Reasoning Traditional.
(Booklet and answer sheet.)
- STEP 3 Administer Pattern Relations Traditional.
(Booklet and answer sheet.)
- STEP 4 Break for 10 minutes.
- STEP 5 Mediation in Deductive Reasoning.
(Each prospective to get mediation handout with blank page for notes. Students to follow the script and make own notes if they want. All notes then to be collected.)
- STEP 6 Administer Deductive Reasoning Enriched.
(Booklet and same answer sheet.)
- STEP 7 Mediation in Pattern Relations.
(Each student to get mediation handout with note paper. Script to be followed with students. All notes then collected.)
- STEP 8 Administer pattern relations Enriched.
(Enriched booklet unbound with enriched answer sheet.)

Appendix 3:

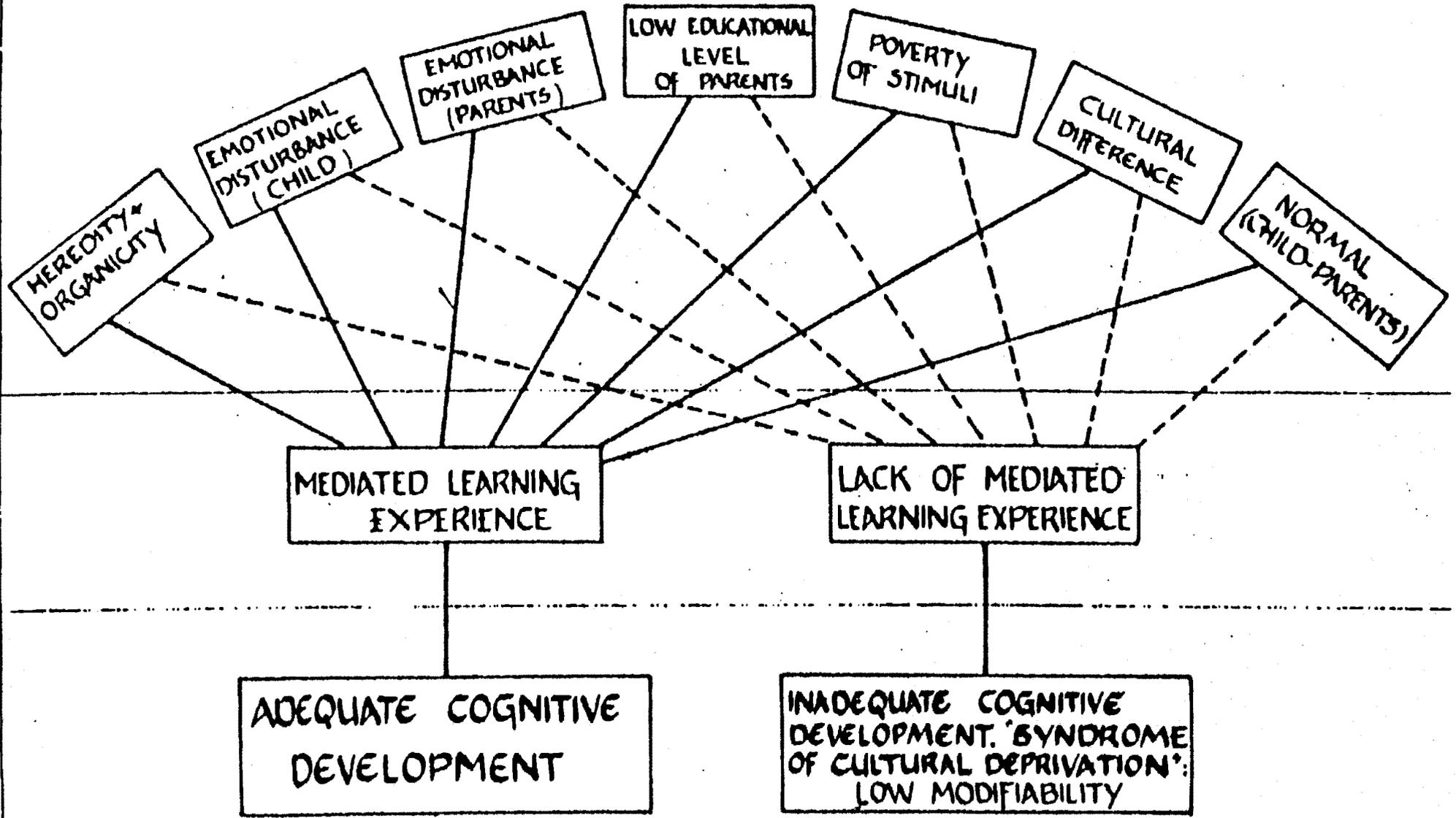
Mediated Learning Experience

DISTAL ETIOLOGICAL FACTORS

DISTAL and PROXIMAL ETIOLOGIES of DIFFERENTIAL COGNITIVE DEVELOPMENT

PROXIMAL

COGNITIVE DEVELOPMENT (END PRODUCT)



Appendix 4:

The Cognitive Map of Feuerstein

There are seven parameters of the cognitive map by which a specific mental act can be analyzed according to Feuerstein (Feuerstein & Hoffman, 1982; Feuerstein, Miller, Rand & Jensen, 1982; Feuerstein, Rand & Hoffman, 1979; Feuerstein, Rand, Hoffman & Miller, 1980). They are:

Content	- the subject matter upon which a mental operation deals with.
Modality	- the language upon which the content and mental act operates within.
Operation	- set of sequential, organized, internalized mental actions required by a task.
Phase	- a loosely defined location within which various cognitive functions can be grouped.
Level of Abstraction	- distance between the object or event and the mental act itself.
Level of Complexity	- refers both to the quality and quantity of units of information dealt with in the mental act.
Level of Efficiency	- consists of both temporal and affective elements in combination with all the other parameters.

The following concepts are found under the *three phases of cognition* Please note that the definitions of these terms have been shortened and explained in less technical language than is used in Feuerstein's IE teacher's manuals:

Input

CP	= <i>clear perception</i> - listening, seeing, smelling, tasting, touching, feeling - to gather clear and complete information.
SS	= <i>systematic search</i> - using a plan so that nothing is skipped, looking in a systematic way, either in time or space.
L	= <i>labelling</i> - giving the thing we become aware of with our senses a name.
SO	= <i>spatial orientation</i> - being aware of where something is, describing where it is located.
TO	= <i>temporal orientation</i> - describing events in terms of when they occur.
C	= <i>conservation</i> - deciding on the characteristics of a thing or event that are always the same even when changes take place.
PA	= <i>precision and accuracy</i> - paying attention to details when it matters.
2S	= using two or more sources of information at one time.

Elaboration

DP	= <i>defining the problem</i> .
RC	= <i>relevant cues</i> - using only that part of the information that applies to the problem and ignoring the rest.
C	= <i>comparing</i> - determining what is the same and different between two objects or experiences.
R	= <i>remembering</i> - keeping in mind various bits of information and determining information that must be retrieved.
SB	= <i>summative behavior</i> - making a general rule or observation or counting objects to know the composition of the group.
SR	= <i>seeing relationships</i> - comparing objects or events on a number of different parameters, their likenesses, similarities.
LE	= <i>logical evidence</i> - using logic to prove or disprove an opinion, deductive and inductive reasoning.
I	= <i>interiorization</i> - having a good mental picture of what one is to do.
HT	= <i>hypothetical thinking</i> - thinking about different alternatives and their consequences, if...then...thinking.
IT	= <i>inferential thinking</i> - assuming a part from looking at the whole or knowing the pattern.
SP	= <i>systematic planning</i> - making a plan that will include all the necessary steps for reaching a goal.
Cat	= <i>categorization</i> - classifying information, finding a commonality that describes a set or group, and differences as subsets.
F	= <i>flexibility</i> - being ready to change your view point, take another course of action.
R	= <i>reversibility</i> - reversing an operation, doing the opposite when required.

Output

OEC	= <i>overcoming egocentric communication/behavior</i> - being aware of what you are doing or saying and how this affects others, being able to put yourself in another's position.
OB	= <i>overcoming blocking</i> - being aware of unhelpful feelings/thoughts which could stop or affect how well you work.
OTE	= <i>overcoming trial and error</i> - not guessing, thinking things through before answering.
PA	= <i>precision and accuracy</i> - using exact words or actions and using them to communicate appropriately, enlarging conceptual tools for language.
VT	= <i>visual transport</i> - carrying an exact picture of an object, words or action in your mind's eye to another place without losing details.
RI	= <i>restraining impulsive behavior</i> - stopping unnecessary or unplanned movements.
M	= <i>motivation</i> - dealing with boredom, trying to create an interest for yourself to help you work on something you don't want to do.

Appendix 5:

Cognitive Processes in Pattern Relations

Cognitive Functions : Pattern Relations

Cognitive Functions: The following functions which are prerequisites for solving the Pattern Relations test, seem also for university success.

1. Input Phase

- Systematic exploratory behaviour
- Conservation of constancies
- Sound spatial orientation
- Need for precision and accuracy
- Ability to provide appropriate verbal labels of elements of the task (ie sound receptive verbal tools).

2. Elaborational Phase

- Sound definition of the problem
- Sound ability to separate relevant from irrelevant cues
- Need for logical evidence
- Inferential, hypothetical thinking
- Sound spontaneous comparative behaviour
- Sound internal representation, ie the ability to keep pictures in one's head and to manipulate these internally.

3. Output Phase

- Need for precision and accuracy.

Appendix 6:

Cognitive Processes in Deductive Reasoning

Cognitive Functions : Deductive Reasoning

Cognitive Functions: The following examples of functioning required to solve the Deductive Reasoning test appear to be important for success at university. The Cognitive Skills are laid out in terms of the LPAD model.

1. Input Phase

- Systematic exploratory behaviour
- Need for precision in data gathering
- Receptive verbal tools

2. Elaborational Phase

- Sound definition of the problem
- Spontaneous comparative behaviour
- Need for logical evidence
- Ability to select relevant versus irrelevant cues
- Hypothetical thinking

3. Output Phase

- Need for precision and accuracy

Appendix 7:

Format of the Dynamic Test Battery (DTB)

NEW APTITUDE TESTING FORMAT

FORMAT

1.	Introduction to testing	5 minutes
2.	Deductive reasoning (traditional)	40 minutes
3.	Pattern Relations (traditional)	50 minutes
4.	Break	10 minutes
5.	Mediation in deductive reasoning	15 minutes
6.	Deductive reasoning enriched	40 minutes
7.	Mediation in pattern relations	15 minutes
8.	Pattern relations enriched	50 minutes
	Total testing time	3 hours 45 minutes

MATERIALS

1. Deductive Reasoning Manual Test
2. Pattern Relations Manual Test
3. Deductive Reasoning Answer sheet (traditional)
4. Pattern Relations Answer sheet (traditional)
5. Pattern Relations Answer sheet (enriched)
6. Scoring Keys for Deductive Reasoning and Pattern Relations
7. Mediation script for Deductive reasoning
8. Mediation script for Pattern Relations

Appendix 8:

Description of the DTB

MODULE 1

DESCRIPTION OF THE TESTS

Deductive Reasoning Test

This test is based on the principles of formal logic and assesses deductive syllogistic reasoning. It requires students to work out the relationships between premises and conclusions of a valid argument.

The test consists of 36 syllogisms from which students are required to choose the correct answer from five possibilities. For example:

Item 1. All helicopters are enormous
 Some hovercrafts are helicopters

Therefore:

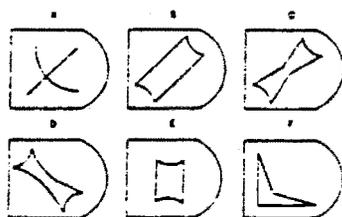
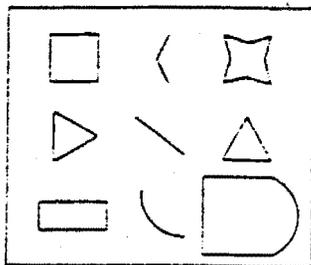
- A All hovercrafts are enormous
- B Some enormous crafts are helicopters
- C Some enormous objects are not hovercrafts
- D Some helicopters are not hovercrafts
- E Some hovercrafts are enormous

The items vary in structure and become more complex than the item presented above. It is designed to consist of nonsense premises rather than contra-factual premises. Syllogistic reasoning is a prerequisite for academic success in the humanities and taps the following cognitive skills:

- Systematic exploratory behaviour
- Need for precision in data gathering
- Receptive verbal task
- Sound definition of the problem
- Spontaneous comparative behaviour
- Need for logical evidence
- Ability to select relevant cues
- Hypothetical thinking

Pattern Relations Test

This test is based on inductive reasoning and reasoning by analogy. It is similar in structure to the advanced form of the Raven's Progressive Matrices but is more complex. The test consists of 30 items containing a 3x3 figural matrix which is governed by a set of rules. The last is left blank and the student is required to select from six alternatives what the appropriate figure should be.



Inductive reasoning is a prerequisite for academic success in the sciences and taps the following cognitive skills:

- Systematic exploratory behaviour
- Conservation of constancies
- Sound spatial orientation
- Need for precision and accuracy
- Inferential and hypothetical thinking.
- Sound internal representation
- Need for logical evidence
- Ability to separate relevant from irrelevant cues.

Appendix 9:

Administration of the DTB

MODULE 2

Administration and scoring of the Tests.

Deductive Reasoning Test

The test is administered with a 40 minute time limit. The subjects should open to the first page of the test book entitled "instructors". The need to be given the answer sheet (NIPR 206).

The administrator should read the instructions aloud and remind the subjects that there is only one correct alternative in each item and is a 40 minute time limit.

The scoring key is placed over the answer sheet. Row scores should be converted to stanines. The mean lies at the centre of stanine 5. Stanines of 1-3 are considered low, 4-6 average and 7-9 high.

Pattern Relations Test

The test is administered with a 50 minute time limit. The subjects should open to the first page of the booklet and be given the answer sheet (NIPR 200).

The administrator should read the instructions aloud and complete the 3 practice examples. The subjects should be watched closely, especially during the first 5 minutes of testing, to ensure that they are marking the answer sheets properly. The "Right answers" Key is placed over each answer sheet. Raw scores are converted to stanines and interpreted the same way as in the Deductive Reasoning Test.

Appendix 10:

Mediation of Deductive Reasoning

MODULE 3

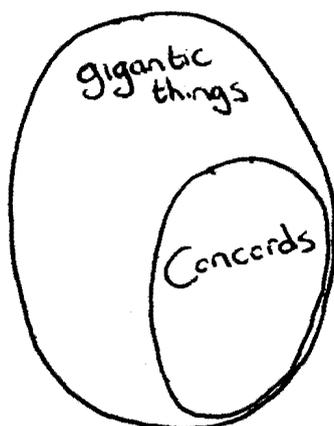
MEDIATION FOR THE DEDUCTIVE REASONING TEST

Introductory talk

You are now going to do the deductive reasoning test again in fifteen minutes. The first test did not measure your potential for learning. We want to compare how well you did in the first test to how well you are capable of doing if given adequate teaching. All you need to try to do this time is to improve on your previous score after this short period of teaching.

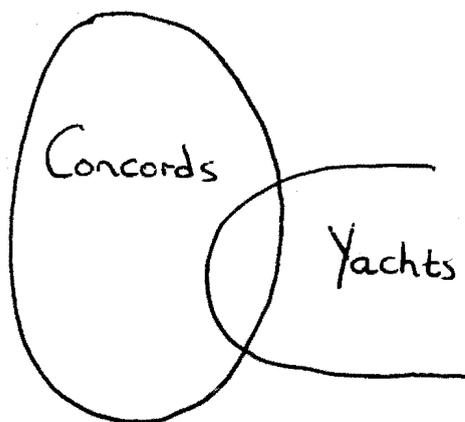
Intensive mediation

A method which is very helpful in organising the information is that of drawing set diagrams for the premises. If the first premise is that **ALL CONCORDS ARE GIGANTIC** then the diagram becomes:



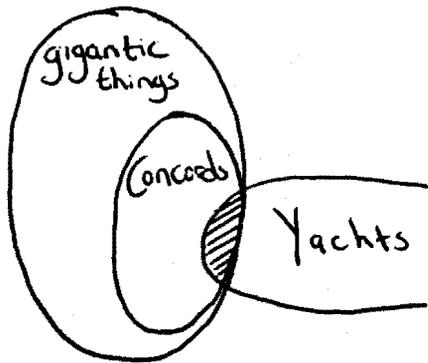
The circle representing the concords is completely inside the set of gigantic things. From the drawing it is clear that there is **no** concord that is **not** gigantic. All the concords are included within the set of gigantic things. Whenever a premise states that **all** of something are something else, then the first set is always drawn completely inside of the second set.

If the second premise states that **SOME YACHTS ARE CONCORDS** then the set diagram looks like:



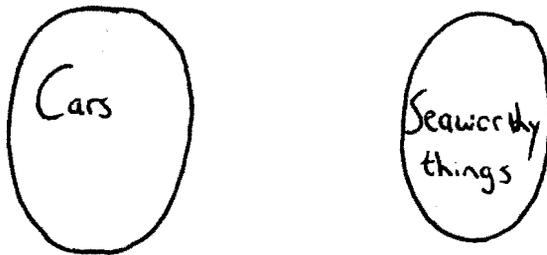
The set of **all** concords overlaps with the set of **some** yachts. Notice that the set of **some** yachts is not closed as we do not know what the other yachts are. In order to find out the relationship

between yachts and gigantic things we need to put both diagrams together:

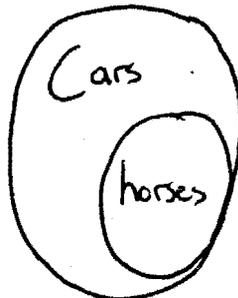


The set of some yachts overlaps with the set of gigantic things. So the correct answer is that **SOME YACHTS ARE GIGANTIC.**

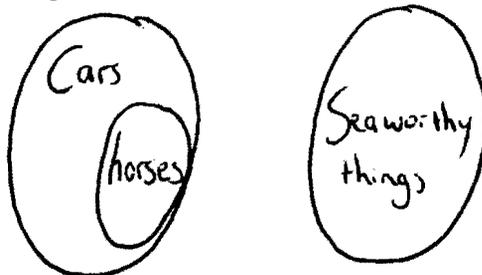
If a first premise states that **NO CARS ARE SEAWORTHY** the relationship is:



There is **no** overlap and the two sets are presented separately from each other. If the second premise states that **ALL HORSES ARE CARS** then we have:



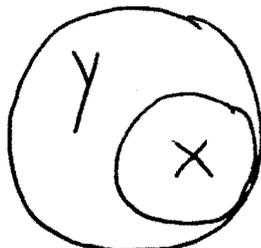
Putting the two premises together we have:



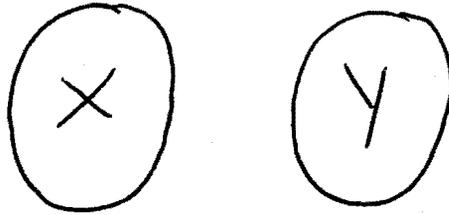
Clearly we see that **NO HORSES ARE SEAWORTHY.**

There are 3 things learnt thus far:

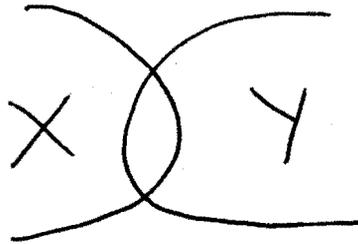
1. When the relationship between things are all X are Y we have:



2. When the relationship between things are **NO X are Y**.

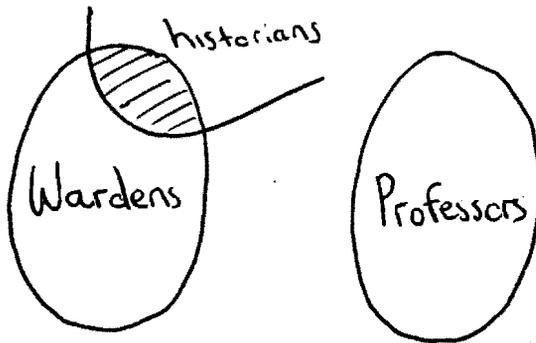


3. When the relationship between two things are **some X are Y** we have:



The stronger premise contains **ALL** or **NO** and should be drawn first. The weaker premise contains **SOME** and should be drawn only after the stronger premise.

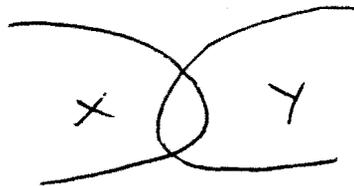
Instead of drawing 3 separate diagrams, one can draw the whole problem in one diagram. If the first premise states that **NO WARDENS ARE PROFESSORS** and the second premise that **SOME HISTORIANS ARE WARDENS** then the diagram would be:



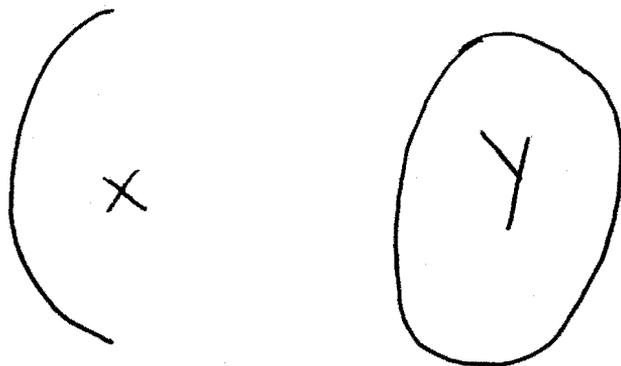
The diagram shows that there are **some** historians who are not professors which is the correct answer.

At this point we have also learnt that:

4. **Some X is Y** is expressed:



5. Some X is NOT Y is expressed:

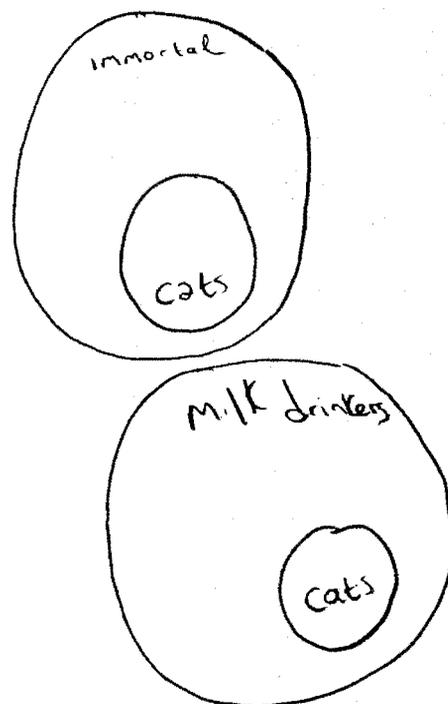


All cats are immortal

All cats are milk-drinkers

Therefore:

- Q. All immortal beings are milk-drinkers
- R. Some immortal beings are cats
- S. Some milk-drinkers are not cats
- T. Some immortal beings are not milk-drinkers
- U. Some milk-drinkers are immortal



All kneecaps are ruddy

All kneecaps are superfluous

Therefore:

- V. Some ruddy things are kneecaps
- W. All superfluous things are kneecaps
- X. All ruddy things are superfluous
- Y. All superfluous things are ruddy
- Z. Some superfluous things are ruddy

No ice creams are red hot poker

Some apples are red hot poker

Therefore:

- A. Not all red hot poker are ice creams
- B. No apples are ice creams
- C. Some apples are not ice creams
- D. No ice creams are apples
- E. Some ice creams are not apples

Appendix 11:

Mediation of Pattern Relations

MODULE 4

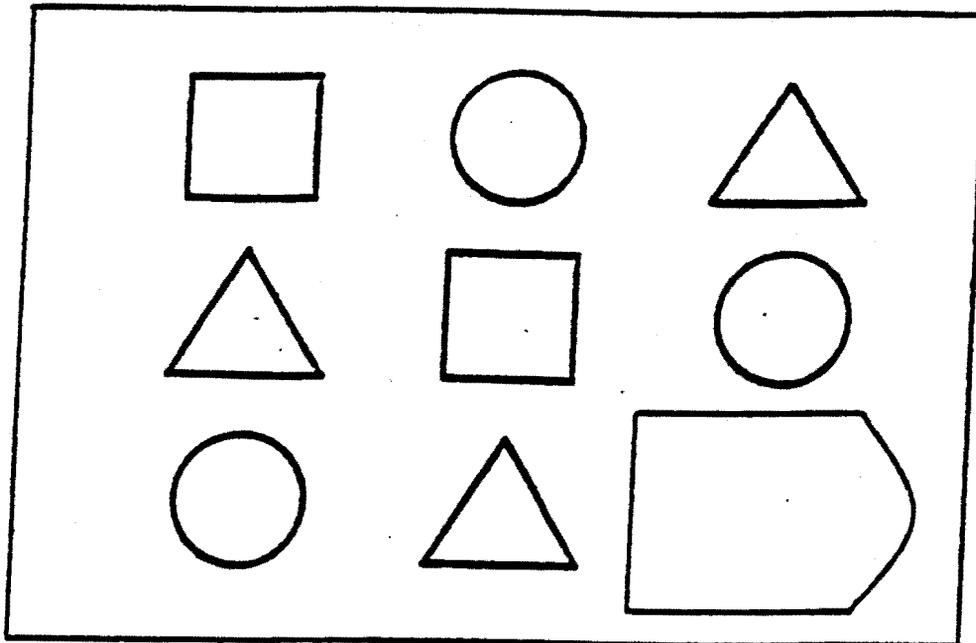
Mediation for the Pattern Relations Test

Introductory talk

You are going to do the same test again but this time with teaching and the items placed in a different order. The items are grouped in such a way so that the ones with the same sorts of rules follow each other in some sort of order.

intensive mediation

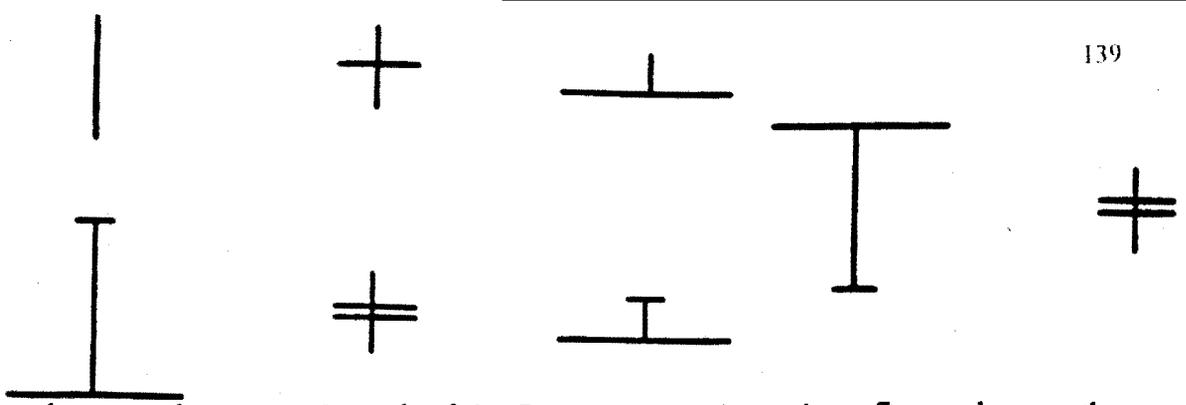
It is a good idea to give the different types of figures different names and then try to see if you can establish any sort of relationship between these different figures. In the following problem we have □'s, O's and Δ's. We can immediately see the relationship between them and thereby arrive at the rules for the problem.



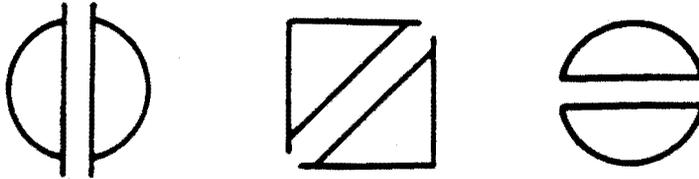
Both the horizontal and vertical patterns contain one of each type of figure. So that the missing figure is a □

The first rule therefore is to look for a horizontal or vertical rule. Also, pay attention to detail. Do not answer too quickly.

Sometimes you have to shift the position of some of the figures or reorientate the figures in order to get the answer. This can be seen as the second rule.

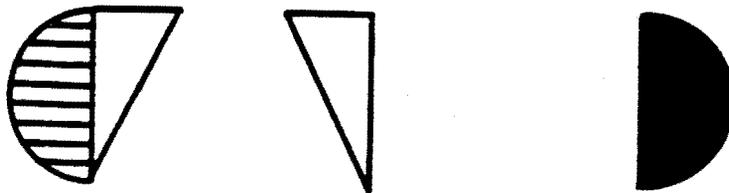


In other items there are details within each of the figures. Sometimes these figures have pathways through them which cut vertically, horizontally, or diagonally. Also the pathways might have different sorts of entrances which could be open, partially closed or partially extended.

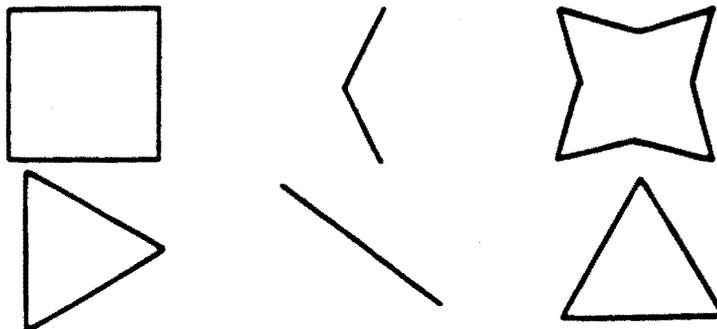


Thus a fourth rule is that you sometimes have to look at a number of different things separately, establish a number of patterns and rules and then apply them to get an answer. Also you sometimes need to count the number of elements and this does not necessarily have to follow a horizontal or vertical pattern.

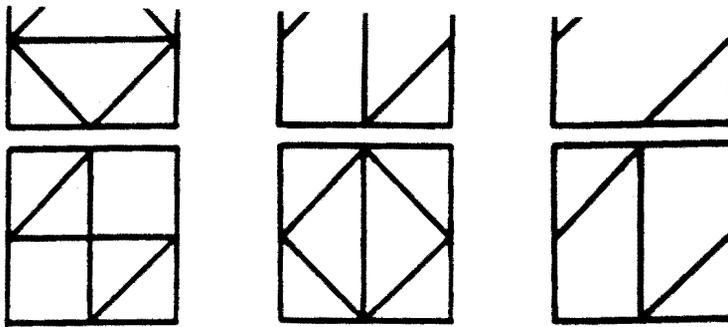
A fifth rule is to do with shading in which you need to establish the type and number of shading. Also you sometimes have to join figures to each other to get an answer.



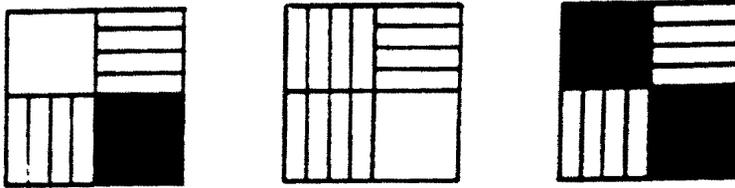
In some items you might have to imagine that the figures in the one column are made of soft clay and in the next column the shapes made of hard plastic. You then have to see how the figures change shape when the plastic figures are pushed against sides of the clay figures. This is a sixth rule.



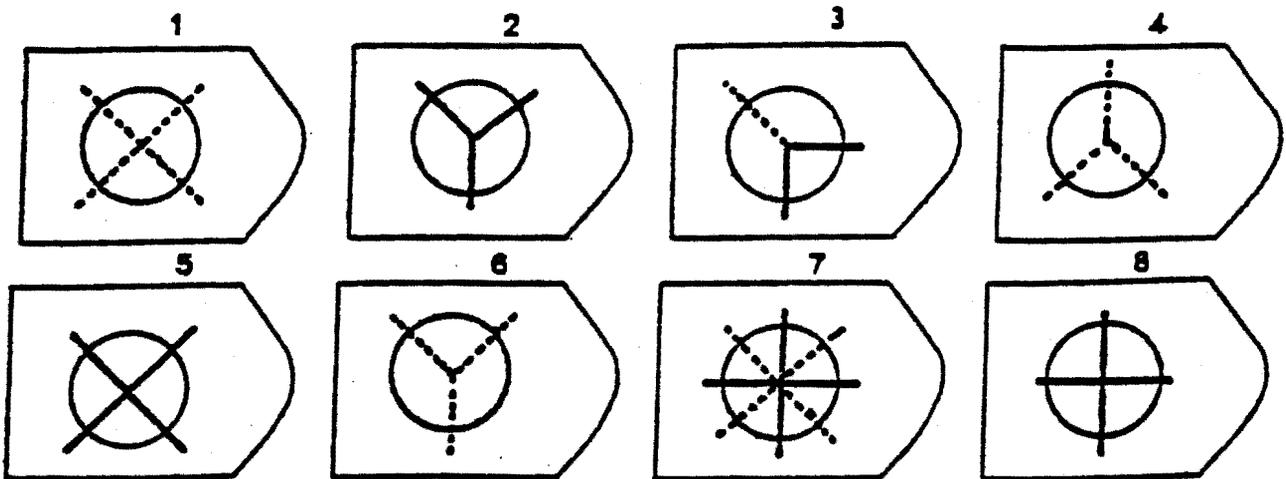
In other items you may need to overlap or superimpose two figures so that wherever they are exactly the same they cancel out and what remains becomes the third figure. This is rule number seven.



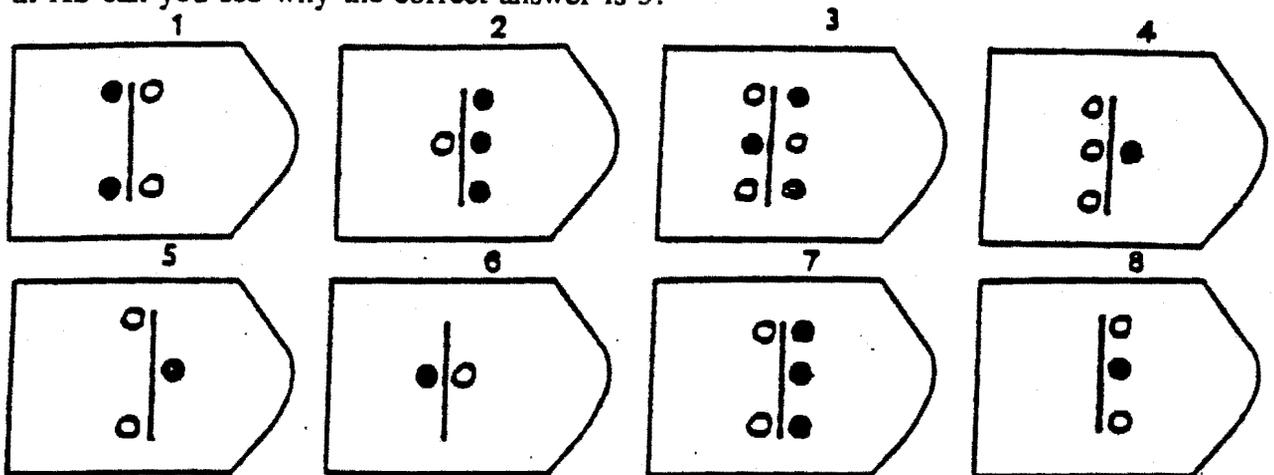
An eighth rule is that if you superimpose two quadrants that are shaded in the same way, it remains the same in the third square but if you superimpose two quadrants that are shaded differently, it becomes black in the third square.



We are now going to do the following FOUR practice exercises and apply some of the eight rules. Look at XI and see why the answer should be 1. According to rule 7 columns and 1 and 2 superimpose to cancel out parts that are the same leaving what doesn't overlap to remain.

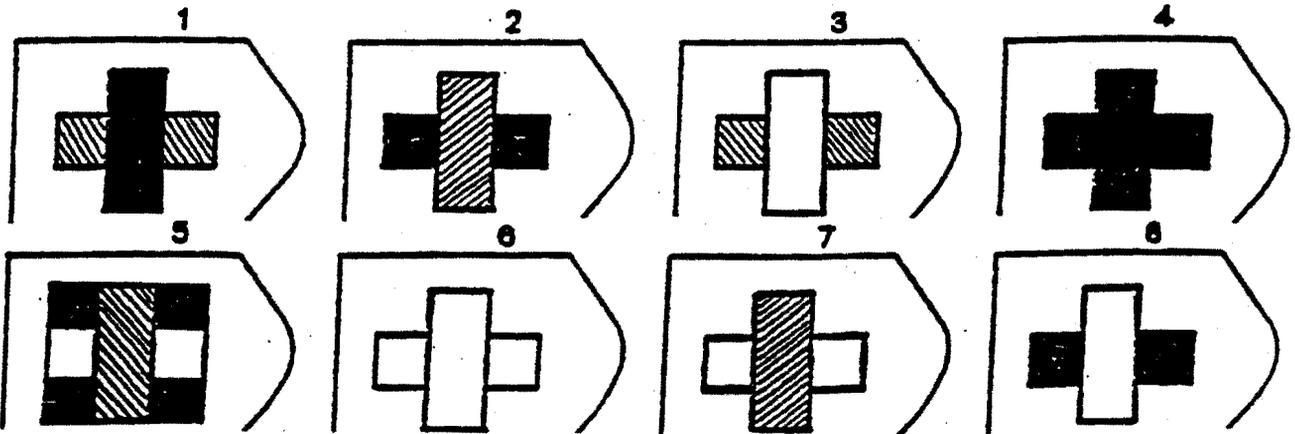


Looking at X2 can you see why the correct answer is 5.

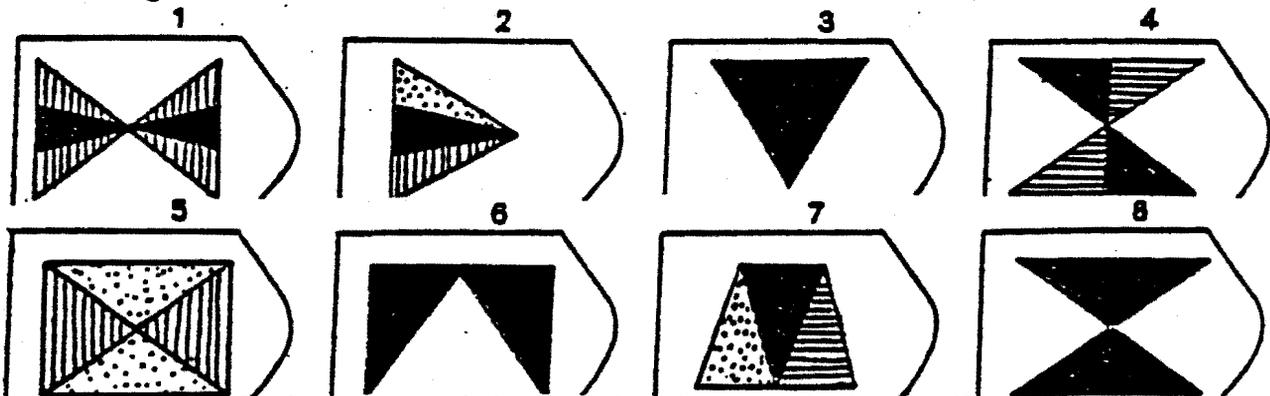


According to rule four you need to establish the rule that the first and second rows either add or subtract the number and colour of marbles. So that in the bottom row 2 black from 1 and 3 white from 2 leave the answer to be no 5.

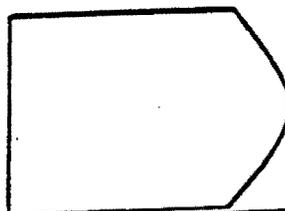
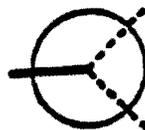
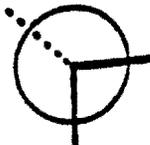
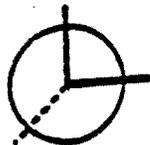
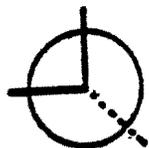
Looking at X3 the rule follows No. 5 that you need to establish how the shading changes by column. The correct answer is no 1.



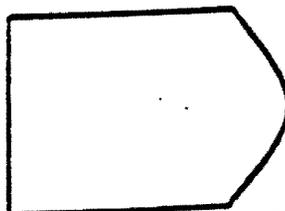
Finally, look at X4 where according to rules 2 and 5, you need to reorientate the middle figure to make a mirror image and shade the solution the colour of the inner shade. So the correct answer is No 8.



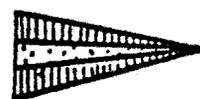
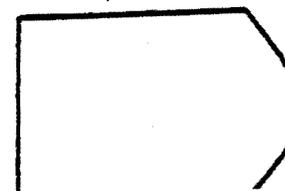
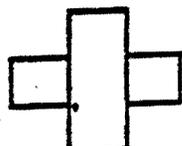
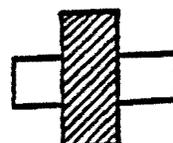
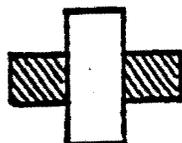
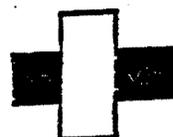
You are now going to re-do the pattern relations test but this time the items will be in a different sequence.



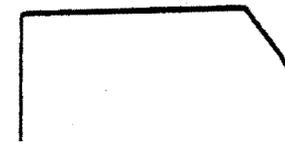
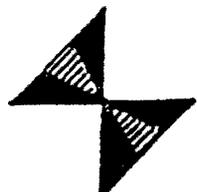
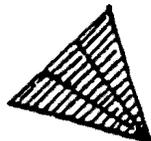
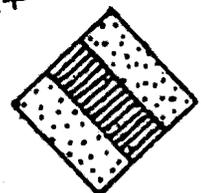
X2



X3



X4



YOU REMEMBER THESE 8 RULES

1. Look for an **Horizontal or Vertical rule**
2. Maybe you need to **shift or re-orientate** the figures
3. Maybe you need to look at **pathways** through figures which could be **open, partially closed or extended**
4. Maybe you need to **count the number of elements** which do not necessarily follow a horizontal or vertical pattern
5. Maybe you need to establish the **type and the number of shading**
6. Maybe you need to see how the figures **change shape** by being pushed in or pulled out
7. Maybe you need to **overlap or superimpose** figures to cancel each other out
8. Maybe you need to **superimpose quadrants** that are shaded in the same way.

Appendix 12:

Scoring of the DTB

MODULE 5

INTERPRETATION OF DEDUCTIVE REASONING AND PATTERN RELATIONS TESTS IN BOTH TRADITIONAL AND ENRICHED FORMS.

The deductive reasoning test administered in the traditional form will generate a raw score which can be used as a baseline measure to assess learning potential for deductive reasoning, the Pattern Relations Traditional form generates a baseline measure for inductive reasoning.

Stanines of 1-3 are low, 4-6 average and 7-9 high. The scores should be transferred to the Aptitude Profile attached. The means are derived from data at this University where these two instruments have been used.

The procedure to follow is:

1. Use the interpretation form attached to transfer:
 - 1.1 The highest stanine in the dynamic test
 - 1.2 Area of highest learning potential
 - 1.3 Area where score is consistently closest to the means of one of three directions.

The study direction most appropriate is in descending order of the above, i.e firstly where highest stanine in dynamic kit is and then the area of highest learning potential.

APTITUDE PROFILE

Student:

	Raw Score	Stanine	Category	Means (Raw Scores)		
				B.A.	BCom	BSc
Deductive Reasoning (Static)				12	(10)	20
Pattern Relations (Static)				7	9	14
Deductive Reasoning (Dynamic)				16	(13)	(27)
Pattern Relations (Dynamic)				13	17	(26)
Learning Potential in Deduction				4	(3)	(7)
Learning Potential in Induction				5	8	(12)

Appendix 13:

Interpretation of DTB Results

APTITUDE INTERPRETATION

Student:

1. Highest Stanine (dynamic) Score Area

Raw Closest mean Area

2. Highest Learning Potential Score Area

Closest mean Area

3. Closest mean for DR (static)

Closest mean for PR (static)

Closest mean for DR (dynamic)

Closest mean for PR (dynamic)

Closest mean for LP (Deduction)

Closest mean for LP (Induction)

Options to be considered

.....

.....

.....

Appendix 14:

The Training programme for Mediators

T R A I N I N G P R O G R A M M E

3 HOUR WORKSHOP

- | | | |
|----|--|-------------|
| 1. | New Testing Format | |
| | 1.1 Critique of traditional tests : learning potential | |
| | 1.2 Standardized general skills testing for potential | |
| | 1.2.1 Deductive reasoning | |
| | 1.2.2 Inductive reasoning | [20 mins] |
| 2. | Aquaintance with Tests | |
| | 2.1 Testees to do DRT items 3, 9, 15, 21, 27, 33 | |
| | PRT items 2, 7, 12, 17, 22, 27 | [30 mins] |
| 3. | Administration of Tests | [20 mins] |
| 4. | Mediation for DRT | [25 mins] |
| 5. | Mediation for PRT | [35 mins] |
| 6. | Retest items DRT/PRT | [20 mins] |
| 7. | Interpretation of Tests | [30 mins] |

3 HOURS

Appendix 15:

Evaluation Questionnaire of DTB

A P T I T U D E T E S T I N G

EVALUATION QUESTIONNAIRE

Note : For convenience, abbreviate as follows:

Deductive Reasoning 1st Test (DRT/T); Deductive Reasoning 2nd Test (DRT/E);
 Pattern Relations 1st Test (PRT/T); Pattern Relations 2nd Test (PRT/E).

1. In what ways did you find this form of testing different from other testing programmes?

2. Which of the tests did you find most difficult? Why?

3. Which of the tests did you find least difficult? Why?

4. Did you find the mediation (teaching) useful? Why?

Additional comments : _____

Appendix 16:

The Rules of Reasoning Mediation Wall-Chart

**YOU WILL IMPROVE YOUR SCORE IF
YOU REMEMBER THESE 8 RULES**

1. Look for an **Horizontal or Vertical rule**
2. Maybe you need to **shift or re-orientate** the figures
3. Maybe you need to look at **pathways** through figures which could be **open, partially closed or extended**
4. Maybe you need to **count the number of elements** which do not necessarily follow a horizontal or vertical pattern
5. Maybe you need to establish the **type and the number of shading**
6. Maybe you need to see how the figures **change shape** by being pushed in or pulled out
7. Maybe you need to **overlap or superimpose** figures to cancel each other out
8. Maybe you need to **superimpose quadrants** that are shaded in the same way.

Appendix 17:

Instructions for Deductive Reasoning Test

4.4 Instructions

- (i) **Language:** Request the subjects to indicate the language of their choice. Both English and Afrikaans books are available and the appropriate booklet should be given to each subject.
- (ii) **Instruct the subjects to fill in the following details on the answer sheet:**
 - (a) **Name**
 - (b) **Occupation**
 - (c) **Home town**
 - (d) **Age**
 - (e) **Sex**
 - (f) **Educational level**
 - (g) **Language**

The administrator should then insert the following information:

- (a) **Tested by**
 - (b) **Place**
-
- (iii) **The subjects should then open to the first page of the test booklet and read the section entitled "Instructions".**
 - (iv) **The administrator reads the instructions aloud in the home language of the group.**
 - (v) **The subjects should be reminded that there is only one correct alternative in each item and that there is a 40 minute time limit.**
 - (vi) **Instruct the subjects to turn over to the first page of items and begin.**
 - (vii) **After 40 minutes instruct the subjects to stop working.**
 - (viii) **Collect the answer sheets immediately, and then the question booklets and pencils. It is advisable not to allow the subjects to leave the room until all the test material has been collected.**

INSTRUCTIONS

In this test you will be asked to solve a number of syllogisms. A syllogism consists of two simple statements from which it is possible to infer a conclusion.

Here is an example of a syllogism:

Statement 1: All snakes are reptiles

Statement 2: All cobras are snakes

Therefore: All cobras are reptiles

Note that in solving a syllogism one cannot always rely on common sense. Sometimes the rules of logic produce conclusions which do not sound right to us.

For example:

All metals are malleable

Some metals are liquids

Therefore: Some liquids are malleable

It is also possible to infer a logically correct conclusion from two completely senseless statements.

For example:

Some spoons are plates

All plates are knives

Therefore: Some knives are spoons

This is a test of your ability to deduce **logically correct** conclusions from given statements. Items in the test will include syllogisms similar to each of the three types outlined in the examples above. Do not concern yourself with whether the statements are factually correct. The test items appear in this booklet. You are to record your answers on the separate answer sheet. Please do not make any marks in the test booklet.

Each item consists of two statements followed by five possible conclusions. Only one conclusion is correct. Your task is to examine each pair of statements and then decide which of the five given conclusions can be logically deduced from the information given in the statements. Record your answer on the separate answer sheet by making a dark cross over the letter corresponding to your choice.

Make sure that the conclusion you select is the best, or logically "strongest" conclusion which can be correctly deduced from the information given in the two statements.

For example, if two of the five possible conclusions given for a particular item are:

All men are mortal and

Some men are mortal

both of which follow from the information given in the two statements, only the "stronger" conclusion, namely **All men are mortal** is correct.

In some cases, however, the information given in the two statements may be such that **only** the "weaker" conclusion, in this case, **Some men are mortal** can be logically deduced. In such cases the weaker conclusion is correct.

Appendix 18:

Sample of Items in Deductive Reasoning

25. All cats are immortal

All cats are milk-drinkers

Therefore:

Q. All immortal beings are milk-drinkers

R. Some immortal beings are cats

S. Some milk-drinkers are not cats

T. Some immortal beings are not milk-drinkers

U. Some milk-drinkers are immortal

26. All kneecaps are ruddy

All kneecaps are superfluous

Therefore:

V. Some ruddy things are kneecaps

W. All superfluous things are kneecaps

X. All ruddy things are superfluous

Y. All superfluous things are ruddy

Z. Some superfluous things are ruddy

27. No ice creams are red hot poker

Some apples are red hot poker

Therefore:

A. Not all red hot poker are ice creams

B. No apples are ice creams

C. Some apples are not ice creams

D. No ice creams are apples

E. Some ice creams are not apples

28. Some substances are elements

All elements are reducible

Therefore:

F. All substances are reducible

G. Some elements are reducible to substances

H. Some reducible things are substances

I. Some substances are not reducible

J. All reducible things are substances

Appendix 19:

Scoresheet for Deductive Reasoning

NIPR 206
NIPN

CODE NUMBER
KODE NOMMER

LANGUAGE
TAAL

TODAY'S DATE
VANDAG SE DATUM _____

AGE _____ **YEARS** _____ **MO** _____
OUDERDOM _____ **JARE** _____ **MA** _____

SEX
GESLAG _____

EDUCATIONAL STD
OPVOEDKUNDIGE STD. _____

NAME _____
NAAM _____

SURNAME--VAN

INITIALS--VOORLETTERS

OCCUPATION _____
BEROEP _____

HOME TOWN/DISTRICT _____
TUISDORP/GEBIED _____

TESTED BY _____ **PLACE** _____
GETOETS **DEUR** _____ **PLEK** _____

1 A B C D E
2 F G H I J
3 K L M N O
4 P Q R S T
5 U V W X Y
6 Z A B C D
7 E F G H I
8 J K L M N
9 O P Q R S
10 T U V W X
11 Y Z A B C
12 D E F G H
13 I J K L M
14 N O P Q R
15 S T U V W
16 X Y Z A B
17 C D E F G
18 H I J K L
19 M N O P Q
20 R S T U V
21 W X Y Z A
22 B C D E F
23 G H I J K
24 L M N O P
25 Q R S T U
26 V W X Y Z
27 A B C D E
28 F G H I J
29 K L M N O
30 P Q R S T
31 U V W X Y
32 Z A B C D
33 E F G H I
34 J K L M N
35 O P Q R S
36 T U V W X

TESTTOETS B/112

Appendix 20:

Instructions for Pattern Relations Test

2.0 ADMINISTRATION OF TEST

2.1 Assistants

Groups of subjects smaller than 20 in number may be tested by one person. For larger groups the administrator will require the help of assistants to distribute and collect testing materials; to answer questions; to ensure that the examples at the beginning of the test have been correctly answered; and to help maintain order in the testing room.

Assistants should be familiar with the "Administration of Test" section of this manual before testing is undertaken.

2.2 Material

One question booklet, one NIPR 200 answer sheet, a HB pencil will be needed for each subject to be tested at a single testing-session. With the exception of the answer sheet, these items may be used again at subsequent testing-sessions. No other material should be made available to subjects whilst they are being tested.

A large clock or timer which can be read by all the subjects must be displayed in the testing room.

2.3 Instructing the Subjects

Follow in detail the instructions given below.

Read aloud: "I am going to hand out the material you will need for the test. Please do not open the question booklet yet".

Give each subject a question booklet, an NIPR 200 answer sheet, and a HB pencil with eraser.

Read aloud: "Do you all have a question booklet, an answer sheet, and a pencil with a rubber?"

Give any subjects who may be lacking any of these items what they need.

Read aloud: "Now complete the biographical details asked for on the answer sheet. Please make quite sure that all the information you give is correct".

Ensure that all subjects have correctly completed the biographical questions.

Read aloud: "Please open your question booklets to the instructions at the beginning".

Look up to see that this has been done.

Read aloud: "Now follow the instructions as I read them".

Read aloud: "This is a test of your ability to think clearly. You will be given a number of patterns each with a part missing. You have to find the missing part.

Look at the page opposite this one headed "Examples". At the top there is a pattern with a piece missing. Below there are six pieces labelled A, B, C, D, E and F that might fit into the piece left out. They are all the right size and shape, but only one has the pattern. Look at A; it is quite the wrong pattern; so are B, C, E and F. D is the right answer, therefore you have to mark D on your separate answer sheet next to Example 1. Use the pencil you have been given to blacken the space thoroughly between the two dotted lines printed over letter D.

Study Example 2".

Wait until all subjects have attempted the example.

Read aloud: "Can you see that C is the correct answer? Now blacken the space between the two dotted lines over C".

Ensure that all subjects have correctly marked the letter C opposite Example 2 of their answer sheets.

INSTRUCTIONS

This is a test of your ability to think clearly. You will be given a number of patterns each with a part missing. You have to find the missing part.

Look at the page opposite to this one headed "Examples". At the top there is a pattern with a piece missing. Down below there are six pieces labelled A, B, C, D, E and F that might fit into the piece left out. They are all the right size and shape, but only one has the right pattern. Look at A; it is quite the wrong pattern; so are B, C, E and F. D is the right answer, therefore you have to mark D on your separate answer sheet next to Example 1. Use the pencil you have been given to blacken thoroughly the space between the two dotted lines printed over letter D.

Study Example 2. Can you see that C is the correct answer? Now blacken the space between the two dotted lines over C.

Try Example 3 yourself and mark the correct answer as you were shown.

On each page of this test there is a different pattern with a piece missing. All you have to do is to find the piece below which will complete the pattern and mark it over the corresponding letter next to the right question number.

They are quite easy at first, but become more difficult as you go on. If you understand how the first ones should be done, it will help you to do the others. Work quickly, but do not worry if you don't finish all the questions; it is more important that those you do are correct.

Your answer sheets will be scored by an electronic computer; therefore do not make unnecessary marks on your answer sheet and do not mark more than one answer for any question. If you want to change an answer, rub it out thoroughly before making a mark over the correct letter.

Are there any questions?

DO NOT MAKE ANY MARKS IN THE QUESTION BOOKLET. AS IT WILL BE USED AGAIN.

DO NOT PAGE OVER UNTIL YOU ARE TOLD TO START DOING THE TEST.

INSTRUKSIES

Hierdie is 'n toets van u vermoë om helder te kan dink. U sal 'n aantal onvoltooide figure gegee word. U taak is om die deel wat nie daar is nie te vind.

Kyk na die bladsy teenoor hierdie een. Bo-aan staan „Voorbeelde". Daar is 'n figuur of patroon wat nie voltooi is nie. Net onderkant is daar ses deeltjies gemerk A, B, C, D, E en F waarvan een uitgesoek moet word om die figuur te voltooi. Hulle is almal die regte grootte en vorm, maar daar is net een wat die korrekte figuur is. Kyk na A; dit is heeltemaal die verkeerde figuur, en B, C, E en F is ook verkeerd. D is die regte antwoord en daarom moet u nou D langs Voorbeeld 1 op u aparte antwoordvel merk. Kleur die spatie tussen die twee gestippelde lyne oor D duidelik in met die potlood wat aan u gegee is.

Probeer nou Voorbeeld 2. Kan u sien dat C die regte antwoord is? Kleur nou die spatie tussen die gestippelde lyne oor C in.

Probeer Voorbeeld 3 self en merk die korrekte antwoord soos aan u verduidelik is.

Op elke bladsy van die toets is daar 'n nuwe figuur wat voltooi moet word. Al wat u moet doen is om die deeltjie te vind wat die patroon sal voltooi en dit dan oor die ooreenstemmende letter langs die regte vraag-nommer te merk.

Hulle is maklik aan die begin, maar word later moeiliker. As u verstaan hoe die eerstes gedoen moet word, sal dit u help met die wat later kom. Werk vinnig, maar moet u nie daarvoor bekommer as u nie al die vrae kan klaarkry nie; dit is meer belangrik dat die wat u doen korrek is.

Die antwoordvelle sal deur 'n elektroniese rekenaar nagesien word. Moet dus nie onnodige merke op u antwoordvel maak nie en moenie meer as een antwoord by 'n vraag merk nie. As u 'n antwoord wil verander, vee dit deeglik uit voordat u 'n merk oor die korrekte letter maak.

Is daar enige vrae?

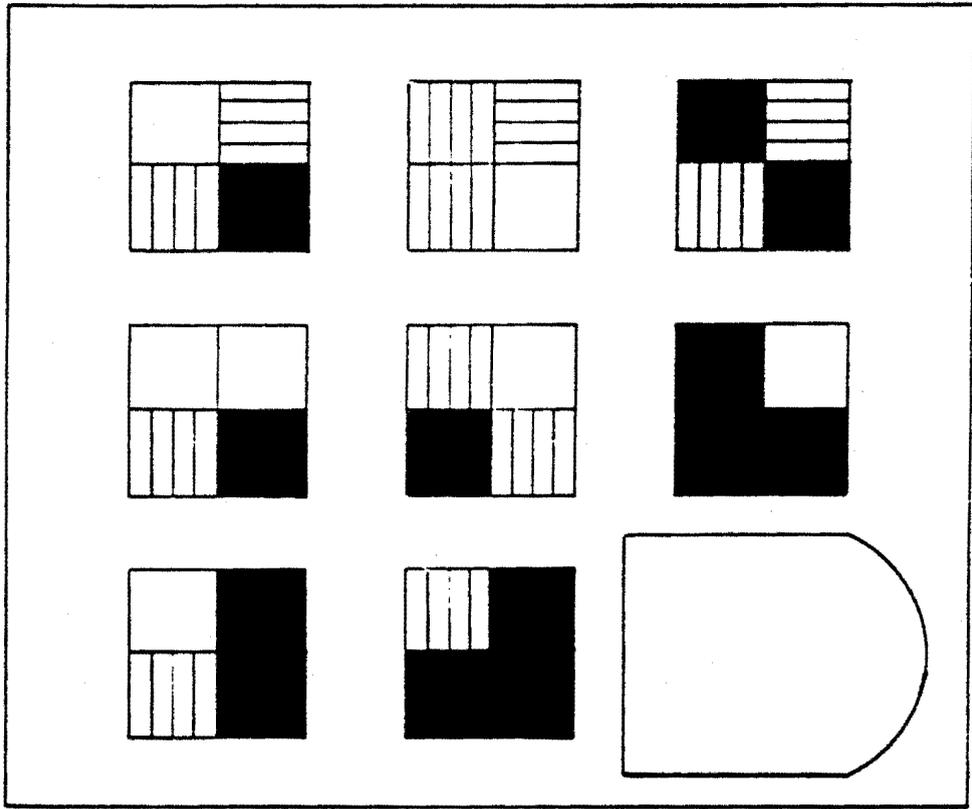
MOENIE MERKE IN DIE TOETSBOEKIE MAAK NIE. WANT DIT MOET WEER GEBRUIK WORD.

MOENIE OMBLAAI VOORDAT U GEVRA WORD OM DIE TOETS TE BEGIN NIE.

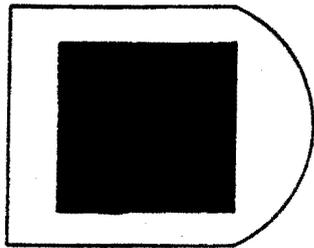
Appendix 21:

Sample of Items in Pattern Relations Tests

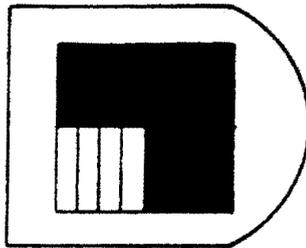
9



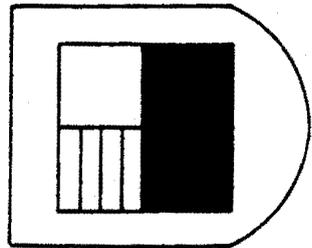
A



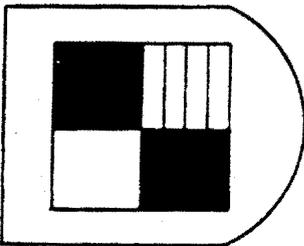
B



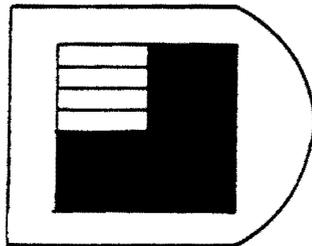
C



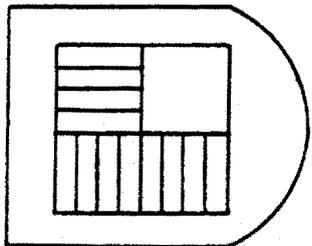
D



E



F



Appendix 22:

Answer Sheet for Pattern Relations Enriched

ANSWER SHEET

NAME _____

DATE _____

ITEM NO.	RESPONSE
1	
10	
16	
12	
11	
8	
4	
7	
13	
2	
3	
23	
26	
5	
6	
18	
9	
25	
17	
27	
20	
21	
22	
15	
19	
24	
14	

28	
29	
30	

STANINE	
STANDARD SCORE	
RAW SCORE	

Appendix 23:

The Cognitive Functions and Dysfunctions of Feuerstein

	COGNITIVE FUNCTIONS	COGNITIVE DYSFUNCTIONS
INPUT	1) Clear Perception/ Data Gathering	Blurred & Sweeping
	2) Systematic Exploration of a learning situation	Impulsive
	3) Precise and Accurate Receptive Verbal Tools and Concepts	Impaired
	4) Well developed Understanding of Spatial Concepts	Impaired
	5) Well developed Understanding of Temporal Concepts	Lack of/Impaired
	6) Well developed Ability to conserve Constancies	Impaired
	7) Precise and Accurate Data gathering	Impaired
	8) Well developed Capacity to consider more than one source of information.	Impaired

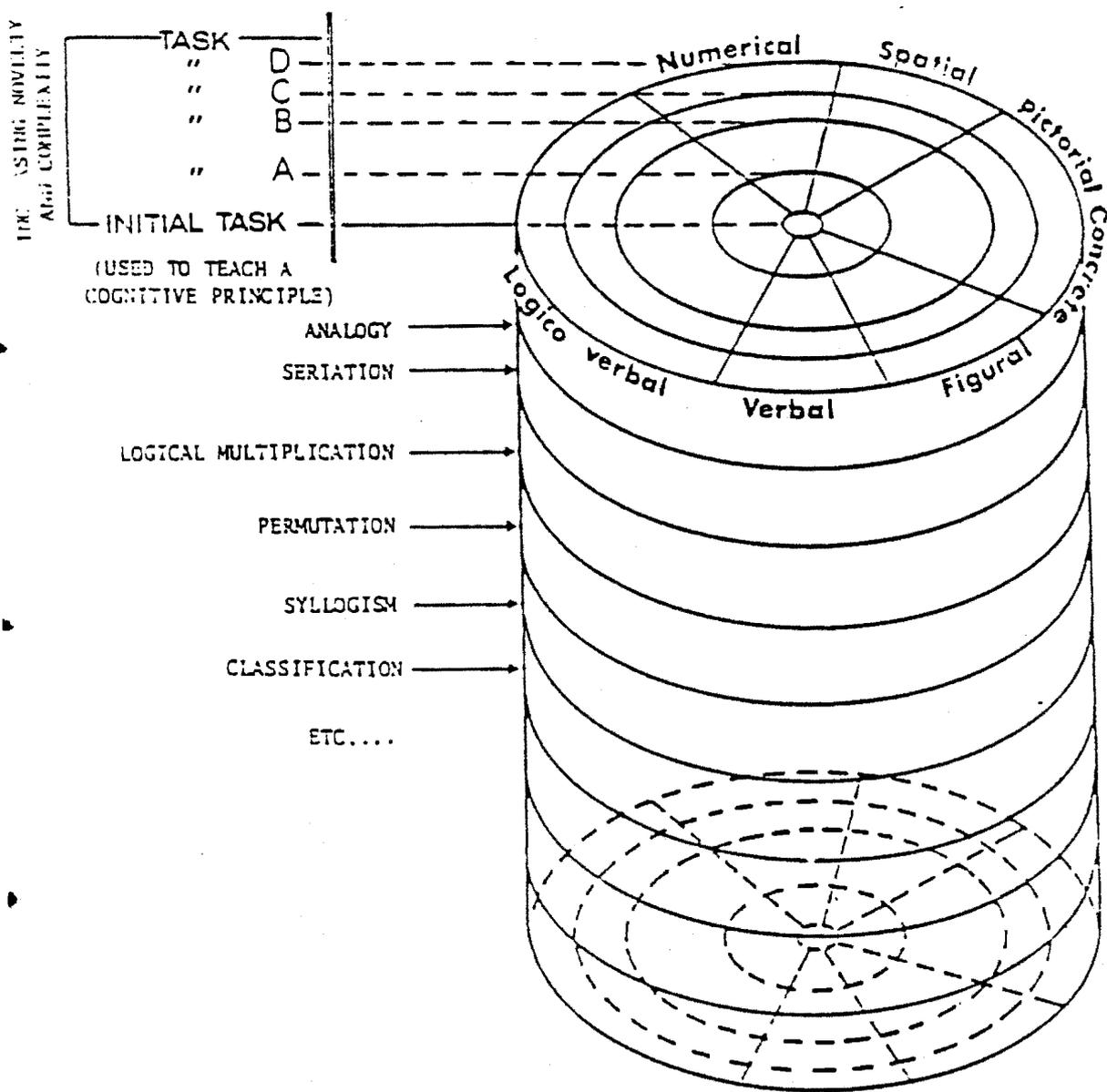
ELABORATION	1) Accurate Definition of the problem	Inaccurate
	2) Ability to Select relevant cues	Impaired ability to
	3) Ability to Engage in spontaneous comparative behaviour	Inability to
	4) Broad and wide Mental field.	Narrow and limited
	5) Need for Spontaneous summative behaviour	Impaired need for
	6) Ability to Project virtual relationships	Inability to
	7) Need for Logical evidence	Lack of need for
	8) Ability to Internalize events	Inability to
	9) Ability to use Inferential-hypothetical thinking	Restricted use of
	10) Ability to use Strategies for hypothesis testing	Impaired
	11) Need for Planning behaviour	Lack of
	12) Ability to Elaboration of cognitive categories	Impaired
	13) Meaningful Grasp of reality	Episodic

OUTPUT	1) Mature Communication modalities	Egocentric
	2) Participatory Output responses	Blocking
	3) Worked through Output responses	Trial and error
	4) Adequate Expressive verbal tools	Impaired
	5) Precise & Accurate Data Output	Impaired
	6) Accurate Visual Transport	Impaired
	7) Appropriate	Impulsive/ Acting-out

Appendix 24:

The LPAD Model

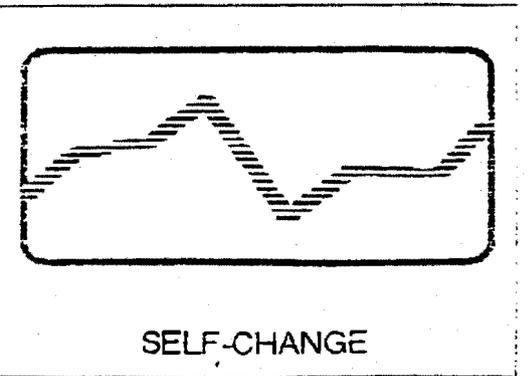
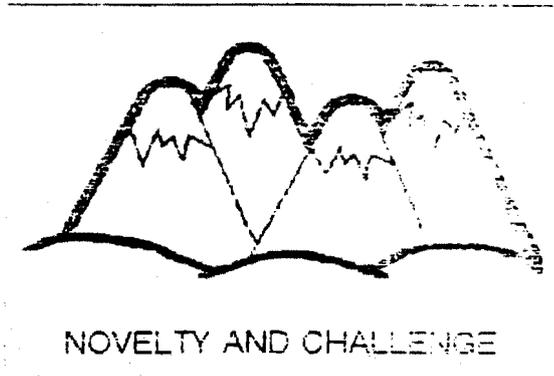
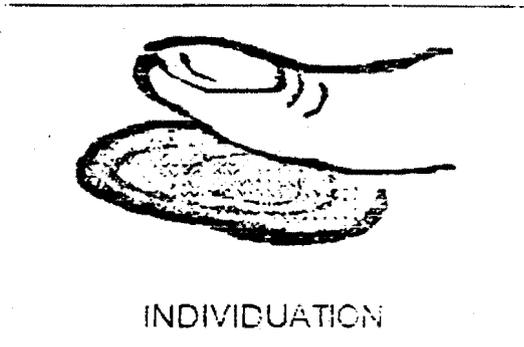
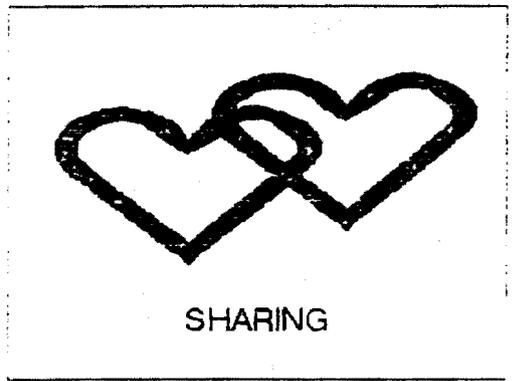
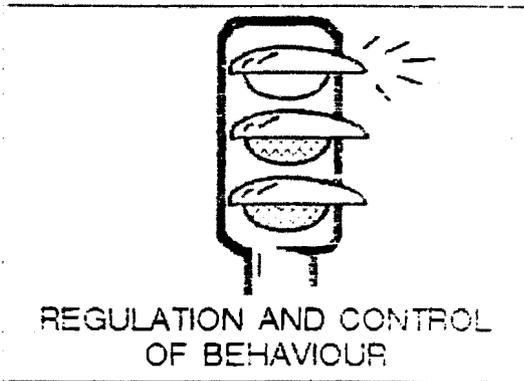
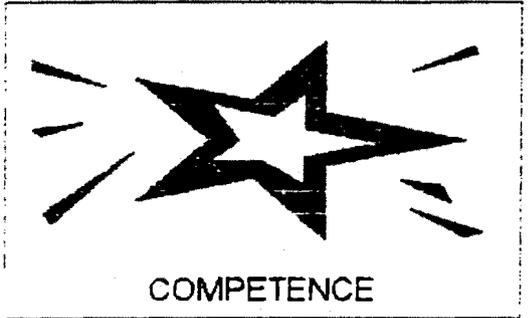
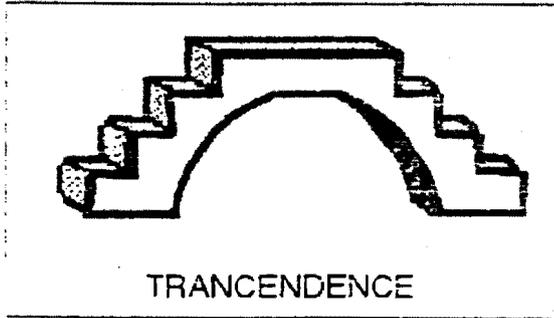
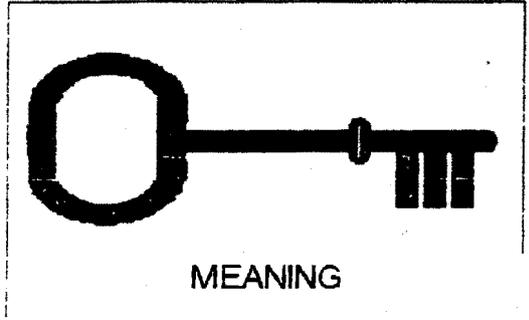
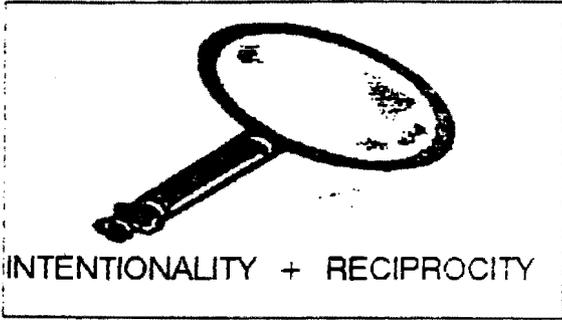
L.P.A.D Model



Appendix 25:

The Criteria of Mediation

THE 10 CRITERIA OF MEDIATED LEARNING EXPERIENCE



Appendix 26:

Components of the Mental Act

COGNITIVE MAP

Components of the mental act

1. The universe of content around which the mental act is centered.
2. The modality or language in which the mental act is expressed
3. The phase of the cognitive functions required by the mental act. (Input, Elaboration, Output).
4. The cognitive operations required by the mental act.
5. Level of complexity.
6. Level of abstraction.
7. The level of efficiency with which the mental act is performed.

REFERENCES

- Abel, T H 1973. *Psychological Testing in Cultural contexts*. New Haven: University Press.
- Adelman, H S & Taylor, L 1979. Initial Psychoeducational Assessment and Related consultation. *Learning Disability Quarterly*, 2: 52-64.
- Anastasi, A 1976. *Psychological Testing* (5th ed). New York: MacMillan.
- Anastasi, A 1982. *Psychological testing*. New York: MacMillan.
- Auerbach, FE 1977. *South African school enrolment patterns*. Unpublished Doctoral publication, University of South Africa.
- Babad, E Y & Budoff, M 1974. Sensitivity and validity of learning-potential measurement in three levels of ability. *Journal of Educational Psychology*, 66(3): 439-447.
- Baggaley, A R 1974. Academic prediction at Ivy League college moderated by demographic variables. *Measurement and Evaluation in Guidance*, 6(4): 232-235.
- Behr, D 1982. The predictors of academic performance of first-year engineering students. *South African Journal of Education*, 2(3): 89-95.
- Beretter, C 1962. Using tests to measure change. *Personnel and Guidance Journal*, 41: 6-11.
- Bethge, H, Carlson, J S & Weidl, K H 1982. The effects of dynamic assessment procedures on Raven Matrices performance, visual search behaviour, test anxiety and test orientation. *Intelligence*, 6: 89-97.
- Biesheuvel, S 1972. An examination of Jensen's theory concerning educability, heritability and population differences. *Psychologia Africana*, 14: 87-94.
- Biesheuvel, S 1972. Adaptability: It's measurement and determinants. In L J Cronback & P J Drenth (eds), *Mental Tests and Cultural Adaptation*. The Hague: Mouton.
- Block, N & Dworkin, G (eds) 1976. *The IQ Controversy: Critical readings*. London: Quartet Books.
- Blum, J M 1978. *Pseudoscience and Mental Ability*. London: Monthly Review Press.

Boeyens, J 1989. *Learning Potential and Academic Performance*, M A Thesis, UNISA.

Brand, C R & Deary, I J 1982. Intelligence and 'Inspection Time'. In H J Eysenck (ed), *A Model for Intelligence*. New York: Springer-Verlag.

Bransford, J D, Delclos, V R, Vye, N J, Burns, M S & Hasselbring, T S 1987. State of the art and future directions. In C S Lidz(ed), *Dynamic assessment: an interactional approach to evaluating learning potential* (479-496). New York: Guilford Press.

Bransford, J D, Stein, B S, Arbitman-Smith, R & Vye, N J 1985. Improving thinking and learning skills: An analysis of three approaches. In J Segal, S F Chipman & R Glaser (eds), *Thinking and learning skills: Relating instruction to research* 1: 133-208. Hillsdale, NJ: Erlbaum.

Breland, 1979. Population validity and College entrance measures. *Research Monograph* 8.

Bronfenbrenner, U 1970. Is early intervention effective? Some studies of early education in familial and extra-familial settings. In A Montague (ed), *Race and IQ*. New York: Oxford University Press.

Brown, A L 1974. The role of strategic behaviour in retardate memory. In N R Ellis (ed), *International review of research in mental retardation* 7: 51-111. New York: Academic Press.

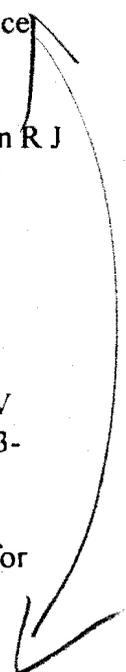
Brown, A L 1979. The zone of the potential development: implications for intelligence testing in the year 2000. *Intelligence*. 3: 255-273.

Brown, A L & Campione, J C 1985. Academic intelligence and learning potential. In R J Sternberg & Detersman (eds), *What is intelligence? Contemporary viewpoints on its nature and definition*. Ablex.

Brown, A L & Campione, J C 1986. Psychological theory and the study of learning disabilities. *American Psychologist*, 41: 1059-1068.

Brown, A L & Ferrara, R A 1985. diagnosing zones of proximal development. In J V Wertsch (ed), *Culture, communication, and cognition: Vygotskian perspectives* (273-305). Cambridge University Press.

Brown, A L & French, L A 1979. The zone of potential development: Implications for intelligence testing in the year 2000. *Intelligence*, 3: 255-273.



Bruner, J S 1975. *Poverty and childhood*. Oxford Review of Education. 1: 31-50.

Budoff, M 1969. Learning potential: a supplementary procedure for assessing the ability to reason. *Seminars in Psychiatry*, 1(3): 278-290.

Budoff, M 1987. The validity of learning potential assesment. In C S Lidz(ed), *Dynamic assessment: An interactional approach to evaluating learning potential* (52-81). New York: Guilford Press.

Budoff, M 1987. Measures for assessing learning potential. In C S Lidz (ed), *Dynamic assessment: An interactional approach to evaluating learning potential* (173-195). New York: Guilford Press.

Budoff, M & Freidman, M 1964. 'Learning potential' as an assessment approach to the adolescent mentally retarded. *Journal of Consulting Psychology*, 28: 434-439.

Budoff, M & Corman, I 1974. Demographic and psychometric factors related to improvement performance on the Kohs learning procedure. *American Journal of Mental Deficiency*, 78:578-585.

Burns, M S 1985. Comparison of 'graduated prompt' and 'mediational' dynamicassessment and static assessment with young children (Tech Rep No 2). *Alternative assessments of young handicapped children*. Nashville, TN: Vanderbilt University, John F Kennedy Center for Research on Human Development.

Burns, M S, Haywood, H C, Delclos, V R & Sieward, L 1987. Young children's problem-solving strategies: An observational study. *Journal of Applied Developmental Psychology*, 8(1): 113-121.

Burt, C 1966. The genetic determination of differences in intelligence. A study of monozygotic twins reared together and apart. *British Journal of Psychology*, 57: 137-153.

Burt, C 1968. Mental capacity and its critics. *Bulletin of the British Psychological Society*, 21: 11-18.

Butterfield, E C 1988. Intelligent Action, Learning, and Cognitive Development might all be explained with the Same Theory. In Sternberg R J & Detterman D K, *What is Intelligence?* Ablex.

Campione, J C 1989. Assisted assessment: A taxonomy of approaches and an outline of strengths and weaknesses. *Journal of Learning Disabilities*, 22: 151-165.

Campione, J C & Brown, A L 1978. Toward a theory of intelligence: Contributions from research with retarded children. *Intelligence*, 2: 279-304.

Campione, J C & Brown, A L 1987. Linking dynamic assessment with school achievement. In C S Lidz(ed) *Dynamic assessment: An interactional approach to evaluating learning potential* (82-115). New York: Guilford Press.

Campione, J C, Brown, A L & Bryant, N R 1985. Individual differences in learning and memory. In R J Sternberg (ed), *Human abilities: An information processing approach* (103-126). New York: Freeman.

Campione, J C, Brown, A L & Connell, M L 1989. Metacognition: On the importance of understanding what you are doing. In R I Charles & E A Silver (eds), *The teaching and assess of mathematical problem solving* (93-114). Hillsdale, NJ: Erlbaum.

Campione, S C, Brown, A L & Ferrara, R A 1982. Mental retardation and intelligence. In R J Sternberg (ed), *Handbook of Human Intelligence*. (392-492). Cambridge University Press.

Campione, J C, Brown, A , Ferrara, R A & Bryant, N R 1984. The zone of proximal development: Implications for individual differences and learning. In B Rogoff & J V Wertsch (eds), *Children's learning in the 'zone of proximal development'* (77-91). San Francisco: Jossey-Bass.

Campione, J C, Brown, A L, Ferrara, R A, Jones, R S & Steinberg, E 1985. Breakdowns in flexible use of information: Intelligence-related differences in transfer following equivalent learning performance. *Intelligence* 9: 297-315.

Carlson, J S 1983. *Dynamic assessment in relation to learning characteristics and teaching strategies for children with specific learning disability* (final report). Washington, DC: Department of Education.

Carlson, J S & Weidl, K H 1978. Use of testing-the-limits procedures in the assessment of intellectual capabilities in children with learning difficulties. *American Journal of Mental Deficiency*, 82: 559-564.

Carlson, J S & Weidl, K H 1979. Toward a differential testing approach: Testing-the-limits employing the Raven Matrices. *Intelligence*, 3: 323-344.

Carlson, J S & Weidl, K H 1980. *An approach toward reducing test bias*. Paper presented at the annual meeting of the Western Psychological Association, Honolulu, HI.

- Carney, J J & Cioffi, G 1990. Extending traditional diagnoses: The dynamic assesment of reading abilities. *Reading Psychology*, 11(3): 177-192.
- Cattell, R B 1963. Theory of fluid and crystallized intelligence: A critical experiment. *Journal of Educational Psychology*, 18: 165-244.
- Cleary, T A & Humphreys G L 1975. Educational uses of tests with disadvantaged students. *American Psychologist* 30: 15-41.
- Cole, N S. Bias in testing. *American Psychologist*. 36: 1067-1077.
- Cooper, C, Shindler, J, McCaul, C, Potter, F, Cullum, M, Narsoo, M & Brouard, P 1985. *Race relations survey 1985*. Johannesburg: South African Institute of Race Relations.
- Corman, I & Budoff, M 1973. *The Series Test as a measure of learning potential*. RIEPrint No 47. Cambridge, MA: Research Institute for Educational Problems.
- Corman, I & Budoff, M 1974. Factor structures of retarded and nonretarded children on Raven Progressive Matrices. *Educational and Psychological Measurement*, 34: 407-412.
- Cowley, A M 1977. Report on first Year Failure Research Project. Unpublished manuscript, University of the Witwatersrand, Counselling and Careers Unit, Johannesburg.
- Cross, C T 1990. National goals: four priorities for educational researchers. *Educational Researcher*, 19(8): 21-24.
- Csapo, M 1986. Separate development: Education and special education in South Africa, *International Journal of Special Education*, 1: 49-91.
- Culverwell, P 1989. *Learning strategies and academic success of undergraduate Arts students*. M A Thesis, Wits University.
- Dalton, S 1976. A decline in the predictive validity of the SAT and high school achievement. *Educational and Psychological Measurement*, 36, 445-448.
- Deutsch, C P 1968. Environment and perception. In M Deutsch, I Katz & A Jensen (eds), *Social class, race and psychological development* (58-85). New York: Holt, Rinehart and Winston.

Donald, D R & Hlongwane, M M 1989. Consultative psychological service delivery in the context of black education in South Africa. *International Journal of Special Education*, 4: 119-140.

Embretson, S E 1987. Toward development of a psychometric approach. In C S Lidz (ed), *Dynamic assessment: An interactional approach to evaluating learning potential* (141-170). New York: Guilford Press.

Entwistle, N 1977. Strategies of learning and studying. *British Journal of Educational Studies*, 25(3): 225-238.

Entwistle, N 1984. Contrasting perspectives on learnings. In F Marton, D Hounsell, and N Entwistle (eds), *The Experience of Learning* (1-19). Edinburgh: Scottish Academic Press.

Entwistle, N 1987. *Changing Perspectives in Education*. London: Hodder and Stoughton.

Evans, B & Waites, B 1981. *IQ and mental testing*. MacMillan, Hong Kong.

Eysenck, H J 1971. *Race, Intelligence and Education*. London: Temple Smith.

Eysenck, H J 1981. In H J Eysenck versus L Kamin, *Intelligence: The Battle of the Mind*. London: Multimedia Publications.

Ferrara, R A, Brown, A L & Campione, J C 1986. Children's learning and transfer of inductive reasoning rules: Studies in proximal development. *Child Development*, 57: 1087-1099.

Ferrara, R A 1987. *Learning mathematics in the zone of proximal development: The importance of flexible use of knowledge*. Unpublished doctoral dissertation, University of Illinois: Champaign.

Feuerstein, R 1970. A dynamic approach to the caustion, prevention and alleviation of retarded performance. In H C Haywood (ed), *Socio-cultural aspects of Mental retardation*. New York: Appleton-Century Crofts.

Feuerstein, R 1979. *The dynamic assessment of retarded performers*. Baltimore: University Park Press.

Feuerstein, R 1980. *Instrumental Enrichment: An Intervention Programme for cognitive Modifiability*. Baltimore: University Park Press.

Feuerstein, R & Jensen, M R 1980. Instrumental enrichment: Theoretical basis, goals, and instruments. *The Educational Forum*, May: 401-423.

Feuerstein, R, Miller, R & Jensen, M 1981. Can evolving techniques better measure cognitive change? *Journal of Special Education*, 15: 201-219.

Feuerstein, R, Rand Y, Hoffman, M B, Hoffman, M & Miller, R 1979. Cognitive Modifiability in retarded adolescents: effects of instrumental enrichment. *American Journal of Mental Deficiency*, 6: 571-679.

Feuerstein, R, Rand, Y, Hoffman, M B & Miller, R 1980. *Instrumental enrichment*. Baltimore: University Park Press.

Feuerstein, R, Rand, Y, Hoffman M B & Miller, R 1980. *Instrumental enrichment: An Intervention Program for Cognitive Modifiability*. Illinois : Scott, Foreman & Co.

Feuerstein, R, Rand, Y, Hoffman, M B, Egozi, M & Shachar-Segev, N M 1991. Intervention programs for retarded performers: Goals, means and expected outcomes. In L Idol & B F Jones (eds), *Educational values and cognitive instruction: Implications for Reform* (139-178). Hillsdale, NJ: Erlbaum.

Garcia, J 1981. *The logic & limits of mental aptitude testing*. *American Psychologist*, 36: 1172-1180.

Gardner, E 1982. Some aspects of the uses and misuse of standardized aptitude and achievement tests. In A K Wigdor & W R Garner (eds), *Ability testing: Uses, consequences, and controversies* (315-334). Washington, DC: National Academy Press.

Gardner, H 1983. *Frames of Mind: The Theory of Multiple Intelligences*. New York: Basic books.

Glaser, R 1981. The Future of Testing: A research agenda for cognitive Psychology and Psychometrics. *American Psychologist*, 36(9): 923-936.

Glaser, R 1982. *The future of testing: A research agenda for cognitive Psychology and psychometrics*. University of Pittsburgh, Learning research and development centre, technical report No. 3.

- Glaser, R 1984. Education and Thinking: The Role of Knowledge. *American Psychologist* 39: 93-104.
- Greenfield, P M 1966. On culture and conservation. In J S Bruner et al (eds), *Studies in cognitive growth* (225-256). New York: Wiley.
- Greenfield, P M & Bruner, J S 1966. Culture and cognitive growth. *International Journal of Psychology*, 1(2): 89-107.
- Guilford, J P 1967. *The nature of human intelligence*. New York: McGraw-Hill.
- Hall, B A 1979. *Interim validation of a selection procedure for black medical technologists*. Johannesburg: National Institute for Personnel Research. Pers 289.
- Hamilton, J L & Budoff, M 1974. Learning potential among moderately and severely mentally retarded. *Mental Retardation*, 12(4): 33-36.
- Hanson, R 1975. Consistency and stability of home environmental measures related to IQ. *Child Development* 46: 470-480.
- Hartshorne, K B 1983. *Black secondary School Leavers, Trends in Senior certificate Matriculation 1960-1982*. Wits University, Johannesburg: Paper presented at committee of University Principals (CUP) conference on academic support.
- Hartshorne, K B 1984. *Notes on Secondary Education*. Johannesburg: University of the Witwatersrand. Paper presented at Wits Senate Academic Freedom Committee Seminar Programme.
- Hartshorne, K B 1986. African Matric results: The disintegration of urban education. *Indicator S A*, 4(2): 54-48.
- Hartshorne, K 1988/9. 'Black Matriculation Results: a Mechanism of Social Control, by Elmon Mathonsi', review, *Perspectives in Education* 10(2): 93-93.
- Hartman, W T & Bell, D P 1978. The predictive value of the Stanford University Admission Rating System. *College and University*, 53(3).
- Haywood, H C (ed) 1970. *Socio-cultural Aspects of Mental Retardation*. New York: Appleton-Century-Crofts.
- Herrnstein, R J 1973. *IQ in the Meritocracy*. Boston: Little Brown.

- Heller, K A, Holtzman, W H & Messick, S (eds) 1982. *Placing children in special education: A strategy for equity*. Washington, DC: National Academy Press.
- Hosseini, A A 1978. The predictive validity of the scholastic aptitude test of the National Organisation for Education Evaluation of the Iranian Ministry of Sciences and Higher Education for a group of Iranian students. *Educational and Psychological Measurement*, 38: 1041-1047.
- Houston, L N 1983. The comparative predictive ability of high school rank, the Ammon Quick Test, and two scholastic aptitude test measures for a sample of black female college students. *Educational and Psychological measurement*, 43: 1123-1126.
- Howard, R W 1991. *All about intelligence*. Kensington (Australia): NSW University Press.
- Humphreys, L G 1968. The fleeting nature of the prediction of college academic success. *Journal of Educational Psychology*, 59(5): 375-380.
- Hunt, E 1980. Intelligence as an information-processing concept. *British Journal of Psychology*, 71: 449-475.
- Hunt, J McV 1975. *Intelligence and experience*. New York: The Ronald Press Company.
- Irvine, S H 1966. Towards a rationale for testing attainments and abilities in Africa. *British Journal of Educational Psychology*, 36: 24-32.
- Irvine, S H 1966. Adapting tests to the cultural setting: A comment. *Occupational Psychology*, 39: 12-23.
- Jencks, C & Crouse, J 1982. Aptitude vs Achievement: Should we replace the SAT. *The Public Interest*, 67: 21-35.
- Jensen, A R 1969. How much can be boost IQ and scholastic achievement? *Harvard Educational Review*, 39: 1-123.
- Jensen, A R 1972. *Genetics and Education*. London: Methuen.
- Jensen, A R 1973. *Educability and Group Differences*. New York: Harper and Row.
- Jensen, A R 1974. How Biased are Culture-Loaded Tests? *Genet. Psychol. Monogr.*, 90: 185-245.

- Jensen, A R 1980. *Bias in Mental Testing*. London: Methuen.
- Kameenui, E J & Simmons, D C 1990. *Designing instructional strategies: The prevention of academic learning problems*. Columbus OH: Merrill.
- Kamin, L J 1974. *The science and politics of IQ*. New York: John Wiley & Sons.
- Katz, M A & Buchholz, E S 1984. Use of the LPAD for cognitive enrichment of a deaf child. *School Psychology Review* 13: 99-106.
- Kletzien, S B & Bednar, M R 1990. Dynamic assessment for at-risk readers. *Journal of Reading*, 33(7): 28-33.
- Kormann, A & Sporer, S L 1983. Learning Tests: Concepts and Critical Evaluation. *Studies in Educational Evaluation*, 9: 169-184.
- Levenstein, P 1970. Cognitive growth in pre-schoolers through verbal interaction with mothers. *American Journal of Orthopsychiatry*, 40: 426-432.
- Lidz, C S 1987. Historical perspectives. In C S Lidz (ed), *Dynamic assessment: An interactional approach to evaluating learning potential* (3-34). New York: Guilford Press.
- Lidz, C S 1987. *Dynamic Assessment*. New York: Guilford Press.
- Lidz, C S 1991. *Practitioner's Guide to dynamic assessment*. New York: Guilford Press.
- Lloyd, F & Pidgeon D A 1961. An investigation into the effects of coaching on non-verbal test material with European, Indian and African children. *British Journal of Educational Psychology*, 31: 145-151.
- Lord, F M 1963. Elementary models for measuring change. In C Harris (ed), *Problems in measuring change*. Madison: The University of Wisconsin Press.
- Lord, F M & Novick, M R 1968. *Statistical theories of mental test scores*. London: Addison-Wesley Publishing Company.
- McCall, R, Applebaum, M & Hogarty, P 1973. *Developmental Changes in Mental Performance*. Monographs of the Society for Research in Child Development, Series 150(3): 38.

- Mc Donnell, N 1975. *Testing for student selection at Tertiary level*. Australian Council for Electoral Research.
- McNemar, Q 1969. *Psychological statistics* (4th ed). New York: Wiley & Sons.
- Mann, L 1979. *On the trail of process*. New York: Grune and Stratton.
- Marcum, J A 1982. *Education, Race and Social Change in South Africa*. Berkley: University of California Press.
- Marten, F & Svenson, L 1979. Conceptions of research and student learning. *Higher Education* 8 : 471-486.
- Matarazzo, J D & Wiens, A N 1977. Black intelligence test of cultural homogeneity and Weschler Adult Intelligence scale scores of black and white applicants. *Journal of Applied Psychology*, 62(1): 57-63.
- Meyers, J 1987. The training of dynamic assessors. In C S Lidz (ed), *Dynamic assessment: An interactional approach to evaluating learning potential* (403-425). New York: Guilford Press.
- Miller, R (1989). Conceptual issues in theorising about cognition. New students in old universities: cognitive development in the South African tertiary educational context. *South African Journal of Higher Education*. 3(1), 1989.
- Miller, R & Meltzer, L 1978. the effect of schooling and technology on the cognitive development of African children. *Genetic Psychology Monographs*, 98: 113-155.
- Mitchell, G & Fridjohn, P 1987. Matriculation examinations and university performance. *South African Journal of Science*, 83: 555-559.
- Molteno, F 1984. The historical foundations of the schooling of Black South Africans. In P Kallaway (ed), *Apartheid and Education*. Johannesburg: Ravan Press.
- Mueller, K H & Mueller, J H 1953. Class structure and academic and social success. *Educational and Psychological Measurement*, 13: 486-496.
- Murray, D 1988. *Effectiveness of Feuerstein's Learning Potential Assessment device in a South African Context*. M A Thesis, Wits University.
- Murray, M M 1961. *The development of spatial concepts in African and European children*. Unpublished master's thesis, University of Natal, Pietermaritzberg.

- Newell, A & Simon, H 1972. *Human Problem-Solving*. Prentice Hall.
- Nisbet, J & Welsh, J 1966. Predicting student performance. *Universities Quarterly*, 20: 468-481.
- Nunnally, J 1975. Psychometric theory - 25 years ago and now. *Educational Research* 4(1): 7-21.
- Oakland, T M 1977. *Psychological and Educational Assessment of Minority Children*. New York.
- Ord, I G 1972. Testing for educational and occupational selection in developing countries - a review. *Occupational Psychology*, 46: 123-166.
- Palincsar, A S & Brown, A L 1984. Reciprocal teaching of comprehension-fostering and monitoring activities. *Cognition and Instruction*, 1(2): 117-175.
- Perry, W 1970. *Forms of intellectual and ethical development in the college years: a scheme*. New York: Holt, Reinhart & Winston.
- Piaget, J 1950. *The psychology of intelligence*. London: Routledge & Kegan Paul.
- Piaget, J 1953. *The origin of intelligence in the child*. London: Routledge & Kegan Paul.
- Piaget, J 1972. Intellectual evolution from adolescence to adulthood. *Human Development*, 15: 1-12.
- Pfeifer, C M & Sedlaker, W E 1971. The validity of academic predictors for Black and White students at a predominantly White University. *Journal of Educational Measurement*, 8(4): 253-261.
- Potter, C S & Jamotte, A W 1985. African Matric results: Dubious indicators of academic merit. *Indicator S A*, 13(1): 10-13.
- Potter, C S, Jamotte, A W, & Van der Merwe, E 1983. *Report on Analysis of Results from Selection for 1981 Cadets: School Performance Variables*. (Unpublished manuscript, Cadet Scheme Working Paper No 8.6) Johannesburg: University of the Witwatersrand.
- Ramsden, P 1988. Improving teaching and learning in higher education: The case for a relational perspective. *Studies in Higher Education*, 12: 275-286.

- Resnick, L 1979. The future of IQ Testing in Education. *Intelligence*, 3: 244-253.
- Rogoff, B & Wertsch, J V (eds) 1984. *Children's learning in the 'zone of proximal development'*. San Francisco: Jossey-Bass.
- Rutherford, M & Watson, P 1991. *Selection of wait-listed students for the Faculty of Science: University of the Witwatersrand, 1988-1991*. Research Report, University of the Witwatersrand.
- Samuda, R J 1987. *The link between racism and the assessment of minorities*. Paper presented at Symposium of the IACCP Regional North American Conference at Kingston, Ontario.
- Sattler, J M 1982. *Assessment of children's intelligence and special abilities*. Second edition. Allyn and Bacon, Inc. Boston.
- Scarr, S 1978. From evolution to Larry P, or what shall we do about IQ tests? *Journal of Intelligence* 2: 325-342.
- Scarr, S 1981. *Race, social class, and individual differences in IQ*. New Jersey: Lawrence Erlbaum.
- Scarr, S & Weinberg, R A 1976. IQ test performance of black children adopted by white families. *American Psychologist*, 31: 726-739.
- Schafer, E W P 1982. Neural adaptability: A biological determinant of behavioral intelligence. *International Journal of Neuroscience*, 17: 183-191.
- Sedlacek, W E & Brooks, G C 1972. *Predictors of Academic success for University Students in special Programmes*. Maryland: Maryland University, College Park Cultural Study Centre. (ERIC Document Reproduction Service No ED 073 222)
- Sewell, W & Shah, V 1976. Socio-economic status. Intelligence and the attainment of higher education. *Sociology of Education* 40: 1-23.
- Shochet, I 1986. *Manifest and potential performance in advantaged and disadvantaged students*. PhD Thesis, Wits University.
- Silverman, H 1985. Dynamic Cognitive Assessment: An Alternative to Intelligence Testing. *Canadian Journal of Special Education* 1(1): 63-72.

- Silvey, J 1963. Aptitude testing and education selection in Africa. *Rhodes-Livingstone Journal* 34: 9-22.
- Simon, H 1979. *Models of thought*. Yale.
- Skuy, M, Archer, M & Roth, I 1987. Effectiveness of the LPAD: the Assessment and Remediation of a Learning Problem. *S A Journal of Education* 7: 53-58.
- Skuy, M, and Gaydon V 1990. Predictors of Performance of Disadvantaged students in an Enrichment Program. *Gifted Child Quarterly*, 34: 97-101.
- Skuy, M S & Shmukler, D 1987. Effectiveness of the Learning Potential Assessment Device with Indian and Coloured Adolescents in South Africa. *International Journal of Special Education* 2(2): 121-149.
- Skuy, M, Kaniel, S & Tzuriel, D 1988. Dynamic assessment of intellectually superior Israeli children in a low socioeconomic status community. *Gifted Education International*, 5: 90-96.
- Slack, W V & Porter, D 1980. The Scholastic Aptitude Test: A Critical Appraisal. *Harvard Educational Review*, 50: 154-175.
- Slonimsky, L & Turton, R 1985. Developments in the conceptual skills programme for ASP in the Faculty of Arts at Wits University. *ASPECTS 6. Journal of the Academic support Programme*. Johannesburg: Wits University (61-66).
- Spearman, C E 1904. *The abilities of man: their nature and measurement*. New York: Crowell-Collier & Macmillan.
- Spearman, C E 1927. *The abilities of man, their nature and measurement*. New York: Macmillan.
- Stanley, J C 1971. Predicting College success of the Educationally Disadvantaged. *Science*, 171: 640-647.
- Sternberg, R J 1977. *Intelligence, information processing and analogical reasoning: The componential analysis of human abilities*. New Jersey: Lawrence Erlbaum Associates.
- Sternberg, R J 1984. Toward a triadic theory of human intelligence. *The Behavioural and Brain Sciences*, 47: 269-315.

Sternberg, R J 1985. *Beyond IQ: A triarchic theory of human intelligence*. Cambridge: Cambridge University Press.

Sternberg, R J 1985. The black-white differences and Spearman's g: Old wine in new bottles that still does not talk good. *The Behavioural and Brain Sciences*, 8(2): 344-350.
 Sternberg, R J 1991. Death, taxes and bad intelligence tests. *Intelligence*, 15(3): 257-269.

Sternberg, R J & Gardner M K 1982. A componential interpretation of the general factor in human intelligence. In H J Eysenck (ed), *A model for intelligence*. New York: Springer-Verlag.

Stevenson, H, et al 1978. *Schooling, environment, and cognitive development: A cross-cultural study*. Monographs of the Society for Research in Child Development, Series 175, 43(3).

Steward, M & Steward, D 1974. Effects of social distance on teaching strategies of Anglo-American and Mexican-American mothers. *Dev Psych*, 10: 787-807.

Survey of Race Relations in South Africa 1990. Johannesburg: SA Institute of Race Relations.

Taylor, H 1980. *The IQ game: A methodological inquiry into the hereditary-environment controversy*. New Jersey: Rutgers.

Taylor, J M 1985. *The prediction of academic success of black engineering technicians* (PERS 386). Johannesburg: National Institute for Personnel Research.

Taylor, N 1989. *Falling at the First Hurdle*, Johannesburg, University of the Witwatersrand Education Policy Unit research Report No 1.

Terman, L M & Merrill, M A 1937. *Measuring intelligence*. Boston: Houghton-Mifflin.

Thurstone, L L 1938. *Primary Mental Abilities*. Psychometric monographs, 1, 1938.

Tracey, T J & Sedlacek, W E 1987. *A Comparison of White and Black Student Academic succes Using Non-cognitive variables*. Paper presented at the annual meeting of the American Educational Research Association, Washington, DC, April 1987.

- Tzuriel, D & Klein, P 1987. Assessing the young child: Children's analogical thinking modifiability. In C S Lidz (ed), *Dynamic assessment: An interactional approach to evaluating learning potential* (268-287). New York: Guilford Press.
- Vernon, P E 1979. *Intelligence: Hereditary and Environment*. Freeman and Co: San Francisco.
- Verster, J 1973. *Test Administrators Manual for deductive Reasoning Test*. Johannesburg: National Institute for Personnel Research.
- Visser, B L 1978. *Development of a testing programme for black university students for selection and careers counselling*. Johannesburg: CSIR Report Pers 281.
- Vrey, J D 1979. *The self-actualising educand*. University of South Africa.
- Vye, N J, Burns, S, Delclos, V R & Bransford, J D 1987. a comprehensive approach to assessing intellectually handicapped children. In C S Lidz (ed), *Dynamic assessment: An interactional approach to evaluating learning potential* (327-359). New York: Guilford Press.
- Vygotsky, L S 1962. *Thought and language*. Massachusetts: MIT Press.
- Vygotsky, L S 1978. *Mind in society: The development of higher psychological processes*. London: Harvard University Press.
- Vygotsky, L S 1979. The genesis of higher mental functions. In J W Wertsch (ed), *The concept of activity in Soviet Psychology* (144-188). New York: Sharpe.
- Wagner, R K & Sternberg, R J 1984. Alternative conceptions of intelligence and their implications for education. *Review of Educational Research*, 54(2): 179-223.
- West, L H & Pines, A L 1985. *Cognitive Structure and Conceptual Change*. Academic Press Inc.
- Wilcocks, A 1973. *Intermediate Battery Test Administrator's Manual*. Johannesburg: National Institute for Personnel Research.
- Wilson, J D 1971. Predicting levels of first year university performance. *British Journal of Educational Psychology*, 41: 163-170.
- Wilson, K 1983. *A Review of Research on the Prediction of Academic Performance after the Freshman Year*. New York: College Board Publications.

Ysseldyke, J E & Regan, R 1980. Nondiscriminatory assessment: A formative model. *Exceptional Children*, 46: 465-466.

Zolezzi, S A 1992. *Alternative selection measures for university undergraduate admissions*. M Ed Thesis: University of the Witwatersrand.