THE RELATIONSHIP OF GENERAL RETENTION ABILITY TO NEW SOUTH AFRICAN GROUP TEST NON-VERBAL/VERBAL IQ DISCREPANCIES AND THEIR ACADEMIC CORRELATES

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To my wonderful parents who
imbued me with the Scottish lust
for knowledge

I dedicate this thesis to them

with love.

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ABSTRACT

Both experimental research (Robbertse,1962)and clinical observation (Kruger, 1972; van der Merwe,1978) have indicated that pupils with a Verbal IQ score 10 or more points lower than their non-Verbal IQ (termed a 'Type 1' discrepancy in the present research) on the New South African Group Test (NSAGT) show poorer academic achievement than their peers of similar ability.

The present research investigates the relationship of general retention ability,as defined by Hakstian and Cattell (1978), to Type 1 discrepancies as well as to their academic correlates. One hundred and thirty-nine standard seven English-speaking boys were tested on the NSAGT and the Junior Aptitude Test (JAT) (of which tests 8 and 9 give an indication of general retention ability) and divided into a group with Type 1 discrepancies and two control groups. All three groups were matched on full-scale IQ.

Comparison of these three groups, using the analysis of variance technique, showed that there was no significant difference between them in level of general retention ability or in academic performance (measured by average percentage in the final standard seven examination). While no significant difference was found between the three groups regarding the relationship of general retention ability to academic performance, in the Type 1 discrepancy group the relationship of rote memory (JAT test 8) to academic performance differed markedly from that of associative memory (JAT test 9) to academic performance.

In the Type 1 discrepancy group rote memory was highly associated with academic performance, possibly indicating a compensatory strategy for the lower Verbal ability in this group, enabling it to achieve academically on par with the control groups, contrary to what would be expected on the basis of Robbertse's (1962) findings.

In terms of Jensen's (1982) Level 1/Level 11 theory of intelligence, it appears from the present research that rote memory ability (JAT test 8) varies between being a Level 11 ability (in the Type 1 discrepancy group) to acting as a Level 1 ability in the two control groups. The present research questions Verwey and Wolmarans's (1980) description of both JAT tests 8 and 9 as simple measures of retention - Test 9, in particular, appears to function consistently as a Level 11 ability.

TABLE OF CONTENTS

CONTENTS PAGE

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Background to the present research

The focus of the present research is on the relationship between general retention ability and non-Verbal/Verbal IQ discrepancies (as measured by the New South African Group Test). 'General retention ability' is defined by Hakstian and Cattell (1978) as a higher-order factor involving associative memory and rote memory at the primary level. Reber (1986: p.429) defines associative memory as:

> A label for any memory system that is hypothesized to rest on the notion of an association. Thus the empiricist assumption of association between ideas, the behaviourist S-R bond and the cognitivist propositionally-based associationism are all classifiable as associative-memory theories.

Reber (1986: p.398) has described 'rote memory' in terms of the learning which it entails; it is:

> Learning (really memorizing) that takes place purely by repetition devoid of meaningfulness of the material or of other operations like organization, inference or the use of mnemonics etc.

The present research has been instigated by the clinical observation that pupils who have a Verbal IQ significantly lower than their non-Verbal IQ demonstrate poorer academic performance than their peers who show no such discrepancy or for whom the discrepancy is reversed (Kruger, 1972; van der Merwe, 1978).Such observation has been supplemented by experimental findings (Gundersen and Feldt, 1960; Whittington, 1988), but it nevertheless remains contentious.

For the purpose of stylistic convenience, the discrepancy where the Verbal IQ is significantly lower than the non-Verbal IQ will be termed a `Type 1' discrepancy in this thesis. Similarly,where the discrepancy involves a significantly higher Verbal than non-Verbal IQ, the term `Type 2' discrepancy will be used. The statistical aspects of such discrepancies are discussed in chapter 3.2.1 (page 48).

Lezak (1988) has forcefully articulated what she considers to be the oversimplification of the division between `non-Verbal' and`Verbal' abilities and the failure of this division to reflect the dynamic complexity of cognitive functioning. While such criticism seems valid, the separation of intelligence scores into non-Verbal and Verbal scales has had some virtue. It has enabled test interpreters to compare a testee's comprehension and use of words and symbols (Verbal IQ) with his ability to perceive and comprehend visual patterns (non-Verbal IQ) (Madge and van der Westhuizen, 1971).

From an educational point of view the latter discrimination is of some value. Current practice in intellectual assessment favours the evaluation of interacting cognitive abilities rather than the production of a single IQ quotient (Letteri, 1980). Shuell (1986:p.374) stresses the educational importance of a comprehensive intellectual assessment which reflects the multi-faceted nature of cognitive ability:

> The need to adapt education to fit the individual needs and characteristics of students, rather than the other way round, is an old adage, but it remains a valid goal if we hope to provide the type of education required to function in a modern, free society. A combination of various aspects of competence, learning, cognition, and <u>memory</u> must be considered if we are to achieve an adequate understanding of individual differences and the way in which they influence, and are influenced by, learning in an educational setting (present writer's emphasis).

The quest for the "understanding of individual differences" seems to have been the motivating force behind the studies of the few researchers who have made the New South African Group Test (NSAGT) the object of their studies (e.g. Robbertse, 1962; Kruger, 1972; van der Merwe, 1978). These workers have been fascinated by the discrepancy between non-Verbal and Verbal IQ scores on the NSAGT, a fascination which has been stimulated by theoretical and practical issues.

From the theoretical point of view the focus of interest has been the phenomenon of significantly lower Verbal than non-Verbal IQ in an individual's profile. Kruger (1967) has suggested that non-

Verbal abilities, with their emphasis on the manipulation of concrete data, are a less sophisticated precursor of Verbal abilities, where abstraction (via language) is the essential operation. Such a developmental view would interpret a significantly lower Verbal than non-Verbal IQ (a Type I discrepancy) as an instance of a relative failure to move from the concrete to the abstract.

The division of the IQ score into non-Verbal and Verbal components has become theoretically aligned with Cattell's (1971) idea of 'fluid' and 'crystallized' intelligence. In terms of this idea, 'fluid' intelligence represents the innate ability of the individual which is invested through incidental and scholastic learning and is reflected in his 'crystallized' intelligence. 'Fluid' intelligence has been roughly equated with non-Verbal ability and 'crystallized' intelligence with 'Verbal' ability (Eysenck, 1979).

While differing in other respects, both Kruger's (1967) and Cattell's (1971) views would consider a significantly lower Verbal than non-Verbal IQ to be the result of a type of developmental problem. The possible reasons for such a developmental problem are numerous, as will be discussed later on in this chapter, but the significance of this problem is apparent when the higher predictive validity of verbal intelligence for scholastic achievement is considered (van Eeden and Grobbelaar, 1967). Thus discrepancies between non-Verbal and Verbal IQ scores are of educational concern, especially when the Verbal IQ is the significantly lower one.

The choice of the NSAGT as a focus for the current research is directly related to the interest in scholastic achievement expressed above. The NSAGT plays a crucial rôle in the assessment of the intellectual functioning of white school pupils in the Republic of South Africa. This test has, since its introduction in 1963, been one of the most commonly used psychometric tests in South Africa by virtue of the fact that each child in the Department of Education and Culture (the body governing education for 'whites') is routinely tested twice during his or her school career.

Ideally, the NSAGT should be used in association with aptitude tests, interest questionnaire profiles, examination results and more informal information to advise the pupil and his parents about type of secondary school education as well as subject and grade choice in the secondary school. In addition, the NSAGT IQ is frequently one of the parameters consulted when decisions have to be made concerning either the advisability of, or direction in, tertiary education. Thus this intelligence test is an integral part of the system of differentiated education in South Africa, providing supplementary guidelines at critical junctures in the pupil's school career.

Another aspect of the rôle of the NSAGT is that it is often used as an indication of intellectual potential against which a pupil's current level of academic achievement can be evaluated. Although the NSAGT should be used, in all its diverse functions, in conjunction with the previously mentioned collateral information, often it is the only psychometric information available on the pupil (Le Roux and van der Merwe, 1985).

In the light of the frequent employment of the NSAGT and the latter's importance in the South African educational system, the paucity of research conducted on this intelligence test is somewhat surprising. As mentioned earlier, much of the research which has been conducted concerns the division of the NSAGT into non-Verbal and Verbal sections, a division typical of intelligence tests since the advent of the Wechsler-Bellevue Scale in 1939.

However, as Kruger (1967) points out, no rationale for this division is supplied in the manual of the NSAGT Intermediate Form (G) (National Council for Social Research, 1963) or in the combined manual for the Senior Forms (S and T) and the Junior Forms (J and K) (National Bureau for Educational and Social Research, 1965).

Research by Robbertse (1962), quoted in the manual for the Intermediate Form (G), seems to have provoked much of the subsequent research on non-Verbal/Verbal IQ discrepancies on the NSAGT. Robbertse's investigation showed that pupils with Type 1 discrepancies were apparently at a disadvantage in both scholastic achievement and school adjustment when compared with pupils who displayed no significant discrepancy or who had a Type 2 discrepancy.

The search for factors contributing to the above significant discrepancies presupposes that there should be some kind of equality between the two IQ scores in the first place. Indeed, there are theorists such as Guilford (1988) who would argue that mental abilities are essentially separate and that one shouldn't expect equality between them. This is a complex issue which will be discussed in chapters 2 and 3. However, a theory such as Cattell's (1971) would suggest that , given ideal conditions, the relatively culture-free non-Verbal ('fluid') abilities should be fully implemented in the environment.

Patently, conditions are not always ideal. A myriad of factors which are often intangible and unquantifiable intrudes. Thus motivation, personality variables, linguistic deprivation, interest and other factors are bound to play a part in the failure to realise innate potential (Madge and van der Westhuizen, 1971). However, in an experiment reported by Le Roux and van der Merwe (1985) the only factors found to be associated with non-Verbal/Verbal IQ discrepancies on the NSAGT were minor temperamental ones.

In the search for factors which might play a part in Type I discrepancies the rôle of general retention ability does not seem to have been addressed. The NSAGT does not have a memory test. This is somewhat unusual, since memory has been viewed as a component of intelligence by most of the major theorists in the field of cognitive abilities (e.g. Thurstone, 1938; Wechsler, 1939; Guilford, 1988). On logical grounds memory should be one of the prime mechanisms in the acquisition of knowledge and such knowledge, both culturally and scholastically acquired, is central to the skills tapped in the Verbal scale of the NSAGT.

Further substantiation of the possible relationship of general retention ability to non-Verbal/Verbal IQ discrepancies comes from studies of underachievement where 'associative' and 'meaningful' (rote) [1] memory have been found to be significantly poorer for underachievers than achievers (Murakawa and Pierce-Jones, 1969). In a sense, those whose Verbal IQ on the NSAGT is significantly lower than their non-Verbal IQ are 'underachievers', if Cattell's (1971) premise is granted.

The interest of the present research in the relationship of general retention ability to Type I discrepancies can also be justified in terms of the material used in the two IQ scales. In true non-Verbal scales the material to be dealt with is immediately present and needs only to be held in visual memory during the performance of the skill. In contrast, the Verbal skills demand the retrieval of knowledge from long-term memory. Hence a Type I discrepancy may well be partially attributable to a deficit in general retention ability.

The focus of the present research on the possible rôle of general retention ability in such discrepancies is also supported by the suggestions of cognitive - process theorists, such as Baddeley (1978), regarding the rôle of memory in the acquisition of knowledge. Baddeley suggests that the processing of knowledge is contingent upon an active working memory which activates long-term knowledge in order to integrate new information into long-term memory. Once more, a deficit in general retention ability would affect the Verbal scale (which taps acquisition of knowledge) on the NSAGT, rather than the non-Verbal scale.

Jensen's (1982) concept of Level I intelligence (rote memory) as a relatively independent precursor for Level II intelligence (higher-level cognitive abilities) also suggests memory as an important factor on Verbal tests, tests which par excellence measure such higher-level cognitive abilities. Other studies, such as the factor-analytic investigation of Hakstian and Cattell (1978) have also demonstrated the relative independence of general retention ability as a higher-order factor in intelligence.
Thus the relationship between general retention ability and Type

I discrepancies on the NSAGT is worthy of investigation. That this investigation will take place within the parameters of the psychometric tradition is an obvious function of the operationalised definitions of both intelligence and memory. However, this choice of paradigm should in no way be seen as a negation of the richness, nuances and basic human complexity which inform the educational situation in general and the processes of intelligence, learning and memory in particular.

1.2 Aims of the current research

In the light of the argument presented so far, the following are the aims of the present research:

Firstly, to examine the relationship of the general retention ability of pupils to their academic performance. This examination will determine the level of significance of such a relationship and place the other research findings in context.

Secondly, the present research will compare the relationship of general retention ability and academic performance in those pupils with Type I discrepancies to the same relationship in pupils with Type 2 discrepancies and in pupils who show no significant non-Verbal/Verbal IQ discrepancies.

Thirdly, the current research will compare the general retention ability of those pupils who have Type I discrepancies with the general retention ability of pupils who have Type 2 discrepancies and with the general retention ability of pupils who do not have significant non-Verbal/Verbal IQ discrepancies.

Finally, this research will compare the academic performance of those pupils with Type I discrepancies to that of pupils who show a Type 2 discrepancy as well as to the academic performance of pupils who do not have significant non-Verbal/Verbal IQ discrepancies.

If the present study finds that general retention ability is significantly related to Type I discrepancies on the NSAGT, then this will be an important step towards further research in the area and in the practical use of the NSAGT to reflect memory deficits. Further research would have to establish whether such memory deficits are in any way associated with the differential use of rehearsal strategies; if they are, early identification of pupils with such memory deficits, using the routinely applied NSAGT, could enable school personnel to teach rehearsal strategies to such pupils.

Nor are such rehearsal strategies necessarily solely dependent on general intellectual level. Ozier (1980) has demonstrated that subjective organization on material <u>that otherwise does not have any obvious organization</u> helps subjects perform better in free-recall tasks, serial learning, paired-associate learning and recognition tasks. Indeed, Goodenough (1976) has indicated that the likelihood of a subject restructuring material to be learned or using mediators is a function of cognitive style, not merely of intellectual level. Thus field-independent people are more likely to be actively involved in restructuring the learning situation than field-dependent people are.

In the light of the brief comments made in this chapter concerning the rôle of memory in the acquisition of knowledge and in the process of abstract thinking, the remediation discussed above could prove invaluable.

1.3 Outline of the Contents

Chapter 2 will examine the concept of intelligence in terms of its historical development and will consider the theoretical debates about the nature of intelligence, in particular the unifocal versus the multifocal viewpoints concerning intelligence, viewpoints which are of prime importance to this thesis. The test measurement of intelligence, a brief history of the testing movement, as well as criticism of intelligence testing, will be overviewed in Chapter 3. In addition, Chapter 3 will examine, in some detail, the test measurement of non-Verbal and Verbal intelligence and the literature concerning the meaning of the discrepancy between these two measures.

In Chapter 4 the literature concerning the relationship between intelligence, personality and academic achievement will be surveyed. Chapter 5 presents an examination of the literature about memory, the other major variable in this research, and focuses on the relationship between memory and intelligence. In Chapter 6 the problem which is to be addressed in this research will be delineated and postulates concerning the results formulated.

The methodology employed in the present research is discussed in Chapter 7, while the results of the experiment are statistically analysed in Chapter 8. Chapter 9 involves the detailed discussion of the results and recommendations based upon them.

[1] A note on the apparently contradictory terms 'meaningful' and 'rote' would serve to clarify the use of these terms throughout the present thesis. The use of the term 'meaningful' by Murakawa and Pierce-Jones (1969) to describe the memory factor involved in retaining information verbally presented, is somewhat misleading.The label 'meaningful' appears to have been used to distinguish this factor from the factor which involves the learning of nonsense syllables and other material which is not inherently meaningful.

The Mm (meaningful memory) factor always involves retention of related material which is not (or should not be) amenable to conceptual grouping.This point is well made by the authors of the Junior Aptitude Test (Verwey and Wolmarans, 1980),quoted on page 133 of the present thesis.Thus difficulty level of the material presented in an Mm test has been reduced to obviate the use of conceptual strategies. Ekstrom et al.(1979), quoted on page 96 of the present thesis, have defined Mm as indicative of a rote memory of related material.Mm has been linked to Jensen's (1973) concept of Level 1 intelligence (see p.95 of the present thesis) as a simple measure of retention with little transformation of material occurring between input and output.

CHAPTER 2

THE CONCEPT OF INTELLIGENCE

2.1 Introduction

A detailed examination of the various concepts of intelligence is essential since there exists an intimate relationship between theoretical concepts of intelligence and the construction of intelligence tests. The abstract nature of intelligence necessitates that any definition of it is an inferential one using observed behaviour as its basis. Which observed behaviour to use is, as will be seen from the discussion in this section, a question of theoretical preference. Once a set of observable behaviours has been chosen and tests developed to quantify such behaviour, the results of the tests usually confirm the theoretical bias of the test constructor. So the circle is completed and the disagreement between theorists about the nature of intelligence becomes less puzzling.

The derivation of the concept `intelligence' is instructive inasmuch as it contains the seeds of the controversy which has steadily developed this century. Burt (1955) credits Aristotle with differentiating between `orexis' (the emotional and moral functions) and `dianoia' (the cognitive and intellectual functions). Cicero's translation of 'dianoia' as 'intelligentsia' ('inter' - within; 'leger' - to bring together, choose, discriminate) brings us close to the modern terminology.

However, Aristotle's distinction introduced the dualism which continues to be a controversial issue in the field of intelligence theory. With the development of factor analysis by Charles Spearman early in this century this dualism was dramatically accentuated in the form of statistical entities such as 'g' (discussed later in the section on psychometric theory: p.29) whose abstract quality seemed to stress the cognitive solely and ignore all other aspects of adaptive human functioning.

Hunt (referred to in Downie, 1967: p.256) maintains that our current concepts of intelligence:

> ...go back to the middle of the nineteenth century to the work of Charles Darwin and his theory of the survival of the fittest.

That Hunt's contention is valid is borne out by the fact that the theory of intelligence which still prevails widely today is that of the philosopher Herbert Spencer who viewed cognition as having both an analytic and synthetic or integrative function which enabled man to adapt to his changing environment. Spencer postulated a progressive differentiation into more complex abilities within the animal kingdom and within the growth of the child (Eysenck, 1979). Spencer's emphasis on the evolutionary aspects of intelligence strengthened the view that intelligence was a biological phenomenon.

Thus Sir Frances Galton concentrated on using anthropometric measures to measure intelligence. The rationale fundamental to Galton's enterprise was that since all information reaches a man through his senses, the more perceptive the senses are, particularly of differences, the greater the possibility of intelligence being able to act on any given area. The corollary of this, for Galton, was that speed of sensory response is the differential ability underlying intelligence (Walsh and Betz, 1985). Using what Eysenck (1986) considers a methodologically weak study, Wissler in 1901 showed that there was no correlation between reaction time and intelligence, effectively disproving, for the time being, Galton's physiological hypothesis.

The next stage in the conceptualization of intelligence began with the development of tests by Spearman (1904) and Binet (1905). Lezak (1988: p.353), assessing Spearman's treatment of the correlation between the scores of the school-type tests which he employed, states:

> His intercorrelations also yielded a "first factor" which he interpreted as reflecting the non-independence of the abilities measured by each test. He took this first factor to be evidence for general intelligence as a basic underlying attribute of mental activity, and called it `g'. Thus Spearman set the stage both for the subsequent factorial analyses of measurements of mental ability, and for longstanding disputes among theoreticians concerning the factorial nature of intelligence.

The ramifications of Spearman's positing of `g' and the importance which he attributed to it are worthy of examination. Historically, this represents a statistical `sanctioning' of a restricted view of intelligence which, as will be seen in section 2.3 (p.29), attributed a structure to intelligence which minimized factors such as motivation, personality and other non-intellective factors.

One of Binet's contributions was the development of age scales whereby the mental age of a child could be determined. This emphasized the developmental aspect of intelligence, an aspect to be elaborated on by Piaget. It is interesting to note that Binet, at this early stage of the history of intelligence testing, expressed reservations about the use of the mental age score. He was apprehensive about the reification of this score and the status that might subsequently be attributed to it.

Here, it would be appropriate to consider, briefly, the impact of the psychometric tradition on the concept of intelligence. The use of tests to measure intelligence involves the implicit concession that our knowledge of intelligence can only be inferential. As Thorndike (1928) pointed out:

> ...all scientific measures of intelligence that we have at present are measures of some product produced by the person or animal in question, or of the way in which some product is produced.
>
> (quoted in Eysenck, 1979: p.17)

This limitation to the observable led some theorists such as Cattell to propose that intelligence consists of two components, 'fluid intelligence' (which corresponds roughly to innate, untaught ability) and 'crystallized intelligence' (which indicates the knowledge gained by the investment of fluid intelligence in the environment). Reaching a similar conclusion, Hebb (quoted in Maloney and Ward, 1976: p.181), on the basis of his work with brain-injured soldiers and supported by experimental observations, suggested that:

> ...there are really two kinds of intelligence, one largely innate and biological (intelligence A), and the other largely the result of environment and experience (intelligence B). Intelligence A is assumed to be related to the area of problem-solving abilities, while intelligence B is construed in terms of accumulated knowledge and skills.

Hebb states that only intelligence B can be measured directly and that this is a reflection of the level of intelligence A, given a conducive environment. Level A could only be measured by some sort of neurological measure and would indicate the efficiency and intactness of the central nervous system.

Both Hebb and Cattell's theories of innate, untaught intelligence, are congruent with Spearman's theorizing. Moreover the high heritability of `g' (see section 2.3: p.29) would be consonant with both theories. Hebb and Cattell's conceptualizations of intelligence represent a continuation of the view that intelligence is a biologically based phenomenon. Wechsler (1958: pp vii-viii) agrees that any definition of intelligence would have to be a biological one but expands the scope of the term beyond the cognitive:

> I look upon intelligence as an effect rather than a cause, that is, as a resultant of interacting abilities - non-intellective included. The problem confronting psychologists today is how these abilities interact to give the resultant effect we call intelligence.

The movement away from the conception of intelligence solely as a cognitive function, saw the emphasis shift towards locating the essence of intelligence partially in the environment. Thus Fischer (in Phares, 1979: p.205) defines intelligence as follows:

> Intelligence refers to the effectiveness, relative to age peers, of the individual's approaches to situations in which competence is highly regarded by the culture.

Cleary et al. (in Phares, 1979: p.205) place similar emphasis in their definition:

> Intelligence is defined as the entire repertoire of acquired skills, knowledge, learning sets, and generalization tendencies considered intellectual in nature that are available at any one period in time. An intelligence test contains items that sample such acquisitions. Intelligence so defined is not an entity such as Spearman's "mental energy".

Thus the argument for a more inclusive definition of intelligence and a recognition of cultural selectivity grew, not that this was entirely new. Vernon (1979) notes that Binet had made some references to motivational as well as cognitive traits. Binet was followed in this by Wechsler with his now famous definition of intelligence as:

> The global aggregate or global capacity of the individual to act purposefully, to think rationally and to deal effectively with his environment.
>
> (in Pyle, 1979: p.3)

Another relatively recent way of conceptualizing intelligence is in terms of describing its component processes. Shuell (1986: p.369), in examining this trend, focuses on Sternberg who:

> ...has begun to develop a componential theory of intelligence. This theory differs from older theories of intellectual abilities determined by factor analysis in that information-processing components specify more precisely the nature of the competencies that underlie intellectual performance, and this specification is in terms of psychological process rather than in terms of psychometric factors determined by somewhat arbitrary statistical procedures.

In summary, it is useful to look at Eysenck's diagrammatic illustration of the three different ways psychologists have viewed intelligence:

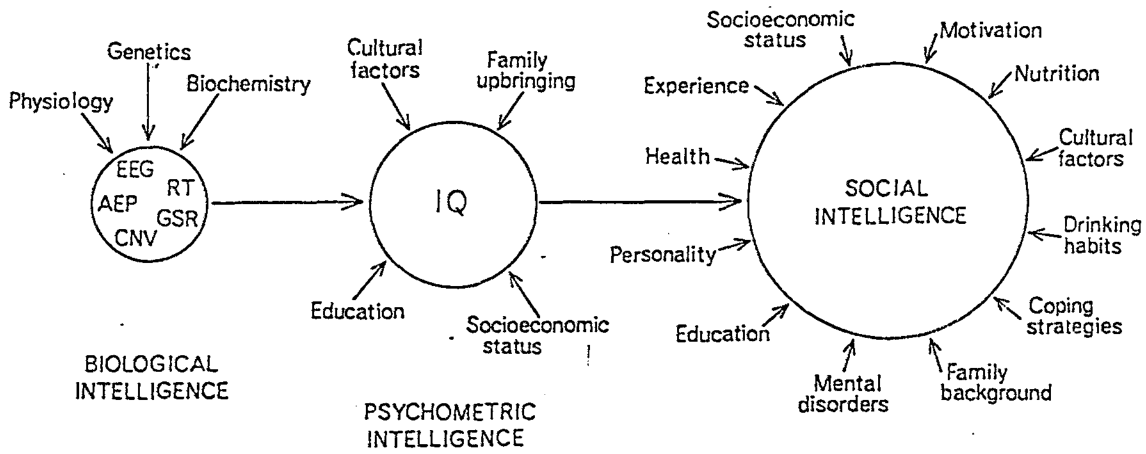

Figure 2.1 (From Eysenck, 1987: p.265).

In the above-mentioned paper Eysenck suggests that on the basis of recent information-processing studies scientific opinion is swinging back to Galton's view of the nature of intelligence. These studies will be discussed in the following section on neurological theories of intelligence.

Any classification of the theories of intelligence would have to take cognisance of the disciplines from which the theories emerged. From the physical study of the brain the neurologists developed a particular approach to intelligence, the psychometrists used statistical methods to define their concepts of intelligence, while from the observations of the philosopher/biologist Jean Piaget came a developmental theory of intelligence. The links between some of these theories are as important as the distinctions. However, for the sake of simplicity, they will be discussed separately.

2.2 Neurological Theories

Under this heading a number of loosely linked approaches will be discussed. Despite their methodological differences, these approaches share a preoccupation with the physical basis of intelligence. Hence the research of the physiologists into the structure of the brain, investigations of the information-processing researchers, experimental findings of biochemical researchers, and empirical findings of investigators into the effects of the genetic inheritance of intelligence will be overviewed.

2.2.1 The Physiological Approach

The clinical work of Jackson, Sherrington, Campbell and Brodman, early this century, on the structure of the brain seemed to confirm Spencer's theory of a hierarchy of neural functions. Through their investigations they were able to distinguish in the architecture of the brain different layers of development and to determine that these specializations developed in the first months of infant life. Sherrington drew attention to the integrated activity of the brain and Lashley contributed the concept of 'mass action' of the brain, a concept which has been theoretically identified with intelligence (Eysenck, 1979).

Burt (who worked as Sherrington's assistant) accepted the theory of a general cognitive capacity probably dependent upon the number and complexity of connections as well as the organization of the nerve cells in the cerebral cortex (Butcher, 1968). Butcher maintains that this hypothesis is still accepted by many modern neurologists.

Hebb's concept of biological intelligence A and acquired knowledge and skills which comprise intelligence B has been briefly discussed in section 2.1 (p.18). Halstead has also developed a theory of biological intelligence (discussed in Maloney and Ward, 1976) and, on the basis of his clinical findings, maintains that factor A (capacity for abstracting universals or rational concepts) is localized in the cortex of the prefrontal lobes of the brain. The other factors which he identified are: P-cerebral power; D - directionality, referring to the modality through which intelligence is expressed, and C-a memory factor.

This theory involves the synthesis of elements of psychometric and neurophysiological approaches. Halstead's conclusion was that these factors, which are localized in the prefrontal lobes, are involved in the organism's ability to adapt to its environment and are independent of cultural considerations.

Wechsler (1958) contested Halstead's findings, ironically also with empirical data. He cited evidence which showed that decrements in general intelligence or in specific intellectual performance were minimal after partial or complete removal of the frontal lobes. In addition, intellectual performance seemed to be least affected by injury to the frontal lobes, whereas in other areas performance was more seriously affected. In the same study Wechsler claimed that local injuries to the brain are more likely to affect measures of specific ability than those of global intelligence.

Posner (1986: p.5) provides a sobering assessment of the rôle of physiology in explaining intelligence:

> Still there is a great chasm that yawns between the study of brain and the study of mind. No electrode yet has been sufficiently subtle to seek out the mechanisms by which subjects perceive and act. Even if one remains reductionist in principle, supposing that all of psychology could be reduced to physiology, there appears no more likelihood that the principle will be realized than there is that complex social phenomena will be predictable by individual personality. Fourteen billion nerve cells responding in complex ways with multitudinous connections to each other give little likelihood of providing a rational solution that would allow prediction of mental process.

2.2.2 The Information-Processing Approach

It may be somewhat of an anomaly that this approach should be grouped together with "neurological" theories, so a brief explanation is appropriate. In an historical sense Galton (discussed in section 2.1: page 16) straddles both the physiological and the information-processing approaches. Galton's approach, which yielded negligible results, was to measure the organism's response to a single signal. This simple reaction-time then would give an indication of neural efficiency.

The emphasis in modern information-processing studies is on choice reaction-time when more than one `bit' of information is presented and an amount of cognitive work is involved before the response is made (Eysenck, 1986).

Walsh and Betz (1985) report that correlations of information-processing task scores with intelligence test scores are on average reasonably low (about 0.30) but attribute this to the failure of the information-processing tasks to reflect the complexity of cognitive functioning.

From a purely logical point of view a progressively larger correlation with IQ tests would be expected as the element of choice, or the cognitive aspect, of reaction-time experiments is increased. Indeed, Anderson (1988) refers to a correlation of 0.5

between 'inspection time' (an aspect of speed of perceptual processing) and psychometric intelligence found by Nettlebeck in 1986. Much of the renewed interest in reaction-time must be attributed to Eysenck and Furneaux (Eysenck, 1979) who proposed the theory that differences in IQ were largely dependent on mental speed, but also on such non-cognitive factors as continuance (or persistence) and error-checking (or impulsivity).

Another way of measuring neural efficiency is through the use of the 'average evoked potential' (AEP). This involves a measure of the latency and amplitude of the brainwaves recorded on the electroencephalograph (EEG) when auditory or visual stimuli are suddenly presented to the subject. Turnbull (in Sternberg, 1981) gives examples of the evoked potential work of Ertl (1971) and the Hendricksons (1978) who found an average correlation between AEP and IQ of 0.6.

Eysenck (1979) in 1973 found heritabilities of between 80% and 90% for these average evoked potentials and views this physiological measure as a substratum of intelligence, one which fits in very well with Spearman's 'g' concept and gives a measure of general neural efficiency.

2.2.3 **Biochemical Approaches**

One promising line of research concerns the investigation of glucose metabolism in the brain. The rationale behind this research is that glucose is almost the sole source of energy in the brain. Weisman (1986: p.245), viewing the ability to reduce the uncertainty of information (negentropy) as a function of glucose metabolism in the brain, states emphatically:

> It would defy the most fundamental laws of thermodynamics if individual differences in intellectual work capacity, ie. in brain power, and negentropy could not find their counterpart in individual differences in brain energy metabolism. Therefore, it is an outstanding event that two research groups (de Leon et al 1983: Chase et al 1984) report significant correlations between regional cerebral glucose metabolism rate and a number of tests, including memory span and mental speed.

Weisman interprets these correlations as evidence that individual differences in general intelligence (Spearman's `g') are reflected by differential ability in entropy reduction, caused by individual differences in metabolism of glucose in the brain.

Weiss (1986: p.737) has summarized some of the latest biochemical research:

> During the last years a number of empirical correlations between biochemical parameters and results in conventional mental tests, measuring the intelligence quotient (IQ), have been reported by several investigators. Activities of brain choline acetyltransferase (r = .81, Perry et al, 1978), brain acetylcholinesterase (.35; Soininen et al.,1984 erythrocyte glutathione peroxidase (.58; Sinet et al., 1979) are correlated with IQ and, especially intriguing, also the cerebral glucose metabolism rate (about .60, de Leon et al. 1983; Chase et al. 1984).

2.2.4 Genetic Approaches

In examining genetic inheritance one of the main strategies has been the use of twin studies. The rationale behind these studies is that monozygotic (MZ) twins have identical genes and therefore should have the same innate potential, whereas dizygotic twins (DZ) have the same genetic similarity as ordinary siblings. MZ twins who have been separated at birth are studied and a correlation of their attainments on IQ measures is made. Any differences between their intelligence scores would, according to this strategy, be the result of environmental factors.

Dean (1987) cites a number of such studies. Thus in 1938 Newman et al found an IQ correlation of .67 over 19 sets of MZ twins who varied in age from 11 to 59. Vernon (1979), evaluating four studies of MZ twins reared apart, found a weighted average correlation of 0.82. Eysenck (1979) reports the following estimates, based on the 1963 Erlenmeyer-Kimling survey of twin studies, of components of variance in intelligence.

v (genetic) = 68%

v (common environment) = 19%

v (special environment) = 13%

Loehlin, Willerman and Horn (1988) refer to the first results of the Minnesota Study of Twins Reared Apart: of the 29 pairs of adult monozygotic twins reared apart a mean correlation of .71

was found for general intelligence, compared with .78 for a control group of MZ twins reared together.

Loehlin et al (1988: p.104), reviewing the results of twin studies, say:

> To summarize the results for general intelligence since 1982: separated identical twins are almost as similar as identical twins reared together; in studies of twins reared together, DZ correlations are lower and in adoption studies, unrelated children become less similar the longer they live together.

Overall, twin studies suggest that genetic inheritance is the major factor in variance between the intelligence of individuals, although Kamin (1974) has questioned the validity of such studies on the basis that they have ignored some important data which would increase the correlation of DZ twins raised together.

2.3 Psychometric Theory

This approach was a logical outflow of the positivist tradition, a consequence of the **zeitgeist** which viewed quantitative measurement as the desirable goal of all scientific endeavour. From the beginning psychometry was to be polarized by the divergent conceptual viewpoints of the nature/nurture theorists. So Galton, who followed Darwin's theory of evolution and who was the earliest of the investigators into the quantitative aspects of intelligence, tried to quantify physiological measures which he thought were correlates of intelligence. As mentioned (in section 2.1:p.16) Wissler in 1901 showed that there was no significant correlation between reaction-time and intelligence, thus, it seemed, invalidating Galton's efforts.

The other quantitative approach to the measuring of intelligence began when Binet and Simon were assigned the task in 1904 of developing a test to measure the ability of children who were `retarded' to profit from schooling. Binet and Simon were determined not to include items which only measured simple sensory-motor functioning, in contrast with the work of Galton.

An interesting trend in the tests of Binet and Simon was that in their revisions of the initial test, they concentrated on items which would measure diverse and complex aspects of mental functioning such as verbal memory, execution of simple commands and abstract reasoning. Dean (1987: p.8), commenting on this trend, makes the point that:

> The final 1911 revision focused on measuring "intelligence" rather than academically related information by eliminating items pertaining to school achievement such as reading and other acquired information.

Thus Binet and Simon were the originators of what was to be formulated later by Cattell as `fluid' intelligence in contrast to `crystallised' intelligence (the acquired skills). This distinction is an important one which will be briefly dealt with later on in this section.

Wechsler (1958: p.8) comments that it was E.L. Thorndike who was:

> ...the first to develop clearly the idea that the measurement of intelligence consists essentially of a quantitative evaluation of mental productions in terms of number, and the excellence and speed with which they are effected.

The course of psychometric theory has, to some extent, been dictated by advances in statistical techniques. Galton developed the statistical technique of correlation and in his classic on "Classification of Men according to Their Natural Gifts" (1869) anticipated Spearman's theory of general ability and minor special abilities. Building onto the technique of correlation, Spearman, early in this century, developed the technique of factor analysis first suggested by Karl Pearson, and produced statistical evidence for the predominance of general ability or intelligence ('g').

Spearman stubbornly emphasized the 'g' factor to the exclusion of any significant special abilities. By definition general ability or intelligence is the broadest and most pervasive cognitive trait, and is conceived of as being involved in virtually every kind of intellectual skill.

Spearman's dogmatic assertion of 'g' became the focus of an argument in the psychometric tradition between those who asserted the primacy of `g' and those who insisted on the importance of group factors. The disagreement will be discussed in this section. In addition a more comprehensive argument existed between those who saw `g' as the most important facet of intelligence and those who viewed `g' as a statistical construct which had little validity outside factor-analytic studies.

The virulence of this latter argument is partially explained by the finding that `g' is highly heritable and the inference drawn from this that intelligence is mostly genetic in its origin, with all the ideological, social and political implications inherent in such an inference.

A modern proponent of psychometric `g' who has been at pains to draw attention to the importance of `g' in predictions of success in `real-life' situations (school, university, the armed forces, business and industry) is Jensen (1987). To do justice to the vehemence of his defence of `g', it will be necessary to quote at length. Jensen (1987: p.197) states that:

> The degree to which various psychometric tests, such as Wechsler subscales, for example, are correlated with certain nonpsychometric variables is found to be directly related to the tests' `g' loadings. This relationship has been found for the heritability of various tests, the **spouse correlations** and other **kinship correlations** on various tests, the degree of **inbreeding depression** of scores on various tests, and its converse, hybrid vigor (variables which, in genetic

> theory, have important implications concerning the evolution of 'g'), evoked potentials of the brain; the size of the average black-white difference on various tests; and reaction-time (averaging less than one second) on very simple tasks that require no knowledge or acquired specific skills. Therefore, 'g' is no mere artifact of psychometric or factor analysis as some psychologists have mistakenly believed, but it is a real phenomenon, a variable which links psychology to biology and evolution.

Thurstone (1938), Spearman's most formidable opponent, developed a multifactor theory of intelligence from a comprehensive factor-analytic study. Thurstone found multiple broad group factors with no general factor. His 'Primary Mental Abilities' consist of seven factors (Pyle, 1979).

S - spatial ability ; P - perceptual speed

N - numerical ability ; V - verbal comprehension

M - memory ; W - verbal fluency

I or R - inductive reasoning

The crucial point here is that Thurstone viewed these factors as completely independent of each other.

Eysenck (1979) in 1939 reanalysed Thurstone's data and concluded that an alternative solution was equally possible, resulting in a strong general factor and a number of special ability factors, similar to Thurstone's 'primary abilities'. This re-assessment led Thurstone to concede that his 'primary abilities' were correlated. The second-order factor so formed was similar to

Spearman's `g'. Thurstone's modified theory resulted in an hierarchical model which appeared to reconcile his and Spearman's theoretical contentions.

Walsh and Betz (1985: p.133) note that while

> ...the existence of Spearman's `g' is now generally accepted... researchers, including Spearman himself, soon began to conclude that there were factors of mental ability somewhere inbetween the global generality of `g' and the absolute uniqueness of specific factors. These factors of intermediate generality, often called "group factors" were the focus of multiple factor theories of intelligence.

It is important to stress that these `group factors' have the ability to predict differential success in a number of areas.

Vernon (1965) emphasised that after the general factor has been removed from intelligence test scores, the next most important factor has very often been found to be one which distinguishes verbal from non-verbal abilities. This distinction will be discussed in some detail in the next chapter as the theoretical and empirical reasons for the division between verbal and non-verbal factors are basic to this thesis.

The psychometric theories discussed so far in this section are post-data constructions which have attempted to synthesize and reconcile conflicting views based on data produced from factor analyses. One of the most important apriori models of intelligence is Guilford's 'Structure of Intellect' theory which includes:

> [a] systematic set of variables that have been used in psychological measurement.
> (Guilford, 1988: p.1)

This 'Structure of Intellect' theory completely denies the existence of a general factor and posits a large number of independent abilities.

Guilford's model (which has been reproduced diagrammatically in Figure 2.2 (p.36) for easier conceptualization), inasmuch as it consists of three dimensions which interact to determine certain mental abilities, is consonant with theories such as those of Wechsler and Stern who also emphasize the interactive aspects of intelligence. The first of these dimensions refers to the kind of <u>mental operations</u> involved in the ability. In his latest (and final) revision of this model there are six operations, entitled: cognition, memory recording, memory retention, divergent production, convergent production, and evaluation (Guilford, 1988).

The second dimension relates to the <u>content</u> or area of information in which the operations are performed, including: visual, auditory, symbolic, semantic and behavioural areas. The third dimension is concerned with the <u>product</u> that results from a particular kind of mental operation applied to a particular kind of content and includes: units, cases, relations, systems, transformations and implications.

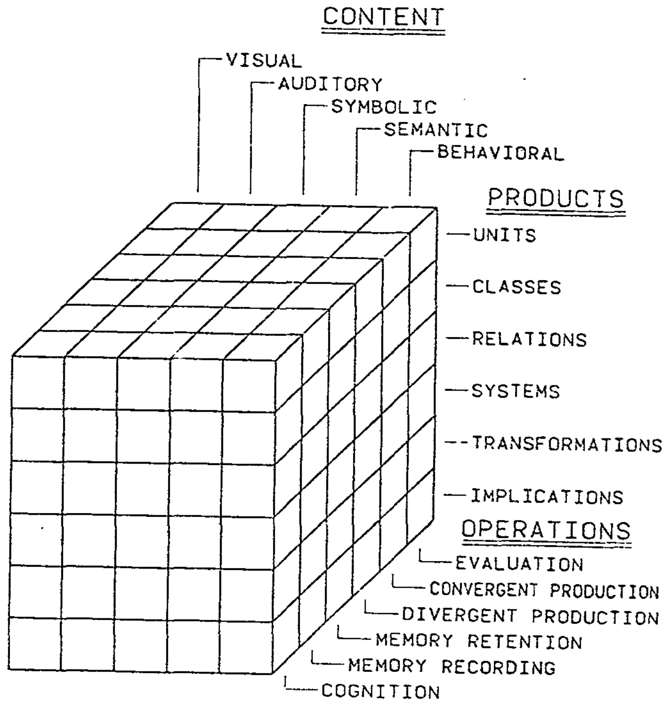

Figure 2.2 (From Guilford, 1988: p.3)

Guilford's first 'Structure of Intellect' model had a total of 120 possible abilities defined by the interaction of all three dimensions. By 1971 Guilford and Hoepfner (1971) claimed that they had identified 98 of the abilities and had developed the tests for defining them. The final version of the 'Structure of Intellect' model (discussed above) involves 180 possible abilities.

Maloney and Ward (1976) refer to the criticism of Guilford's model on the grounds that what he has presented is a taxonomy of actual and possible tests, rather than a dynamic model of intellect. This model does, however, stress several important factors which have been neglected by intelligence theorists ie. creativity and social intelligence.

Guilford's emphasis on the dynamics of a multifactorial intelligence is an echo of Wechsler's definition of intelligence (discussed in section 2.1 p.20). Wechsler disagreed with Spearman's 'narrow' conception of intelligence as the ability to educe relations, synonymous with 'g'. Wechsler (1958: p.14), propounding his 'global intelligence' viewpoint, contends that the entity measured by tests is not a 'simple quantity':

> Intelligence is all this and something more. It is the ability to utilize this energy or to exercise this ability in contextual situations, situations that have content and purpose as well as form and meaning. To concede as much is to admit that any practical definition of intelligence must be fundamentally a biological one in the widest sense of the term.

Wechsler's concern is that ability, as measured on an intelligence test, should not be equated with intelligence. He is particularly concerned about the linear addition of subtest scores in intelligence tests, as the resultant scores in no way reflect the dynamics of the process of intelligence. Wechsler agrees with Stern (quoted in Wechsler, 1958: p.22) who concludes that:

> Intelligence is the resultant collective behaviour among the intellective factors, and 'g' the measure of the strength of the resonance evoked by the coupling process.

2.4 The Developmental Approach

Probably the best known developmental theory, and the one which has spawned the most research and practical application , is that of Piaget. Here, once more, historical and discipline-related factors proved important in the formation of the conceptual framework of the theory.

Piaget was a biology student who worked in the laboratories of Alfred Binet and was fascinated by the latter's conception of 'age scales' (Pyle, 1979). What provoked Piaget's interest was the quality of the wrong answers which children often gave at different age levels. This led to Piaget viewing intelligence as a problem-solving behaviour which is developed and internalized according to the maturational stage of the child.

Informing Piaget's theory is the evolutionary emphasis on biological adaptation of the organism to its environment. This adaptation takes place through internalization of constructions of reality which progress in complexity and functional efficiency in defined stages. Congruent with his evolutionary theory of intelligence, Piaget conceives of logical substructures underpinning each of these stages.

Although the sequence of maturational stages is invariant, children pass through the stages at their own speed (Reynolds and Gutkin,1987). Nor does Piaget espouse a completely genetic basis for intelligence. Vernon (1979: p.46) calls attention to Piaget's awareness of environmental influences:

> His linking of these stages to particular ages suggested that he attributed them wholly to maturation. Later, however, he specifically pointed out that intellectual progress depends not only on cerebral growth but also on interaction of the child with the physical and social environment and the process he called equilibration, that is, the building up of a hierarchy of more and more effective schemata or mental structures.

This equilibration provides the motive force behind the developmental stages of the child's intellect inasmuch as it takes place through an increasingly higher-level internalization of the environment. As Piaget (quoted in Matarazzo, 1972: p.60) says, intelligence:

> is the form of equilibration towards which all the cognitive structures .... tend.

Baldwin (1967) discerns that the dynamics of this process of 'equilibration' reveal how Piaget has transferred two aspects of biological evolution to his theory of the development of human intelligence. One is the use of old mental structures (schemata) to deal with new situations ('assimilation') and the other is the adaptation of old schemata to deal with new situations ('accommodation').

These processes interact to maintain the 'equilibrium' between child and environment. In terms of Piaget's theory the 'schema' is the psychological equivalent of the biological structure of adaptation, in which the child reconstitutes reality internally on the basis of his own responses.

Piaget's clinical observation led him to distinguish four stages in the attainment of adult thought. Each stage is a prerequisite for the ensuing one and the differential speed at which children progress through these stages is a function of genetic endowment and environmental stimulation, and provides an important link between this theory and others, such as those of the psychometric school, where differences in intelligence are measured.

Elkind (1980) finds it useful to characterize the Piagetian stages not only in terms of the structures developed but also the aspects of reality that are constructed during the stage. These aspects of reality are constructed by means of the structural system which the child acquires during the stage and are consonant with his current level of intellectual ability.

Sensorimotor Period (birth to 2 years)

This period sees the initially instinctive actions of the infant, such as sucking and grasping, developing into more goal-directed behaviour, such as reaching out to grasp something. Thus of primary concern in this stage is the establishment of the permanence of objects, an achievement which is carried out through the co-ordination of the sensory and motor functions (Matlin, 1983).

During the sensorimotor period there is what Piaget (quoted in Eysenck, 1979) sees as the evolution of an 'intelligence of the limbs' through which the infant learns to differentiate himself from the environment and to observe the effect of his own action on his surroundings (Guilford, 1984). This behaviour lays the basis for more complex skills in later stages, such as cognitive thinking, which has internalized the actions of the sensorimotor period.

Preoperational Stage (2 - 7 years)

From the beginning of this stage the child begins to demonstrate the ability to function at a higher level of mental functioning. This is evidenced, for example, by his use of language where he is increasingly able to represent things in terms of their functions. Perception still plays a dominant role in thinking, thus the inability of the child to grasp the concept of 'conservation of quantity' because he perceives that the bottles containing the water are shaped differently - he judges by what he sees (the shape), despite observing the water being poured from one bottle into the other.

This stage is characterized by what Elkind (1980) describes as 'phenomenological causality' (concurrent events cause one another), animism and nominal realism (words are inextricably identified with the object or quality that they represent).

Concrete Operational Stage (ages 7 - 11)

This phase is notable for the acquisition of a logic which is no longer dependent solely on perception. Thus the child can now understand the transformations characteristic of conservation of quantity. He has reached the higher level system of mental structures that Piaget termed 'concrete operations'. These 'concrete operations' involve the use of syllogistic reasoning and the construction of unit concepts so that the child can quantify his experience.

These advances in reasoning make it possible for the child to follow rules and to comprehend the reversibility of transformations. The stage is set for the final development of abstract reasoning.

Formal Operational Period (ages 11 or 12 onwards)

This stage encapsulates the final development of abstract reasoning. It is functionally dependent on the stage of concrete operations, but whereas in the latter stage the child was only able to reason about things, the child in the stage of formal operations can reason about thinking or reasoning. Thus logic and thinking become further divorced from the perceived.

Importantly, the characteristics of 'scientific thinking' manifest themselves. Thus, the adolescent becomes able to hypothesize and think of all possible solutions to a problem without having to try these solutions in practice (Walsh and Betz, 1985). Along with this hypothetical-deductive reasoning, the adolescent now can engage in inductive reasoning (Kail and Pellegrino, 1985).

Piagetian - type tests have been developed and purport to be a more flexible method of assessing the qualitative development of intelligence than orthodox IQ tests. Reynolds et al. (1981) and Vernon (1979) cite evidence which shows that Piagetian-type tests are heavily loaded on the 'g' factor and the non - 'g' variance is task-specific and is not related to any other indicator of intelligence.

CHAPTER 3

THE MEASUREMENT OF INTELLIGENCE

3.1 The Test Measurement of Intelligence

This section will deal with the test measurement of intelligence and will not delve into the philosophical issues raised in chapter 2.

Wechsler (quoted in Maloney and Ward, 1976: p.223) remarks:

> Notwithstanding their theoretical views, authors of intelligence scales tend to make use of the same sort of tasks and items. Procedures may vary, but the tests themselves do not differ very much. The reason is that basically there are really not very many different ways of appraising intelligence. One is limited by the kind of reasonable tasks that can be set and the suitable questions that can be asked.

The nature of what the subtests measure is intimately related to theories about the concept of intelligence. Thus Spearman's well known 'laws of Neogenesis', which stress eduction of correlates and relations have found expression in most subtests which measure reasoning (often by analogy). Thurstone's 'Primary Abilities' are well represented by subtests which tap different kinds of memory (such as 'Digit Span' subtests), measure number ability, verbal comprehension and vocabulary, as well as visual-spatial skills and perceptual speed.

A watershed event for the testing of intelligence was the publication of the Wechsler - Bellevue Intelligence Scale in 1939. Wechsler's intelligence test was innovative in a number of areas. Firstly, Wechsler divided the subtests of his scale into two groups: non-Verbal (performance) and Verbal. The theoretical and practical issues raised by this division will be discussed in detail in the following section. Suffice it to say, that the non-Verbal scale aimed to test the responses of testees to fairly novel material that was presented in a non-verbal way.

This scale aimed to test visual-spatial abilities, short-term and visual memory, sequential thinking, understanding of social situations (an obvious expression of Wechsler's `global intelligence' concept), psychomotor abilities and perceptual speed. All of these non-Verbal tests were timed and bonus points allocated for speedy correct solutions.

The Verbal scale largely tests acquired knowledge such as in the Information and Vocabulary subtests, as well as rote and sequential memory (Digit Span), computational ability (Arithmetic subtest), verbal comprehension and analogical inference (Similarities). Only the Arithmetic subtest, of the Verbal scale, is timed.

Of importance to note, is that with the Wechsler-Bellevue, Wechsler broke away from the single IQ score which summarised the individual's mental ability. The Wechsler-Bellevue yields separate non-Verbal and Verbal scores, as well as a full-scale score. Another divergence from established intelligence tests was Wechsler's abandoning of the original IQ ratio expression of mental ability. He devised an ordinal scale and a deviation score with a mean of 100 and a standard deviation of 15. This meant that an individual's score could be compared with all other individuals' scores.

Also, of significant clinical value, a profile of the testee's scores on the various subtests could be drawn up and, because these are scaled scores, they could be compared with each other and the average scaled score of the standardization sample. Thus terms such as `test scatter' became relevant in assessing an individual's mental abilities. Although the `IQ' is still used, it no longer refers to a ratio concept at all and is an anomaly of usage. Most modern intelligence tests follow the format of the Wechsler-Bellevue.

Another trend in the development of intelligence measures involved the construction of group tests. The urgent need for intelligence testing for selection of personnel in World War 1 led to the development of group tests which could be administered to several subjects simultaneously (Huysamen, 1983). Robert Yerkes improved on the work of Otis and others to develop a paper-and-pencil test of intelligence, the Army Alpha, which consisted of eight subtests assessing areas such as `practical judgement', `arithmetical reasoning' and `analogies' (Graham and Lilly, 1984). What is of theoretical concern for the following section is Yerkes' development of an alternative, non-Verbal intelligence test, the Army Beta, for those of limited verbal ability, immigrants and those with impoverished educational backgrounds.

After the war group tests were used extensively in many fields of life, such as industry and education. Their obvious advantages were that vast numbers of people could be tested and much more economically than with individual tests of intelligence.

Anastasi (1988), discussing the form of the questions in group tests, distinguishes between the more open-ended questions in some individual scales and the multiple-choice format of group intelligence test questions. She also draws attention to the flexibility which the examiner has in individual tests in allowing the testee entry to the sub-test at appropriate levels and being able to discern ceiling levels quickly, so avoiding testee frustration.

From a clinical point of view the individual scales are far more useful, as they allow a sensitive observer to pick up extra-test information about the testee, such as characteristic ways of approaching problems, nervousness and perseverance. In addition, the individual intelligence tests allow timing of individual responses, a situation which is clearly not possible in group situations. On the plus side for group intelligence tests is the fact that these tests have better established norms than individual tests because of the very large samples used in the standardization process.

3.2 The Meaning of Differences between non-Verbal and Verbal Measures of Intelligence

3.2.1 The Statistical Value of Discrepancies between non-Verbal and Verbal IQ

At the outset of such an examination of non-Verbal/Verbal IQ discrepancies, it is salutary to take note of some of the reservations which have been expressed about the value of such discrepancies. Any such measured discrepancy is the difference between two statistically measured concepts and is subject to the laws which govern statistics. Thus, as Madge (1965) cautions, both the non-Verbal and the Verbal IQ measures are subject to measurement error and the error for each score must be taken into account when assessing discrepancies between non-Verbal and Verbal scores.

Robbertse (1962) found in the standardization group of the New South African Group Test that one out of three pupils differed by more than 10 points between their Verbal and non-Verbal scores and one out of six had non-Verbal scores 10 points or more higher than their Verbal scores. In the manual (undated) for the Intermediate Series of the New South African Group Test the National Bureau of Educational and Social Research investigated the significance of the differences between non-Verbal and Verbal intelligence scores and stated:

> In the investigation only differences of at least 10 were considered as real differences. Smaller differences were considered accidental.
> (p.13)

The authors provide no rationale for choosing 10 points as a significant discrepancy, nor does their claim for significance agree with that of Le Roux and van der Merwe (1985) who, mindful of Madge's warning (above), calculated that 16.8 points was the statistically significant discrepancy between non-Verbal and Verbal IQ scores of the New South African Group Test (NSAGT).

Two questions arise out of the preceding discussion. The first deals with the data extracted from standardization groups. Given that one out of three pupils in the standardization group of the NSAGT showed differences of 10 points or more (in either direction) between their non-Verbal and Verbal scores, while this makes such discrepancies fairly frequent or 'normal' in statistical terms, it certainly doesn't necessarily mean that such discrepancies are 'normal' in terms of their behavioural or academic correlates.

Indeed, the authors of the manual for the Intermediate Series of the NSAGT claim that the group from the standardization sample who had non-Verbal IQ scores of 10 points or more higher than their Verbal IQ scores were scholastically the weakest when compared with the other groups where the direction of the discrepancy was reversed or where the discrepancy was less than 10 points. Unfortunately, the compilers of the manual fail to mention whether the groups were controlled for full-scale IQ, so their findings must remain controversial.

The second question touches on the theoretical underpinnings of the significance of the difference between non-Verbal and Verbal IQ scores. Test compilers work from the viewpoint that the average person's non-Verbal and Verbal intelligence are on the same level, theoretically, and that a representative group of testees should show a symmetrical curve with respect to these two abilities.

Wechsler (in Maloney and Ward, 1976) is quoted as indicating that in the standardization sample of the Wechsler Adult Intelligence Scale the mean difference between Verbal IQ and Performance IQ was essentially zero. Maloney and Ward (1976) conclude that this data suggests that for most persons a significant difference would not be expected.

As the following section will show, many theorists contend that there should be no expectation that the non-Verbal and Verbal IQ scores should be equal, as the two scales measure fundamentally different abilities. Thus section 3.2.2 will examine the ontological status of the concepts of non-Verbal and Verbal intelligence.

3.2.2 The History and Ontological Status of the Concepts 'non-Verbal' and 'Verbal' Intelligence

The status of these two concepts is historically linked to the pattern of development of intelligence testing in general. The focus of the first Binet-Henri Intelligence scale was on verbal intelligence. This can be explained as a response to the task given to Binet and Henri to develop a test which would distinguish between those children who could profit by being educated at school and those whose intelligence was too low. Thus much of the material included in this intelligence scale was scholastic material which was taught to the pupil and cultural material which the pupil would have been expected to acquire from exposure to his cultural environment.

Clearly the nature of the task influenced the composition of the first intelligence test. It was another response to a demand (see section 3.1 pp 46-47), this time military, which led Otis and Yerkes to develop the 'Army Alpha' and the 'Army Beta' group intelligence tests for literate and illiterate men (as well as immigrants) respectively (Downie, 1967).

Essentially the development of a non-Verbal test (the 'Army Beta') was as a substitute for a Verbal test. Here, two factors seem implicit - the first, that the compilers felt that non-Verbal items could measure intelligence equally as well as Verbal tests, and secondly, that the extension of intelligence test items to include non-Verbal material was not motivated by a more comprehensive picture of intelligence as involving different facets, but rather as a separate way of estimating intelligence levels.

Criticism of Terman's 1916 revision of the Binet Intelligence Test (the Stanford Binet) was that it was too heavily loaded with verbal material. Terman's reply to this criticism was that the verbal and abstract are the essence of mental ability. With respect to the 1937 Stanford-Binet revision, the authors, Terman and Merrill, stated:

> At these levels the major intellectual differences between subjects reduce largely to differences in the ability to do conceptual thinking and facility in dealing with concepts is most readily sampled by the use of verbal tests. Language, essentially, is the

> shorthand of the higher thought process, and the level at which this 'shorthand' functions is one of the most important determinants of the level of the processes themselves.
>
> (quoted in Kruger, 1987: p.36)

This quotation seems to indicate that Verbal tests measure a developmentally more sophisticated form of intelligence which non-Verbal tests, by implication, cannot measure. Certainly, at the least, Terman and Merrill emphasized conceptual thinking as the most important facet of intelligence.

This emphasis on conceptual thinking is echoed in the Two-Factor theory which Spearman propagated. In this theory the general factor (g), measuring a mental energy available for making comparisons or drawing inferences, predominates in the measurement of intelligence and the specific factors are accorded minimal importance. This suggests that non-Verbal and Verbal tests of intelligence essentially measure the same general factor, with task-specific special factors which do not contribute significantly to the variance in intelligence.

Opposed to this unifocal view were theorists such as Thorndike and Thurstone who favoured a multifocal view of intelligence in which there were various group abilities which were totally independent of each other. Seen in this light non-Verbal and Verbal abilities would not be related at all.

A seminal study by Alexander in 1935 experimentally tested the evidence for Spearman's Two-Factor theory and the unique traits theory. The specific focus of Alexander's study was to test whether 'practical' (non-Verbal) and 'Verbal' intelligence were distinct and independent capacities or, as proposed by Spearman, whether they measured the same 'g' factor and only differed in respect of their non-intellective or specific factors (Wechsler, 1958).

Alexander's findings led him to conclude that Spearman was correct in saying that there was only one factor (g) common to all measures of intelligence but that this factor did not account for all the variance between the tests. In addition there were other group factors ('functional unities') which recurred repeatedly in various measures of intelligence and which showed a common factor of their own. Thus 'verbal ability' and 'practical ability', along with other factors, were identified.

However, while each of these 'functional unities' required a specific factor to account for its own contribution to the global measure of intelligence, Alexander found that the 'functional unities' were definitely related (later research has indicated, for example, a correlation of approximately 0.5 between Verbal ability and Practical ability; Wechsler's manual for the Wechsler Adult Intelligence Scales (1955) indicates a consistent moderately high correlation between Verbal IQ and Performance IQ across age groups: .77 for ages 18 to 19 and 25 to 34, .81 for ages 45 to 54) (Maloney and Ward, 1976).

Notwithstanding this, Alexander stated that the 'functional unities' could not be equated with Spearman's specific factors as the former contributed significantly to the variance in intelligence while Spearman's specific factors did not (Wechsler, 1958).

Butcher (1968) notes Vernon's assertion that after the effect of the general factor has been removed, the next most common factor has frequently been found to be the one which distinguishes non-Verbal from Verbal abilities. Vernon labelled the latter two groups k:m (spatial-practical-mechanical) and v:ed (verbal-educational). The k:m complex includes perceptual, physical and psychomotor, as well as spatial and mechanical factors while the v:ed factor after further analysis usually yields minor fluency and divergent thinking abilities, a scholastic and a number factor. Some tests load on a combination of abilities, for example tests of mathematics and science depend on both numerical and spatial abilities (Eysenck, 1979).

Wechsler's innovative division of his 1939 intelligence scale into performance and verbal scales has been criticized by Lezak (1988: p.355), who says:

> Perhaps Wechsler's VIQ and PIQ concepts would have had a greater chance of independent survival if they had been not only theoretically attractive but psychologically sound. However, hundreds of factor-analytic studies - beginning with Cohen's work in the early '50s (1952) - have repeatedly and consistently demonstrated that not all Verbal Scale subtests measure verbal functions, that one Performance Scale subtest has a considerable Verbal loading and that other important aspects of cognitive behaviour - particularly attention and concentration, mental tracking and response speed - contribute variously to both Wechsler's VIQ and PIQ scores without being recognized or measured in their own right.

Part of the debate about the value and inter-dependence of non-Verbal and Verbal abilities revolves around the debaters' conceptual views of intelligence. There are those, such as Cattell (1971) with his notion of 'fluid' and 'crystallized' intelligence, who hold the view that non-Verbal ('fluid') intelligence is the innate potential of the individual and that Verbal intelligence ('crystallized') is an indication of how that innate potential has developed subject to environmental conditions. Thus, for Cattell, non-Verbal intelligence has a biological basis. There is some interesting research which indicates that spatial ability (better developed in males) is genetically mediated and has an evolutionary basis (Eysenck, 1979).

Another finding which supports the biological basis of non-Verbal ('fluid') intelligence is the differential growth and decline curves for non-Verbal and Verbal intelligence. Eysenck

(1979: p.24) comments:

> As we might expect g_c [crystallized intelligence] continues to grow longer and begins to decline much later in life, than g_f [fluid intelligence]; like most bodily skills and sensory abilities, g_f reaches its peak relatively early (between 16 and 20 years) and begins to decline in the thirties. On the other hand, g_c may continue to grow until the fifties, and may not decline until very late in life.

Cattell's view of intelligence leads to the conclusion that a significantly lower Verbal IQ is an indication of a `learning problem' of some kind, as the innate potential of the individual is not achieving full expression.

The proposed reasons for a significantly lower Verbal than non-Verbal score are myriad. Le Roux and Van der Merwe (1985) present a summary of such reasons, which includes: semantic factors, scholastic limitations, a concrete as opposed to an abstract approach to problems, impairment of hearing, cultural neglect, language confusion and psychoneurological dysfunction such as dysphasia.

Madge and van der Westhuizen (1971) suggest, from their experimental findings, that significantly lower non-Verbal scores are due to neurological impediments, such as motor and perceptual problems, educational neglect and, possibly, chronic disease.

Kruger (1967: p.20), working from a developmental approach, considers significantly lower Verbal IQs and concludes:

> Goeie prestasies op die verbale vlak is alleen moontlik as die kind afstand geneem het ten opsigte van die konkrete en tot die abstrakte gevorder het, terwyl die konkrete-visuele tewens noodsaaklike voorvereiste is vir die hoer denkniveaus. Die kind wat dus slegs in staat is om op die nie-Verbale te presteer, het nog nie gevorder tot die ooreenstemmende vlak van abstrahering nie.

This ability to abstract and to distance oneself mentally from the concrete involves the use of language. Kruger's assertion seems implicitly based on Piaget's observation that the more abstract kinds of cognitive reasoning have developed from manipulation of simple ideas, which in turn have developed from physical manipulation in the early period of development. Again, as with Cattell, non-Verbal intelligence is seen as the prerequisite for the development of Verbal intelligence.

Any deficit in the development of language, which is an essential component of the Verbal tests, will obviously have serious implications for school achievement. The conceptualization of a significantly lower Verbal IQ as a manifestation of a learning or language problem introduces the idea of underachievement, relative to the innate potential of the individual, irrespective of the causative factors for this lower Verbal IQ.

Murakawa and Pierce-Jones (1969), in a study comparing the thinking processes of achievers and underachievers, concluded that underachievers tend to focus on one aspect of a situation at a time and tend to approach the problems by trial and error, whereas achievers tend to solve problems systematically by use of the hypothetico-deductive attitude. The latter mode of thinking, which requires sophisticated abstraction, is dependent upon the ability to distance oneself mentally from the problem - again a function of language development.

Murakawa's findings get indirect support from Sternberg (1985) who found that global planning scores correlated .43 with measured intelligence and that local planning scores correlated -.33 with measured intelligence. Sternberg drew the inference that:

> ...more intelligent individuals tended to spend relatively more time than others in global planning, but relatively less time than others in local planning.
>
> (Sternberg, 1985: p.14)

If the identity between significantly lower Verbal scores and underachievement is accepted (Robbertse, 1962, certainly demonstrated this using the New South African Group Test), then Murukawa and Pierce-Jones's (1969) findings become important in understanding the meaning of significantly lower Verbal IQ scores. Although the latter researchers found no significant difference between achievers and underachievers in memory span which was reproduced immediately, they did find significant differences in associative and meaningful memory.

Their results indicated that achievers and underachievers memorize things in different ways. Achievers memorize only necessary parts by concentrating their attention effectively, while underachievers focus on unnecessary parts too. In memorizing a story, much higher scores were gained by achievers then by underachievers in the number of reproduced words, information items and themes. When a series of sentences was given, achievers could group the content to a much greater degree than underachievers could.

While Murakawa and Pierce-Jones (1969) attributed the differences in memory for meaningful material to diverse factors such as different learning sets and a difference in 'abstract and objective thinking attitude', associated studies of learning-disabled children have reached similar conclusions. Cohen and Netley (1978) selected learning-disabled children so as to exclude any children with organic defects, perceptual or emotional disorders. The only other criteria for their selection was that they be of 'normal' intelligence but be achieving poorly at school. When they investigated short-term memory using digit span tests Cohen and Netley found that:

> With the LD (learning-disabled) children, recall performance was much poorer than that of controls over all serial positions probed. This should mean that the subjects have both rehearsal difficulties (also supported by the results of the paired-associate memory

> test) and a possible faster-fading trace for serial items than controls.
>
> (Cohen and Netley, 1978: p.633)

This finding is in line with that of Coleman and Rasof (1963) who found that underachievers are generally low on the scores of the tests which load heavily on verbal or reasoning factors or which require memory or sustained concentration. On the other hand, they showed high scores on the non-Verbal, spatial and perceptual tests.

Similarly Rourke and Telegdy (1971), who matched their two groups on total IQ score, found that the High Verbal - Low Performance group exhibited relative superiority on tasks thought to be subserved primarily by the left cerebral hemisphere (e.g. reading, spelling, arithmetic, speech-sounds discrimination) and relative inferiority on tasks thought to be subserved primarily by the right cerebral hemisphere (eg. spatial visualization, visual memory, complex visual-motor co-ordination), whereas the opposite pattern of relative superiority and impairment characterized the performance of the High Performance - Low Verbal group.

Hunt (in Sternberg, 1985) has proposed that individual differences in verbal intelligence can be viewed in terms of the individual differences in ability to gain access speedily to lexical information in long-term memory. Quick access to such information would enable an individual to perform better on a variety of tasks, especially verbal ones. Lexical access task scores yield a consistent relationship with scores on Verbal IQ tests of about -.3.

The preceding findings suggest that memory is an important factor in underachievement and in the quest for the meaning of the non-Verbal/Verbal IQ discrepancy.

Another approach to the question of the meaningfulness of non-Verbal/Verbal IQ discrepancies is that of Shinagawa (quoted in Le Roux and Van der Merwe, 1985) who maintains that differences between the non-Verbal and Verbal scores are determined by temperamental and other personality factors. According to him, pupils with a higher measured Verbal than non-Verbal IQ tend to be more theoretically inclined, and are generally more tense, asocial, restless and argumentative. On the other hand, pupils whose non-Verbal scores are higher than their Verbal scores are often more practically-minded; they are active, independent and to some extent even aggressive, due to lack of self-control.

Van der Merwe (1978) tested some of the factors which have been suggested as reasons for discrepancies between non-Verbal and Verbal intelligence (such as hearing impairment, personality adjustment and visual acuity). Using the New South African Group Test on first year university students, he divided them into three groups (NV > V; NV = V; V > NV) and found no significant correlations between any of the three groups and hearing ability, visual acuity or the pass/fail academic criterion.

However, he did find significant correlations between the high non-Verbal group and two components on the Personal, Home, Social and Formal Relations Questionnaire (Human Sciences Research Council, 1971), namely 'Preoccupation with Health' and 'Need for sociability with the Opposite Sex'. Van der Merwe concluded that there was an absence of preoccupation with the physical condition in the male group whose non-Verbal scores were higher than their Verbal IQ scores and suggested that they were more even-tempered and phlegmatic individuals. Both male and female subjects in the high non-Verbal group revealed an independent and self-reliant attitude in a one-to-one relationship with the opposite sex.

Evaluating his results, Van der Merwe concluded that no evidence of maladjustment was evident in the high non-Verbal group. His results, however, must be interpreted with caution as, on his own admission, the 10-point differences between non-Verbal and Verbal IQ scores which he used are not statistically significant discrepancies (although they appear to be clinically meaningful: see chapter 7, p.111).

Bornstein, Suga and Prifitera (1987) found that for both males and females, the mean PIQ-VIQ discrepancy was negative (PIQ>VIQ) in the group with fewer years of formal education whereas the groups with more years of formal education showed a higher incidence of positive (VIQ>PIQ) discrepancies. In addition, they confirmed that subjects in the higher full-scale IQ range tend to have discrepancy patterns in favour of Verbal IQ whereas those in the lower full-scale IQ range showed a pattern in favour of Performance IQ.

At the present time there seems to be some disagreement about the value and significance of non-Verbal/Verbal IQ discrepancies. It may well be that the experimenters and theoretical speculators have ignored the interaction that exists between these two aspects of intelligence.

CHAPTER 4

SCHOLASTIC ACHIEVEMENT

4.1 Introduction

Since the present research involves an examination of the relationship between certain aspects of intelligence (non-Verbal and Verbal) and scholastic achievement, it is logical that academic achievement at school should be examined, particularly with regard to non-intellective factors which could influence a child's performance at school. Thus, while the relationship between intelligence and academic achievement at school will be discussed, the emphasis in this chapter will fall on other variables which are important for scholastic achievement.

4.2 The Assessment of Scholastic Achievement

Scholastic achievement has usually been measured either by reference to school marks (the 'grades' referred to in American studies) or in terms of scores on standardised scholastic achievement tests. Jensen (1981 : p.30), in considering these two measures of scholastic achievement, says:

> The correlation between IQ and teachers' grades is generally .10 to .20 lower than the correlation of IQ with achievement test scores. The main reason is that grades are a less reliable measure of achievement; they vary from one teacher to another, and they are

influenced by the teacher's impressions of the pupil's effort, deportment, and other such factors that are not directly related to either cognitive ability or achievement.

4.2.1 Scholastic `underachievement' and `overachievement'

`Underachievement' and `overachievement' have been defined in terms of the relationship between scores on intelligence tests and measures of academic achievement (Butcher, 1968). Thus the emphasis has been on the predictive validity of measured intelligence. Whittington (1988) defines `underachievement' using the regression of achievement measures on the total ability scores. This regression is accepted as predicting the child's achievement, given his ability score. Achievement scores above prediction would be examples of `overachievement' and those below prediction would indicate `underachievement'.

There has been some debate about how far under or over the predicted achievement level scores should be to indicate meaningful deviaton. Thorndike (1963) recommended 2 standard errors as the critical points.

Both `over' and `underachievement' as concepts are predicated on the value of intelligence scores as predictors. As Eysenck (1979) pointed out, an overview of the literature on the efficiency of intelligence scores as predictors of achievement indicates that intelligence accounts for only 25% of the variance in achievement. In terms of the 'over' and 'underachievement' concepts, then, the factors which are responsible for the other 75% of the variance in achievement are, in a sense, inconsequential. Only intelligence is to be the determiner of achievement. Butcher (1968 : p.281) cautions:

> This is to expect too much, by implication, of measured intelligence as a predictor, suggesting that it is in effect the only factor, and that other influences are in some way surprising or abnormal. There are also logical and technical difficulties inherent in this approach, particularly if 'achievement quotients' are calculated. Logically, 'overachievement' should be uncommon, or impossible, if measures of ability are taken at their face value.

Butcher also warns that as intelligence and achievement measures are always positively correlated, regression effects could produce misleading impressions.

4.3 Factors involved in Scholastic Achievement

The issues discussed in the preceding section illustrate the complexity inherent in the prediction of scholastic achievement from measured intelligence. One aspect of this complexity seems to be the tendency to regard intelligence as a reified construct which is divorced from other aspects of personality. Indeed, often it seems to be forgotten that intelligence is a trait of personality, a fact embodied, for example, in the inclusion of the dimensions 'Low Intelligence - High Intelligence' (Factor B) in the High School Personality Questionnaire (Human Sciences Research Council, 1968).

The extent to which intelligence and other personality traits interact is extremely hard to determine. Then, too, personality factors which influence achievement in school, may also have operated on the scores in the Verbal intelligence subscale, as the latter also involves crystallized achievement (Kruger, 1972). One of the few certainties is that complex interaction between personality factors must occur and any isolation of a personality factor is, therefore, artificial.

It is in this light that the following factors which influence school achievement are discussed.

4.3.1 Intelligence

One of the most established findings regarding the rôle of measured intelligence in academic achievement at school is the correlation of approximately .5 between these two variables (Barton,Dielman and Cattell, 1972; Cattell, 1971 ; du Toit, 1970; Eysenck, 1979). These studies, as indicated in section 4.2.1 (pp.66-67) of this chapter, suggest that only 20-30% of the variance in scholastic achievement is attributable to measured intelligence.

In the light of the above it will be useful to examine the relationship between measured intelligence and scholastic achievement in more general terms. Vernon (1979) sees intelligence as referring to the more generalized skills and conceptual levels which apply to a spectrum of activities, particularly to new learning situations. These cognitive skills and strategies are built up by interaction with the environment at home and during leisure activities, not primarily through teaching at school.

Scholastic achievement, in contrast, refers to narrower areas of content in which mastery is contingent to some extent on teaching at school. This achievement would also be affected by motivation of the child to master the given material. The general cognitive strategies comprising intelligence, according to Vernon (1979), would be utilised in learning content areas at school, thus explaining the value of intelligence scores in predicting scholastic achievement. The motivational factor, referred to above, also helps to explain why genetic factors play a far greater rôle in intelligence than in achievement.

Another consistent finding is that Verbal IQ is a better predictor of academic success at school for most subjects than is non-Verbal IQ (e.g. Robbertse, 1968). On logical grounds this finding makes sense as the Verbal IQ involves the implementation of genetic potential on culturally and scholastically acquired material such as vocabulary and also involves the acquisition of skills such as numeracy. Seen from another point of view, the higher predictive validity of the Verbal IQ reflects dynamics which it shares with academic achievement. An elaboration on this point (mentioned briefly in the previous section) is made by Kruger (1972 : p.120):

> Omstandighede wat akademiese onderprestasie veroorsaak, is dikwels eweneens verantwoordelik vir swak ontplooing van die genetiese intelligensie.Persoonlikheidsprobleme emosionele wanaanpassing, gebrekkige konsentrasie, swak leesvermoe, gebrek aan motivering en swak onderrigmetodes het gemeenskaplike negatiewe invloed op die ontwikkeling van die abstrakte denke en die akademiese prestasie.

In the higher standards of school past academic achievement is likely to predict future academic achievement as accurately, or more accurately than IQ score can. The reasons for this are manifold: learning is cumulative and therefore the success of earlier learning is likely to affect the efficiency of later learning; earlier achievement already reflects aspects not directly tapped by IQ measurements - motivation, interest, study habits and self-discipline and therefore is a better predictor of achievement at higher standards in school (Jensen, 1981).

4.3.2 Personality

An overview of the rôle of personality dimensions in the prediction of school achievement yields, in comparison with the rôle of intelligence, a confused and rather dismal picture. Butcher's (1968: p.274) assessment is typical:

> Other factors, broadly classifiable under the headings of personality and motivation must, one would suppose, be of equal total importance, but in spite of attempts to demonstrate their usefulness in prediction (e.g. Cattell and Butcher, 1968) they remain in general so elusive, variable and multifarious that, even in combination, their practical predictive efficiency is lower than that of general intelligence.

In contrast with this view Barton et al. (1972), summarising the results of their experiment, suggest that the intelligence quotient seems responsible for 20% - 30% of the variance in achievement but that the amount of variance predicted can be doubled by the addition of personality measures.

A considerable amount of research has been conducted on the relationship between the personality dimension of extraversion-introversion[1] and academic achievement. Entwistle (1972) proposed that achievement in primary school is possibly linked to extraversion. This association makes sense in terms of the predominance of group work and peer group activity in the primary school. In the secondary school it is introversion, especially when associated with high levels of intelligence (Lewis and Ko, 1973 in Fontana, 1983), which is linked with academic success.

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[1]. Extraversion: characteristic of type of <u>personality</u> (extravert), whose interests are directed outwards to nature and other people, rather than inwards to the thoughts and feelings of the self (introvert) (Drever, 1973: p.91).

Self-esteem is another facet of personality that has proved useful in predicting academic achievement at school. Travers (1982) defines a positive self-esteem as the favourable statements which a person makes about himself regarding his capabilities, his chances of success and his future expectations. Conversely, a negative self-esteem involves disparaging self-statements, self-criticism of what the person believes to be incompetent performance and an avoidance of challenges.

Coopersmith (1968) has shown that children with high self-esteem achieve better than those with similar ability but lower self-esteem. He describes as correlates of high self-esteem realistic establishment of high goals, less dependence on adult approval and a greater ability to handle failure. High self-esteem seems to be nurtured in the home by dynamics which will be discussed in section 4.3.3.(p.76).

Bloom (1976), reviewing the literature, concludes that academic self-concept is the strongest of the non-intellective predictors of academic success at school. However, Potterbaum,Keith and Ehly (1986), in an extensive study, suggest that there is no causal relationship between self-concept and academic success and postulate another variable (unknown) that would account for the relationship between the two.

The obvious candidate amongst affective traits for predicting achievement at school, is motivation. Here McClelland's (1987) 'need for achievement' (n Achievement) motive has been prominent. However the experimental results concerning the predictive validity of the 'need for achievement' motive for school achievement have been disappointing. McClelland (1987, p.227) evaluates the situation as follows:

> Much energy has gone into trying to determine whether there is a relationship between n Achievement and grades in school. Usually such a relationship is not found to be significant; this has led a number of investigators... to conclude that the n Achievement score cannot be valid because it does not predict scholastic achievement. However, there is no theoretical reason for predicting that high n Achievement should lead to better performances in the classroom under all conditions, any more than there is reason to believe... that high n Achievement should always lead to better performance regardless of the incentives present... if there is strong achievement pressure... or if extensive incentives of any kind are introduced, there should be no relationship between high n Achievement and grades.

Uguroglu and Walberg (1979) view the situation in a far more positive light. They reviewed the many studies which have determined correlations between measures of achievement need and measures of achievement and found an average correlation of 0.34 between motivation and achievement.

The relationship between pupil and incentives has another dimension embodied in the concept 'locus of control'. The latter concept refers to the individual's perception of the reinforcements provided by the environment; either he perceives these to be controlled by himself (internal locus of control) or these reinforcements are beyond his control (external locus of control) (Travers, 1982).

Messer (1972) found that fourth grade children who believed that academic success was dependent on their own efforts scored higher academic grades than those who believed that their locus of control was external. Interestingly, he found this to be true for boys who gave themselves credit for achievement and girls who blamed themselves for failure. However, Brown (1980) found that intelligence was significantly related to locus of control for adolescent pupils whereas achievement was not.

Other research on the predictive value of personality variables for scholastic achievement has used Cattell's High School Personality Questionnaire (HSPQ: Madge and du Toit, 1968) and has come up with some consistent, if unsurprising, results. Robbertse (1968), using part of the standardization group for the New South African Group Test, demonstrated the validity of three of the personality dimensions of the HSPQ for predicting achievement in the matriculation final examinations.

Factor G, a measure of conscientiousness, determination and concern about rules, has been found both by Robbertse (1968) and

Barton et al. (1972) to be significantly related to academic achievement. The former also found Factor Q_3, which reflects ambition, control of emotions as well as conscientiousness to have predictive value for scholastic results. Factor I (sensitivity, artistic imagination) showed predictive value as regards achievement in languages. From a common-sense point of view these findings are quite understandable.

Cattell (1971: p.388) found that:

> The negative correlation of achievement with guilt proneness (O) and ergic tension (Frustration, Q_4) on the other hand calls for a sequential experiment to see whether these may not be the products of relative school failure, rather than their causes.

An aspect such as interest has yielded seemingly trivial results in connection with the prediction of scholastic achievement. Robbertse (1968) found that interest in language had predictive validity for achievement both in language and for the average percentage in the matriculation examination, while interest in science had predictive validity for the natural sciences, mathematics and the average percentage in the matriculation examination.

The mutual influence of intelligence and personality traits seems to make accounting for their influence in predicting the variance in achievement exceptionally difficult. Even when intelligence and personality factors are combined their predictive power still leaves a large percentage of the variance in achievement unexplained (Barton et al, 1972). Many of the factors that influence achievement either aren't quantifiable or the instruments that are used to measure them need refinement. In addition, the interaction of factors seems to make the likelihood of accounting for a large part of the variance in achievement unlikely.

4.3.3 Socio-economic Status and Home Background

Studies which examine the relationship between social class (measured by father's occupation and academic achievement) and academic achievement have yielded correlations of between .30 and .35 (Miller, 1970). Conditions in the home are vital for the development of achievement motivation and middle-class homes seem to provide the best environments in this respect (Travers, 1982).

Identification with the father seems to play an important part, as families without fathers tend to produce children lower in achievement motivation (Fontana, 1983).

Self-esteem, discussed in the previous section, seems to be particularly dependent on encouragement and attention from parents as well as parental displays of physical affection, consistency and democratic behaviour. These attitudes establish the child as a valued, respected member of the family.

While measured intelligence seems to provide the best predictor of scholastic success, its accounting for only approximately twenty-five percent of the variance in such success (see section 4.2.1, pp.66-67 of the present chapter) indicates that many other influences contribute to scholastic achievement. That cumulatively these influences still don't seem to account for the majority of the variance seems to be a function of the very nature of the educational situation. Burns (1986: p.206) captures the complexity of this educational milieu and implicitly suggests why quantitative analysis may not account for the variance in achievement between pupils:

> Educational institutions are the arenas in which all young persons are compelled to compete, and in doing so are forced to reveal personal adequacies and inadequacies in public contests, frequently on unequal terms with others, in events not even of their own choosing, against externally imposed standards.

CHAPTER 5

MEMORY

5.1 Introduction

Reviewing the literature on memory, Estes (1986: p.171) observes that a generally acceptable definition of memory is that it is an "abstraction referring to an organism's capability of storing and retrieving information."

In a review of the existing literature Maccoby and Jacklin (1974) concluded that there is probably no difference between the sexes in memory capacity, skills in storing and retrieving information or in choice of memory strategies. However, the nature of the material to be remembered can influence recall. Thus females tend to perform better when the content is verbal or social.

Greene (1987) distinguishes between two ways in which cognitive psychology has used the term 'memory'. The first instance is where memory is seen in terms of a passive store, like long-term memory, where all the knowledge that an individual has ever acquired is stored. The other view is the one which sees memory in terms of the processes which occur during both learning and recall. Modern theory, as will be seen in this chapter, tends to synthesize the two views so that constant interplay between, for example, short- and long-term memory takes place during storage and retrieval. The latter theory allows for the encoding of incoming information and the cumulative production of knowledge.

One approach to memory has been in terms of its physiological aspects.

5.2 Biological Approaches to Memory

Hunter (1976: p.18) is frank in his assessment of modern knowledge of the physiological substratum of memory:

> We do not yet know much about the physiological bases of retaining. But we have no reason to doubt that retaining is accomplished by modifications of the nervous system and, furthermore, that these modifications are of a structural kind whenever retaining persists for longer than a few minutes.

Some of the evidence for the physiological basis of memory has come from the study of concussion and brain damage. Here one of the clearest findings is that damage to the brain (probably to the tissue of the mammillary body and the hippocampus) usually results in losses in short-term memory but not in long-term retention. Thus the individual who has suffered such trauma can, typically, remember events in his past but cannot establish any new long-term memory patterns. These differential effects lend biological plausibility to the distinction between short-term and long-term memory (Baddeley, 1978), although Matlin (1983: P.51) remains unconvinced:

> The issue ... is whether we have enough evidence to support a model with two separate memory storages, a short-term memory that stores information for about 30 seconds or less and a long-term memory that stores material for long periods of time.

Complementary evidence for the physiological basis of memory involves the growth and decline of memory span, which has been identified with short-term memory (the number of elements which can be held in conscious awareness). Behr (1980: p.73) gives a pithy summary of the growth and decline of the immediate memory span:

> The memory span for digits auditorily presented has been fully investigated for different age levels. It has been found that children have average memory spans of 2, 3, 4, 5 and 6 digits at the age of $2^{1}/_{2}$, 3, $4^{1}/_{2}$, 7 and 10 years respectively. Thus there is a steady but progressively diminishing increase in memory span as one grows older. Between the ages of 15 to 30 years, the memory span begins to decline.

Memory span demonstrates, thus, a similar pattern of growth and decline to that of other physiological measures such as reflexes and eye-hand co-ordination. In chapter 3.2.2 (pp. 56-57) the same observation concerning growth and decline was made about Cattell's 'fluid intelligence' (Eysenck, 1979).

Interestingly, Horn (1968), reviewing some major studies, computed the average correlation between memory span and fluid intelligence as .50, while the average correlation of memory span with crystallized intelligence was .00. He concluded that the ability to hold discrete pieces of information in conscious memory (short-term memory) appears to be a function of biological endowment and is independent of cultural learning. While gradual decline is the fate of short-term memory, long-term memory seems to remain intact well into old age.

This comparison between the hypothesized biological basis of intelligence and that of memory is enriched by an important distinction made by Atkinson and Shiffrin (1968) concerning the difference between 'structural' and 'control' processes in memory. 'Structural' refers to aspects of memory which are independent of experience but which do impose limits on the capacity and efficiency of the memory system.

These authors postulate that differences between individuals in terms of the structural aspects are determined by mainly inherited physiological and anatomical characteristics. 'Control' processes are the outcome of training and individual experience. These involve voluntary strategies which include rehearsal, mnemonics and strategies of memory search.

5.3 The Stage Theory of Memory

A British experimental psychologist, Donald Broadbent (1958), conceived of memory in terms of a sequence of stages (see figure

5.1 below).

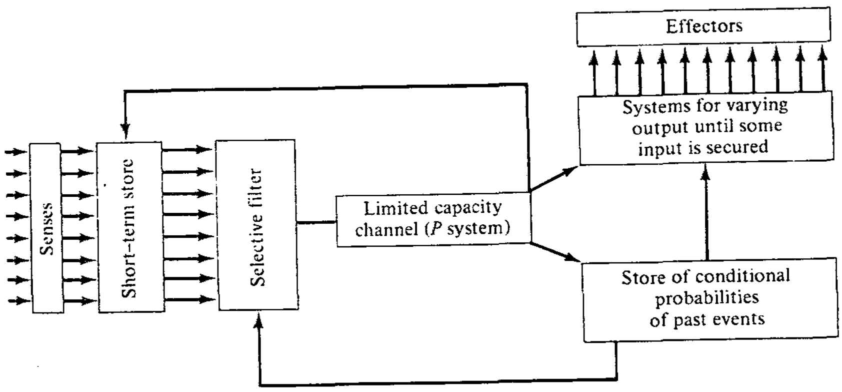

Figure 5.1 Broadbent's flow diagram for newly perceived information. Source: Broadbent (1958).

Broadbent visualized information as arriving via the senses and being held in a temporary short-term store. From here the information is forwarded to a 'selective filter' where some of the information is selected for further processing while that information which is not selected either decays rapidly or is returned, through the 'limited capacity channel', to the short-term memory store for further processing. Information which is selected and processed is transmitted to the long-term memory store.

Stage model theory emphasizes processes rather than structures.

Sperling (1963), as a result of his research, drew attention to a person's ability to retain a brief visual record of newly perceived events, without the involvement of complicated mental processing. Conrad (1964) has found evidence of the same ability regarding brief auditory storage. The function of these 'peripheral' stores is to hold information long enough for it to be processed.

From the 'peripheral' stores most stage theories suggest that information is transmitted to short-term memory. Here the emphasis of stage theory on the active nature of the memory process becomes apparent. Baddeley and Hitch (1974) point to the change in conceptualization of short-term memory from a temporary storage area to a type of working memory where information is held for a brief period of time but where it is subject to various processing operations. So, information in short-term memory activates related information held in the long-term memory store to form a coherent whole which facilitates storage and retention of the information.

This integrating function of short-term memory is crucial in reading, for example, where it maintains the coherence of the sequential logic of the text (Masson and Miller, 1983). The rôle of short-term memory and its relationship with long-term memory is elucidated in the classic serial-position experiments of Ebbinghaus (1885).

Ebbinghaus found that as memory span is exceeded, so the items are recalled with predictable success according to their position in the list. If recall is immediately after the last item has been seen or heard, the last items in the list are remembered best. However, if another task is interposed between the last item and recall, then the first items are remembered best. In both instances the items in the middle of the lists were the most poorly recalled.

What Ebbinghaus (1913) and subsequent experimenters inferred from these results was that when recall took place immediately after the last item was heard or seen, the last items were recalled more often because the memory traces (visual or auditory) still persisted. When recall occurred after an interposing task, the earlier items in the list were recalled better because there had been time to process them into long-term memory.

Glass,Holyoak and Santa (1979) maintain that the last words in a list are maintained in a speech code which is particularly vulnerable to interference (hence the effects of interpolated activity) whereas the earlier words are encoded in semantic terms and hence their processing to long-term memory is facilitated.

5.4 Memory and Learning

Estes (1986: p.170) states that:

> 'Learning' is generally taken to refer to the way organisms profit by experience so as, in the average at least, to increase adaptability to their environments.

The effectiveness of learning is determined by a number of interacting factors which will, however, be presented separately for the sake of clarity.

5.4.1 Motivation of the Learner

The results of telling subjects that they will be tested on recall are equivocal. Thus Craik and Tulving (1975) found that such a warning improved overall performance whereas Hyde and Jenkins (1969) found no significant improvement in recall. Glass et al. (1979: pp.141-142), evaluating the contradictory findings, say:

> It seems, in fact, that whether or not someone intends to learn something is not all that critical in determining later memory performance. What _is_ critical is that the person must perform some kind of activity that sets up a discriminable memory code for the input, with associations to potential retrieval clues.

5.4.2 Encoding Specificity

The chance of information being remembered is functionally related to the mental processes going on at the time of processing of that information. In Craik and Lockhart's (1972) seminal paper they suggested that the amount or form of intellectual effort invested in processing stimulus information determines the type of memory code established, its durability and availability for retrieval. This 'intellectual effort' involves the active description of the information in terms of its different aspects (semantic, phonemic, structural).

The more the information is classified in terms of these aspects, the greater the 'trace distinctiveness' of that piece of information. Hyde and Jenkins (1969) experimentally demonstrated this by showing that subjects' level of recall was much higher when the task demanded that they also consider the meaning of the items than when they were only required to pay attention to the physical structure of the words.

Drewnowski (1980) has demonstrated that even in simple tasks such as memory span tests the individual does not simply record in short-term memory the letter or number presented to him but actively gets involved in the process through voluntary processes which involve the priority ordering of attributes. This ordering determines the order in which the individual will consult these attributes when attempting to recall the item.

5.4.3 Grouping of Material

In economic terms the grouping of separate items into a single group obviously facilitates both processing and recall of information. Miller (1956) coined the term `chunking' to describe this grouping and defined a `chunk' as items of information which function as a single group and can therefore be regarded as a single unit.

This ability to group separate items is a function of background knowledge which in turn is an expression of investment of intelligence in the culture - this will be examined in more detail in section 5.5 of this chapter (p.94). An example of a `scheme' (Howe, 1983) which helps to organise new information and relate it to existing knowledge is given in the experiment conducted by Bower,Clark,Lesgold and Winzenz (1969).

Bower and his associates tested the hypothesis that presenting a list of words in `conceptual hierarchies' could improve levels of recall. Their findings were that subjects recalled on average only 21 out of 112 words when these were presented in a random arrangement. When the words were arranged in `conceptual hierarchies' subjects recalled an average of 73 words.

When 112 words were given to two groups to study for an identical extended period of time, the group who were given the words in random sequence recalled around 40% of the words, whereas those who were given the words in an hierarchical arrangement recalled the full list of words. The results of the experiment would seem to point to the efficacy of the concepts which structured the list as cues which assisted in retrieval.

Minsky (1975 - in Greene, 1987) terms existing knowledge representations 'frames'. These 'frames' which represent categories of objects and events differ from the 'conceptual hierarchies' discussed in the above experiment in that the 'slots' in the frame are left open, the features for each object are not predefined so that these frames are flexible and allow for encounter with different examples of the same concept.

Grouping of incoming information illustrates the interactive nature of memory. In this regard Greene (1987: p.55) comments:

> As Neisser (1976) was one of the first to emphasize, recognition of objects depends on what he called a 'perceptual cycle'. This cycle allows for continual interaction between analysis of perceptual features and retrieval of knowledge schemes. Neisser's suggestion was that first perceptual processes produce a preliminary and temporary representation of input features which act as aids to activate knowledge schema representations, which in turn direct attention to a more detailed analysis of cue features. Neisser termed his model analysis - by - synthesis to reflect the interplay between analysis of cue features and synthesis of interpretations based on knowledge.

5.4.4 Rehearsal

One of the ways in which information is consolidated into long-term memory is by rehearsal. The basis of rehearsal as a means of learning has been viewed as a refreshing of the memory trace so that the decay process has to start over again after each rehearsal (Estes, 1986). Atkinson and Shiffrin (1968) suggested that rehearsal causes items to be moved automatically from temporary short-term to long-term memory. Considering the relative efficiency of 'primary' rehearsal (simple repetition of items) and 'elaborative' rehearsal, Estes (1986: p.199) cites some interesting research associated with this suggestion:

> With regard to the matter of automatic transfer from short- to long-term memory as a consequence of rehearsal, rather ingenious techniques employed by Craik and Watkins (1973) and Woodward and associates (1973) indicate that primary rehearsal has virtually no effect on long-term recallability of items, though it may produce measurable increases in later recognition. Elaborative rehearsal, on the other hand, certainly does further the transition from short- to long-term memory.

'Elaborative rehearsal' has obvious links with the integration of items within the conceptual 'schemes' or 'frames' discussed in the previous section and with the encoding of items in terms of their attributes, a process briefly mentioned in section 5.4.2 (p.86).

Keeney, Cannizzio and Flavell (1967) demonstrated the power of rehearsal in their experiment on 6 and 7 year old children. Children who rehearsed spontaneously recalled all the simple memory test items accurately in 60% of the trials while the percentage of accurate recall for those who did not rehearse spontaneously was less than 40%. When the children who did not rehearse were trained to do so they recalled all the items accurately in over 60% of the trials.

It seems clear that elaborative rehearsal increases recall because not only does it keep the information available for processing for a longer period, but it increases its semantic attributes, thus facilitating its transfer to long-term memory. This is certainly in accord with Craik and Lockhart's (1972) theory regarding the amount and form of intellectual effort spent in processing data (see section 5.4.2: p.86).

The strategy employed in rehearsal also appears to have a profound effect on recall. Mandler and Pearlstone (1966) found that people who organized a list of words into their own conceptual groupings achieved two identical orderings in half as many trials as it took those who were supplied with an organizational scheme to use. The inference from these results appears clear: the people who used their own organization could integrate the words into their long-term memory far more easily because the organization was a product of their own semantic memory.

Ozier (1980) in a sense extended Mandler and Pearlstone's (1966) findings inasmuch as she demonstrated that not only subjective grouping improved memory recall and recognition, but that subjective organization of material which cannot be logically organized also improves memory recall and recognition. She theorised that such subjective organisation increased trace distinctiveness - an idea similar to that of Craik and Lockhart (1972).

The strategies of rehearsal discussed so far involve verbal (semantic) grouping. However, not every person rehearses in this way. Thus, in remembering narrative material, some subjects use verbal prècis while others construct the narrative action in mainly non-verbal items (ie. in the `mind's eye' or `imaging'). Although there appear not to be any consistent findings regarding these differences in rehearsal, they do seem to be reflected in differences in recalling (Hunter, 1976).

5.4.5 Retrieval Strategies

Research in this area has concentrated on the flexibility of memory search in retrieval. Although there appear to be three fundamental factors which determine the likelihood of recall (the type of processing which the original material received, the information which is provided as a recall cue, and the similarity between these two factors) it has been shown by Ceci and Howe (1978) that flexibility of memory search is a vital factor in success of recall.

These investigators supplied children of different ages with groupings (thematic and taxonomic models) as aids to memory recall. They found that older children tended to switch more frequently between models in their attempts to recall, and this flexibility was reflected in higher recall scores. Using an experimental method Ceci and Howe (1978) showed that the older children had not retained much more information but that their greater success at recall was due to a more flexible retrieval strategy (Howe, 1983).

5.4.6 The Interactive Effects of Learning

Hunter (1976) has divided the interactive effects of learning into two logical categories:

(a) The Influence of past learning on the present.

'Pro-active facilitation' or 'positive transfer of learning' are the terms used to indicate the effects of earlier learning facilitating subsequent learning. The obverse of this is 'proactive interference' or 'negative transfer of learning' where the learning of a previous lesson makes subsequent learning more difficult.

(b) The Influence of the present on the past.

'Retroactive facilitation' is where the learning of a second lesson facilitates the remembering of previously learned material. 'Retroactive interference' is possibly the most frequent cause of forgetting and occurs when the learning of a subsequent lesson makes it more difficult to remember previously learned material.

Both (a) and (b) are relevant to this thesis as regards the learning tasks on test 8 and 9 of the Junior Aptitude Test. A quotation from Hunter (1976: p.260) will illustrate the effects of retroactive interference on previously learned material:

> ... three significant relationships have emerged: First, the amount of interference is an increasing function of the similarity between the original and the interpolated activity. Second, the amount of interference is an increasing function of the amount of interpolated activity i.e. the more active we are in the interval, the more likely we are to forget. And third, the greater the degree of original learning, the less susceptible it is to interference, ie. the better we learn the original task, the more likely we are to remember it despite interpolated activities.

The kind of knowledge a person brings to a learning task is obviously important. This knowledge becomes part of a feedback (and forward) system where experience of an event might influence the way a similar subsequent event is interpreted; the interpretation of the subsequent event, in turn, might have a retroactive effect on the remembering of the earlier event.

The knowledge which a person brings to an event is also, to some extent, a function of their intellectual capabilities. Thus memory should be significantly, although not simply, associated with intelligence.

5.5 Memory and Intelligence

Historically, memory appears to have been regarded as a separate ability from intelligence. Estes (1986) mentions that Binet and Simon believed that memory was an unimportant constituent of intelligence relative to judgement, which they considered to be the essence of intelligence. Their inclusion of a memory test in their first and subsequent intelligence scales is somewhat inconsistent with this view.

Horn (1976) draws attention to the knowledge, since the work of Woodrow, in the 1930's, that a low correlation (approximately 0.35) exists between intelligence and short-term memory, as measured by span memory, recognition, paired-associate learning and serial learning.

Second-order analysis of primary intellectual abilities shows a broad memory factor independent of Fluid Intelligence (Gf), Crystallized Intelligence (Gc), General Cognitive Speed (Gs), Visualization Capacity (Gv), and General Retrieval Capacity (Gr) (Hakstian and Cattell, 1978).

The independence of the memory factor led Jensen (1973) to propagate his theory of Level I and Level II intelligence. Jensen believes that short-term acquisition functions are another form of intelligence which is a necessary but not sufficient condition for the development of Level II ability (Gf and Gc), Stankov et al. (1980: p.796), commenting on the similarity of the rôle of memory in Cattell and Jensen's theories as a servant of the higher intellectual capacities, say:

> It is suggested that this SAR [short-term acquisition and retrieval] factor represents organization among memory processes that is analogous in some respects to organizations among visualization (Gv) and auditory (Ga) processes. The SAR, Gv, and Ga organizations represent ways in which information is prepared, as it were, for the induction, eduction, and deduction processes of Gf and Gc... In particular, SAR indicates functions involved in holding information in awareness long enough for it to be processed by the capacities of Gf and Gc.

Factor-analytic studies, such as that of Stankov,Horn and Roy (1980) , have found three distinct primary factors from the spectrum of memory tasks: Ms (span memory), Ma (paired-associate memory) and meaningful memory (Mm). In their factor analysis

Hakstian and Cattell (1978) found that their second-order factor Gm (a 'goodness-of-retention' factor) loaded on Ma and Mm, with the difference between the latter two primaries being in the way material is committed to memory. They classed Gm as a long-term memory factor. In this regard it is interesting that Ekstrom,French and Harmon (1979) interpreted Mm as indicative of a rote memory of related material.

The relationship between short-term retention and verbal intelligence was investigated by Hunt (1978). He divided university age students into two groups, those who had scored high scores on a verbal intelligence scale and those whose score was low. After comparing these two groups on a short-term retention task, Hunt found significant differences between the two groups on retention of item and order information with the high verbal intelligence group scoring higher. Importantly, it was found that the retention curves of the two groups were parallel so that the difference in retention was ascribed to differences in efficiency of coding the information at time of input.

The complex relationship between intelligence and memory, between information-processing skills and concept-formation is briefly sketched by Byrd and Gholson (1985: p.429):

> Several investigators have also proposed that operative capabilities determine the efficiency with which

children use contextual information sources (Byrd and Gholson, 1984, La Berge and Samuels, 1974). Classification skills are said to be related to a child's level of memory organization (Hartman, 1977), which in turn determines the extent to which recognized words lead to the activation of related words and concepts in semantic memory (Haynes and Kulhavy, 1976; Tomlinson- Keasey, Crawford and Miser, 1975; West and Stanovich, 1978).

CHAPTER 6

THE PROBLEM

6.1 General

The aim of this study is to examine the relationship of general retention ability (rote and associative memory), as tested by the Junior Aptitude Test (Human Sciences Research Council, 1980), to:

(1) significant discrepancies between non-Verbal and Verbal IQ scores, as measured by the Senior Series of the New South Group Test (National Bureau for Educational and Social Research, 1965) where the non-Verbal IQ is higher than the Verbal IQ (Type I discrepancy).

(2) academic performance at school, as measured by average percentage in school examinations, of pupils with the IQ discrepancies mentioned in (1).

An associated aim of this research is to test Robbertse's (1962) finding that the group of pupils who have non-Verbal IQ scores of 10 points or more higher than their Verbal IQ scores is scholastically the weakest when compared with the other groups where the direction of the discrepancy is reversed, or where the discrepancy is less than 10 IQ points.

Much of the previous research on non-Verbal/Verbal discrepancies in New South African Group Test (NSAGT) intelligence scores has accepted the division of the NSAGT into non-Verbal and Verbal scales (e.g. Kruger, 1972; Robbertse, 1968; Van der Merwe, 1978). However, recent research (Batt, 1989; Cudeck and Claassen, 1983) has strongly suggested that there is only one significant higher-order factor measured by the six subtests of the NSAGT - the factor of `general intellectual functioning' (see chapter 7 for a more detailed discussion of this recent research).

This conclusion, while it may help to explain some of the inconclusive findings of research into non-Verbal/Verbal discrepancies in NSAGT scores (e.g. Robbertse, 1968; van der Merwe, 1978), seems to be a function of the way the NSAGT was constructed, rather than a denial of the existence of non-Verbal and Verbal factors. The research literature (see chapter 3) indicates that once the general factor is removed from intelligence scores the next most common factor is usually found to be the one that distinguishes non-Verbal from Verbal abilities (Vernon, 1979).

Chapter 7 of this study discusses additional argument presented by Kruger (1967) and the present writer concerning the tapping of verbal skills in the non-Verbal scale of the NSAGT. The view that the distinction between non-Verbal and Verbal subtests of the NSAGT is blurred seems consistent with the findings of Batt (1989) and Cudeck and Claassen (1983) concerning the single-factor nature of the NSAGT. However, the puzzling phenomenon of significantly lower Verbal IQ scores on the NSAGT remains and seems, according to Robbertse (1962), to have both educational significance (see the beginning of this chapter) and a relatively high frequency (one out of six pupils in the standardization sample of the NSAGT).

This contradictory situation has prompted the present researcher to view significant discrepancies between non-Verbal and Verbal scores on the NSAGT (where the Verbal is the lower score) in a slightly different way. This attempt to reconceptualize such discrepancies has some similarities with that of Kruger (1967) who approached the issue in terms of a difference between dealing with the concrete situation (non-Verbal) and the abstract (Verbal). Kruger's approach, seemingly based on Piaget's view of the development of the child (see chapter 2), would suggest that a Type I discrepancy indicates a relative failure on the part of the testee to move from dealing with the concrete situation to dealing with the abstract, for which language is essential.

While the present writer concurs with Kruger's (1967) view, he also sees the issue of Type I discrepancies on the NSAGT in a different way. The non-Verbal tests of the NSAGT <u>do</u> largely measure ability to manipulate concrete data, such as patterns, mentally - despite 'contamination' from 'Verbal' skills. This manipulation involves holding the data in immediate visual memory only, whereas the operations required in the Verbal subtests of the NSAGT require not only immediate visual memory but also retrieval from long-term memory.

Thus this researcher would see the difference between the two scales of the NSAGT not so much in terms of the involvement of non-Verbal or Verbal factors but rather in terms of the types of memory which are involved in dealing with the material of the two scales. This view does not suggest that memory is the only factor which contributes to Type I discrepancies on the NSAGT. Madge and van der Westhuizen (1971) have summarized a number of factors which might contribute to such discrepancies (see chapter 3: p.57).

However, the relationship of memory to non-Verbal/Verbal IQ discrepancies does not seem to have received attention. It may be one of the factors which differentially affects performance on the non-Verbal and Verbal scales of the NSAGT. Expressed in other terms, relative deficit in rote and associative memory may hamper the implementation of 'fluid' intelligence.

Most individual intelligence tests include a test of rote memory in their Verbal scales, as they recognize the importance of this memory in intellectual functioning. However, as the present writer will attempt to demonstrate later in this section, rote and associative memory are relatively independent of general intellectual functioning. This is an important distinction which makes the possibility of remedial work in the area of rehearsal strategies plausible.

Rote memory, as measured by the Junior Aptitude Test (JAT) (test 8), is not of an abstract nature, as it involves the memorization of simple narrative material (a story about students on a picnic). This is not to suggest that conceptual grouping of the material is impossible, but that such grouping would be minimal and the involvement of a general reasoning factor (or ability to educe relations) would not be expected in memorizing such simple narrative material.

Similarly, associative memory (JAT test 9) appears to be simply a measure of the establishment of a stimulus-response association and minimizes the involvement of higher thought processes. Hakstian and Cattell (1978; p.663), evaluating their discovery of `Gm', a second-order memory factor (they use the abbreviations `Ma' for associative memory and `Mm' for rote memory of related material), comment:

> Thus, Gm should likely be regarded as a goodness-of-retention factor, with the discriminability of Ma and Mm found at the first stratum being largely a function of the method of committing the material to memory.

Support for the separation of a general memory factor (involving rote and associative memories) from general intelligence comes from a factor-analytic study by Stankov et al (1980) who found a second-order general memory factor that appeared along with fluid and crystallized intelligence. Thus, general memory does not seem to be a <u>function</u> of intelligence, but rather a separate ability which interacts with it.

This view is congruent with Jensen's (1982) theory of Level I (retention ability) and Level II (higher conceptual processes) intelligence. Level I intelligence is a simple indication of ability to record information, hence JAT tests 8 and 9 should serve as measures of this ability (see chapter 7.3.2: pp.132-133 for a description of these tests). Jensen's view that general memory retention serves as a `servant' of higher-level intelligence receives theoretical support from the information-processing approach. As Baddeley and Hitch (1974) point out, initial storage in short-term memory is necessary before information can activate long-term knowledge which, in turn, can integrate this information into existing schemas.

Thus rote and associative memory provide the material upon which the higher intellectual processes work. Poor retention ability would be expected to affect the Verbal IQ scale in particular as this is the scale which measures the individual's culturally acquired and scholastically learned material. If rote and associative memory were poor it would, in terms of the information processing sequence adversely influence the interactive cycle of acquisition of knowledge, thus affecting the Verbal IQ scale and, importantly, academic performance at school. However, in the light of the loading of `Verbal' items on the non-Verbal scale of the NSAGT, the present researcher would also expect a lower correlation of rote and associative memories with the non-Verbal scale as well.

Depressed Verbal IQ on the NSAGT, therefore, may partially be a consequence of a factor which is not directly measured by the subtests of the Verbal scale. It is the present writer's contention that general retention ability is associated with rehearsal strategies of a non-conceptual nature (e.g. `primary' or non-elaborative rehearsal). These strategies can, to some extent, be taught.

This research does not aim, however, to demonstrate the relationship between non-conceptual rehearsal strategies and general retention ability. Rather, the research aims, as a first step, to determine whether there <u>is</u> a significant difference in general retention ability between those pupils who have significant Type I discrepancies and those who do not. This will indicate whether future research on a much larger, more representative population of pupils should be undertaken, research which would also test whether general retention ability is a function of the use of non-conceptual rehearsal strategies.

As full-scale IQ scores on the NSAGT have been shown to have a moderate correlation with school achievement (du Toit, 1970; Robbertse, 1968), meaningful comparisons between the academic achievement of those pupils who have significant Type I discrepancies and the academic achievement of those pupils without these significant discrepancies can only be made if Full Scale IQ is controlled for.Bearing the latter in mind, the following postulates were formulated for this research:

6.2 Specific Postulates

Research Postulate I

There will be a significant relationship between general retention ability, as measured by Junior Aptitude Tests 8 (rote memory) and 9 (associative memory), and academic performance (as measured by examination results) for the total group of pupils studied.

Null Hypothesis 1.1

There will not be a significant relationship between rote memory, as measured by Junior Aptitiude Test 8, and academic performance (as measured by examination results) for the total group of pupils studied.

Null Hypothesis 1.2

There will not be a significant relationship between associative memory, as measured by Junior Aptitude Test 9, and academic performance (as measured by examination results) for the total group of pupils studied.

Research Postulate 2

The relationship between general retention ability, as measured by Junior Aptitude Tests 8 (rote memory) and 9 (associative memory), and academic performance (as measured by examination results) will differ significantly between those pupils who have significant Type I discrepancies on the New South African Group Test and those pupils who do not have these significant discrepancies.

Null Hypothesis 2.1

There will be no significant difference in the relationship of rote memory (as tested by Junior Aptitude Test 8) and academic performance (as measured by examination results) between those pupils who have significant Type I discrepancies (as measured by the New South African Group Test) and those pupils who do not have these significant discrepancies.

Null Hypothesis 2.2

There will be no significant difference in the relationship of associative memory (as tested by Junior Aptitude Test 9) and academic performance (as measured by examination results) between those pupils who have significant Type I discrepancies (as measured by the New South African Group Test) and those pupils who do not have these significant discrepancies.

Research Postulate 3

General retention ability, as measured by Junior Aptitude Tests 8 (rote memory) and 9 (associative memory), will differ significantly between those pupils who have a significant Type I discrepancy (as measured by the New South African Group Test) and those pupils who do not have this significant discrepancy.

Null Hypothesis 3.1

There will be no significant difference between the rote memory scores (as measured by Junior Aptitude Test 8) of those pupils who have a significant Type I discrepancy (as measured by the New South African Group Test) and those pupils who do not have this significant discrepancy.

Null Hypothesis 3.2

There will be no significant difference between the associative memory scores (as measured by Junior Aptitude Test 9) of those pupils who have a significant Type I discrepancy (as measured by the New South African Group Test) and those pupils who do not have this significant discrepancy.

Research Postulate 4

There will be a significantly lower academic performance (as measured by examination results) for pupils who have a significant Type I discrepancy (as measured by the New South African Group Test) in comparison with pupils who do not have this significant discrepancy.

Null Hypothesis 4

There will be no significant difference in academic performance (as measured by examination results) between those pupils who have a significant Type I discrepancy (as measured by the New South African Group Test) and those pupils who do not have this significant discrepancy.

CHAPTER 7

METHODOLOGY

7.1 Research Design

There will be two parts to the research design used in the present study. The first part involves a correlational study of the relationship of the two general retention ability scores (rote memory and associative memory) to academic performance. This correlational study will not, however, reflect the differences between IQ discrepancy subgroups regarding the above relationship. In order to investigate these differences subjects will have to be divided into subgroups which differ as to the direction and significance of their non-Verbal/Verbal IQ discrepancies.

Thus the second part of the current study will be of a quasi-experimental nature. The present research cannot utilise a true experimental design, as in the latter an independent variable is the only systematically manipulated feature of the experimental situation and as a result of this manipulation direct cause and effect inferences can be made from the results (Foxcroft, 1985). In the present study such a direct manipulation of the independent variable is not possible since the discrepancy between non-Verbal and Verbal NSAGT scores was used as a classification variable to assign subjects to groups.

As such, then, a quasi-experimental design is used in this research to facilitate the investigation of the effects of a non-manipulated subject variable on dependent variables. In this way the relationship of non-Verbal/Verbal IQ discrepancies to rote memory, associative memory and to academic performance can be investigated.

Criticism of the quasi-experimental design has focussed on the experimenter's lack of control of extraneous variables which could also be involved in the assignment of subjects to groups. This is an issue which will have to be discussed when evaluating the results of the present research.

As regards the size of discrepancy as a criterion for qualification for a group, the issue is complex. Robbertse's (1962) research on the standardization group of the NSAGT Intermediate Form used 10 IQ points as a cut-off for minimum significance. No rationale was given for this choice but the groups so formed demonstrated differences in academic achievement, with the group whose non-Verbal IQ was 10 points or more higher than their Verbal IQ (Type I discrepancy), performing the most poorly.

Van der Merwe (1978), in his investigation of the possible meaning of non-Verbal/Verbal differences on the NSAGT calculated that a value of 16.8 points (on the .05 level) and a value of 22.1 points (on the .01 level) would be significant. However, when he conducted a survey of practising psychologists concerning what they would consider, from their experience, to be the minimal clinically meaningful discrepancy they chose 10 IQ points and this is the cut-off value that he used in his experiments.

Kruger (1972) also used a 10 IQ - point discrepancy in his study of the differential predictive value of non-Verbal and Verbal NSAGT IQ scores for academic success, although he provided no justification for his decision. Both Van der Merwe (1978) and Kruger (1972) drew their data from university populations with restricted IQ ranges. The investigation of the relationship between the IQ scores of students with significantly different Verbal abilities and their academic achievement needs careful consideration. One of the postulated reasons for lower Verbal IQ scores is slowness in decoding information. Hunt (1978: p.113) makes the observation that:

> The university population is not a good sample for studying this question because all university students have demonstrated a substantial amount of verbal skill. Indeed it is plausible (though probably unprovable) that slow decoders within a university setting have developed special procedures in order to cope with their environment.

This compensation may be one of the reasons why both Kruger (1972) and van der Merwe (1978) failed to find a significant relationship between Type I IQ discrepancies and academic achievement for their university populations. In addition, it must be remembered that van der Merwe (1978) used a rather broad pass/fail criteria as indicative of academic achievement and Kruger's (1972) criteria for academic success involved examination results across different university faculties with the concomitant lack of homogeneity of difficulty level.

An additional factor to consider in the previous studies which used university students as their sample is the time elapsed between the administration of the NSAGT (during subjects' high school careers) and the university examinations used as achievement criteria.

A multitude of variables such as learning experiences, changes in interest and motivation, as well as developmental factors, are likely to exert their influence during the time between measurement of IQ in the high school and the results of first-year examinations used as indications of academic achievement. This may also have played a part in both Van der Merwe (1978) and Kruger's (1972) failure to establish predictive validity of the 'discrepancy' NSAGT scores for academic achievement.

Since in the current study both IQ and the academic performance criteria (examination results) were measured within two months of each other <u>during</u> the testees' secondary <u>school</u> careers the situation is far more akin to that in the Robbertse (1962) study, therefore the present researcher has decided to make use of Robbertse's 10-point IQ discrepancy as the basis for forming three groups.

Although the original intention of the researcher was also to include a group with the Verbal IQ 10 points or more higher than the non-Verbal IQ (Type 2 discrepancies), this proved not to be possible as there were only six cases in this category from the population used. In order to keep the size of group C (see below) similar to that of groups A (Type I discrepancies) and B (no significant discrepancies) so that the analysis-of-variance technique (see section 5 of this chapter: p.138) could be used, these six cases were included in group C. As the latter group serves only as a control group for group A and the direction of the non-Verbal/Verbal discrepancy remains constant for group C, this inclusion is not seen as a confounding factor in the present research. The following groups were established:

(1) non-Verbal IQ 10 points or more higher than Verbal IQ. (Type I discrepancies) (Group A).

(2) non-Verbal IQ 1-9 points higher than Verbal IQ (Group B).

(3) Verbal IQ equal to or greater than non-Verbal IQ (Group C).

Group B was formed, in terms of the research postulates formulated in the previous chapter, as a control group for group A but with the same direction of discrepancy as that in group A (ie NV>V). The purpose of the formation of group C, also a control group for group A is slightly different as, with the direction of the non-Verbal/Verbal IQ discrepancy being reversed, the theoretical reasoning of the previous chapter would suggest a change in the basic involvement of dependent variables rote memory (JAT test 8) and associative memory (JAT test 9).

7.2 Subjects

The sample for the study consisted of 139 white standard 7 pupils from an urban academic boys' school which falls under the jurisdiction of the Cape Education Department. All the pupils were English-speaking and fell in the middle or upper-middle class socio-economic category. The latter characteristic is a function of the zoning policy of the Department of Education (House of Assembly).

The tests were administered during routine intelligence and aptitude testing towards the end of the standard seven year. The purpose of this testing is to provide psychometric information which can assist teacher-counsellors and school personnel to guide pupils in their final subject choice, which they will take for the rest of their high school careers and which has obvious career implications. This guidance, which also uses academic results and the results of interest questionnaires, is of some importance in assisting pupils with the choice of subject grades.

The relevant characteristics of the subjects are given in Table 7.1 below.

Table 7.1

(N = 139)

Variable	Mean	Standard Deviation	Range
age (months)	179.151	4.897	26.000
NV IQ	117.547	13.960	61.000
V IQ	110.324	13.337	66.000
Total IQ	114.439	13.143	60.000

7.3 Measures

As this study aims to investigate the relationship of rote and associative memory to the academic performance of pupils with Type I discrepancies, two psychometric measures, namely the New South African Group Test (senior series) and the Junior Aptitude Test (subtests 8 and 9) were used. In addition, the examination results of pupils were used as a reflection of their academic performance.

7.3.1 The New South African Group Test

Background

The New South African Group Test (NSAGT) was constructed to replace the South African Group Test of Intelligence which was originally published in 1930 and was revised in 1942. The older test was deemed to rely too heavily on language ability and it was restricted to too narrow an age group. In 1963 the forerunner of the Human Sciences Research Council (the National Bureau for Educational and Social Research), published the Intermediate Series (ages 10-14) of the NSAGT, consisting of a single form (G).

In 1965 followed the Junior Series (ages 8-11), comprised of two parallel forms, J and K, and the Senior Series (ages 13-18), made up of parallel forms S and T (van Eeden and Grobbelaar, 1967). Each form of the test was published in English and Afrikaans separately and has been standardized to have a mean of 100 and a standard deviation of 15. Common norms for Afrikaans- and English-speaking white pupils were compiled (Huysamen, 1988).

Description of the NSAGT

The six subtests of the NSAGT are divided into three non-Verbal and three Verbal subtests. Tests 1, 3 and 5 are the non-Verbal subtests and tests 2, 4 and 6 the Verbal subtests. The NSAGT is a speed and power test and therefore each subtest is timed.

The test items are all of the multiple-choice format. At the beginning of each subtest there is a set of five practice examples, designed to familiarize the testee with the characteristics of the particular subtest.

The following is a brief description of each of the subtests:

Non-Verbal Subtests:

Test 1: Number Series

Here a series of numbers is supplied with one number omitted. The testee must supply the missing number from five possible answers so that the pattern or logical progression in the series is maintained.

Test 3: Figure Analogies

In this test a set of two figures is supplied which have a logical relationship (ie. pear and banana = fruit). Another figure is supplied but its partner is missing. From five possible figures the testee must select one which completes the relationship in the same sense as in the given pair.

Test 5: Pattern Completion

A large block, consisting of nine smaller blocks, is given. One of the smaller blocks is blank while the rest each have a figure in them. From a selection of five figures the testee has to choose one which will fit into the blank square so that there is a logical consistency within the larger block.

Verbal Subtests:

Test 2: Classification of Pairs of Words

Five pairs of words are given. One pair, which does not have the same relationship as the other four pairs, must be indicated.

Test 4: Verbal Reasoning

This test entails the solution of verbally presented problems.

Test 6: Analogies of words

A pair of words is given which has a logical relationship. Then the first word of another pair is given. The testee has to select a word from the five alternatives to complete the second pair so that it displays the same relationship as the first pair.

Each subtest is scored separately. The scores for subtests 1, 3 and 5 are added to give the non-Verbal score, whilst the Verbal score is obtained by adding the scores for subtests 2, 4 and 6. The total score, which is derived by adding up the totals of each of the individual subtests, is expressed as a deviation IQ.

The Standardization of the New South African Group Test (Senior Series)

The following factors, taken from the manual of the NSAGT Senior Series (National Bureau of Educational and Social Research, 1965), were those taken into consideration when the sample for the Senior Series was drawn:

i) In order to reflect the 2:1 preponderance of white Afrikaans-speaking pupils over white English-speaking pupils, from each group in the 13 to 18 year old category samples of 800 Afrikaans-speaking pupils and 400 English-speaking pupils were drawn.

(ii) Proportional to the sizes of the relevant school populations, testees were selected from schools of the four provincial departments of education of the Republic of South Africa, the Department of Education of South West Africa (now Namibia) and the then Department of Education, Arts and Science. The sample also included pupils in provincial-aided and private schools.

(iii) Pupils in schools for the physically handicapped or mentally disturbed were omitted.

(iv) Afrikaans- and English-speaking pupils in parallel and dual-medium schools were taken into consideration.

(v) Attention was paid to the urban-rural distribution.

(vi) Demographic factors such as regional allocation were considered.

(vii) 13 year olds who were still in primary school were taken into account.

(viii) A separate distribution of pupils in the 13-15 and 16-18 year groups was calculated and was acknowledged as a factor when the sample was drawn, because the distribution in schools in the Department of

Education, Arts and Science differed from that in provincial schools.

(ix) The sample was drawn solely from the school population.

(x) A random selection of twelve pupils (six boys and six girls) was made at each age-level in each school.

Statistical characteristics of the NSAGT

Reliability

The reliability co-efficient of the two Senior Series was calculated by means of the Kuder-Richardson 21 formula, which gives an indication of internal consistency.

For English-speaking pupils, with 18 year-olds excluded, the reliability co-efficients were:

Non-Verbal	.82
Verbal	.84
Total	.90

The test-retest reliability (stability) and the parallel-forms reliability were not reported in the 1965 manual. The present writer has not found any subsequent information on the reliability of the NSAGT.

Validity

For purposes of establishing concurrent validity for the Senior Series of the NSAGT the latter, along with the experimental Forms of the General Tests in Language and Arithmetic (National Bureau for Education and Social Research: 1958), was administered to 763 pupils between the ages of 13 and 15 years.

All the correlations of IQ (NV, V and T) with the Arithmetic and Language Tests were found to be significant on the 1% level and varied between 0.46 and 0.78. The correlation of Verbal IQ with the Language Test was the highest while the non-Verbal IQ correlated highly with the Arithmetic Test (van Eeden and Grobbelaar, 1967).

Standard Error of Measurement

The compilers of the manual for the Senior Series of the NSAGT are at pains to point out that although separate error of measurement figures have been computed for Afrikaans- and English-speaking pupils, in practice the error of measurement which has been calculated for the total group of English and Afrikaans together should be used.

From Table 6.3 of the 1965 manual (National Bureau of Educational and Social Research, p.18) the following figures are taken:

Standard Error of Measurement (all given in IQ scores)

English:	Non-Verbal	6.4
	Verbal	6.0
	Total	4.8
Afrikaans and English :	Non-Verbal	6.3
	Verbal	5.8
	Total	4.6

Research involving the New South African Group Test

In a comprehensive study Fouche (1967) performed a factor analysis of the subtests of the New South African Group Test. This investigation involved the application of the test to 3915 standard 7 boys of all the technical high schools in the Republic of South Africa. From his factor-matrix it was clear that all six of the subtests of the NSAGT loaded heavily on a reasoning factor. Pattern completion and Figure Analogies loaded on a factor which Robbertse (1968) calls visualization. Number Series and Verbal Reasoning loaded on the numerical factor. Verbal comprehension is a factor in the three Verbal tests.

Batt (1989), however, has pointed out that in Fouche's (1967) study loadings on these non-`g' factors were .30 or less and do not contribute significantly to the naming of factors.

The relation between NSAGT scores and academic achievement has been well researched. The pioneering study in this regard was carried out by Robbertse (1962) who took a random sample of Afrikaans and English-speaking pupils (aged 10 to 14) from the standardisation sample of the NSAGT (Intermediate Series) and correlated their non-Verbal, Verbal and Total IQ scores with their scores on the Silent Reading Test (home language) and the Arithmetic Test. For the English-speaking pupils the results, relevant for this thesis, were a correlation of .74 between the non-Verbal IQ and Silent Reading Test, a correlation of the Verbal IQ with the Silent Reading test of .88 and a correlation between Total IQ and the Silent Reading test of .86.

The NSAGT non-Verbal IQ score correlated .75 with the Arithmetic Test score for the English-speaking pupils while the correlation of the Verbal IQ with the Arithmetic Test was .80. The total NSAGT score for the English-Speaking pupils correlated .81 with the Arithmetic Test score. Robbertse's conclusion that the verbal score on the NSAGT was a better predictor of success in home language and arithmetic is axiomatic, although the ability of the Verbal NSAGT score to predict achievement on the Arithmetic Test better than the non-Verbal NSAGT score will be examined in more detail in the next section.

All the above correlations were significant on the 0.001 level although, unfortunately, the difference between the non-Verbal and Verbal NSAGT scores as predictors was not tested for significance.

Robbertse (1968), using the Senior Series of the NSAGT, found average validity co-efficients of .35, .31 and .27 between the total score of the NSAGT and examination subjects in matriculation for three successive matriculation years. The co-efficients decreased as the time over which the results were predicted increased. He did test the statistical significance of the difference in predictive validity between the non-Verbal and Verbal NSAGT scores for academic achievement and found that strictly speaking the two scores could not be used for differential prediction of academic success.

Du Toit (1970) found correlations of approximately 0.50 between the NSAGT total IQ scores and scholastic achievement for standard 6 to 10 pupils. This is in line with the results of other research on the relationship between intelligence and achievement, of which Butcher (1968: p.290) says:

> Intelligence is without doubt associated with high achievement in a very wide range of tasks and occupations. But even in those to which it is most directly relevant, it accounts for no more than about half the variation in performance, and in some situations and groups much less.

Du Toit's correlation of 0.50 means that only 25% of the variation in scholastic achievement is explained by the NSAGT IQ score. Additional factors, such as those discussed in chapter 4, have to be examined to gain a fuller picture of the determinants of achievement.

Other research involving the NSAGT has been discussed either in chapter 3.2.(p.48) or in chapter 4.

Criticism of the New South African Group Test

The criticism of the NSAGT discussed in this section will not involve the limitations of group tests in general as these have been touched on in chapter 3.1.(p.47).

Van der Westhuizen (1979, p.77) refers to two possible drawbacks to the test. The first one entails the time limit imposed on each subtest. Speaking of this, he states:

> From the empirical data it can be concluded that certain pupils will do better in the NSAGT if they are allowed more time. Consequently, when a pupil obtains a noticeably lower IQ score than the one indicated by his general achievement, the speed factor should be considered as one of the possible reasons for this lower score.

The second limitation, hardly specific to the NSAGT, is that the latter presupposes a normal reading ability in the testee whereas in fact 5 to 10% of those with normal intelligence have some kind of reading problem. This limitation is obviously linked up with Van der Westhuizen's first reservation, inasmuch as someone with a reading problem would read more slowly through the instructions, thus decreasing the amount of time left for answering the questions.

A major criticism of the NSAGT has been aimed at its division into non-Verbal and Verbal scales. A factor-analytic study by Cudeck and Claassen (1983), concerning the factorial nature of the NSAGT, found that a one-factor model was the best description of their analysis of the correlation matrix of the subtests of the Intermediate Form. However, influenced by the test designers' purpose in creating the two scales, Cudeck and Claassen investigated the plausibility of a two-factor model. They found a correlation of 0.816 between the non-Verbal and Verbal factors, giving a considerable overlap of 67%.

In their 1985 study using the NSAGT, Claassen and Cudeck found an overlap of 71% between the non-Verbal and Verbal reasoning factors. Evaluating the results of this study, the authors conclude:

> Hierdie faktor - korrelasie is so hoog dat afgelei kan word dat die twee faktore hoofsaaklik dieselfde eienskap meet en dat verskille tussen hulle eerder bysaak as hoofsaak is.
>
> (Claassen and Cudeck, 1985: p.6)

A recent examination of the factor structure of the NSAGT by Batt (1989: p.6), who used the Junior, Intermediate and Senior versions on boys and girls in standards 3, 5 and 7 found that:

> For each standard only one significant factor was extracted, accounting for 90.45% , 89.71% and 91.62% of the total variance of the subtests.

Batt considered that the factor was indeed the `general intellectual ability' factor described by Elder (1957) in his account of the development of the NSAGT.

From a philosophical viewpoint Kruger (1967) is also critical of the construction of the NSAGT, particularly of the division between the non-Verbal and Verbal scales. He points out that no justification is offered in the 1965 manual for this division. Moreover, there seems to be `contamination' which makes the NSAGT's division into non-Verbal and Verbal scales questionable:

> Die gebruik om syfertoetse in intelligensietoetse as "nie-verbale" toetse te beskou, moet dus betwyfel word. Om met die syfer simbool om te gaan, vra van die kind om met 'n verteenwoordigende getal te handel in plaas van met die konkrete objek. Van der Stoep verklaar dan ook dat daar 'n verband is tussen taal en rekenkunde as simboliese sisteme, en dat taal die gemeenskaplike wortel is van alle kultuurvaardighede. Die hele oorgang vanaf konkrete getalle-omgang na 'n abstrakte rekenbegrip is aangeleentheid van taal, deurdat die taal 'n geskematiseerde wete en kennis vir die rekenhandeling beskikbaar stel.
>
> (Kruger, 1967: p.20)

This criticism, involving as it does the inclusion of Test 1

(Number Series) in the non-Verbal scale, is associated with Fouche's finding (discussed at the beginning of this section: p.123) that both Number Series and Verbal Reasoning load on the numerical factor. The Verbal Reasoning subtest is on the Verbal Scale and requires abstract manipulation of situations in order to arrive at an answer. The Number Series, which presents series of numbers in a concrete way, also, according to Kruger, requires abstraction and manipulation in the realm of the symbolic.

There seems to be some confusion in Test 1 (Number Series) as to the terms 'Verbal' and 'non-Verbal'. The latter has, it appears, been equated with' physical representation not in words'. This argument is valid for another of the subtests grouped under 'non-Verbal' ie. Test 3 - Figure Analogies.

Two of the practice examples and twelve of the thirty test items in Figure Analogies involve the presentation of pictures which are meaningful, rather than geometric or other figures. Thus, for example, the analogical process might entail the pictorial presentation of a given pair (a rhinoceros and hippopotamus, for argument's sake) and the further presentation of the first picture of another pair (ie. a giraffe). What the testee is required to do is to select from five alternatives the one which will complete the second pair and will stand in relation to giraffe as hippopotamus does to rhinoceros.

What is obviously required is the induction from the first pair of a similarity which can then be transferred to the second pair. In the example used the induction of a similarity would produce something like `herbivorous wild animal' and the testee would use this as a classification via which he can select a picture of an `herbivorous wild animal' from the five alternatives.

None of the above is particularly noteworthy, except that the process (identical with Spearman's eduction of relations and eduction of correlates) involves both general knowledge and classification skills, both of which should resort under the `Verbal' scale. Indeed, Test 2 (Classification of Words), a Verbal subtest, tests precisely the same mental skills as do these twelve items of `Figure Analogies'. Again the mistaken identity between `physical representation not in words' and `non-Verbal' seems to have been made.

Thus the present writer would contend that `Figure Analogies' is forty percent a Verbal subtest. If to this is added Kruger's (1967) assertion regarding the Number Series Test (Test I), then it appears that Test 5, Pattern Completion, is the only truly uncontaminated test of `non-Verbal' ability. Perhaps these factors help to explain why non-Verbal/Verbal discrepancies on the NSAGT have proved to be of such little diagnostic value.

7.3.2 The Junior Aptitude Test (JAT) (Human Sciences Research Council)

Background

In 1975 these tests replaced the N.B. Junior Aptitude Tests (1961) because of the change to metrication, the possible inapplicability of existing norms, difficulties in scoring and in response to the emphasis on the Junior Secondary Phase (standards, 5, 6 and 7) which would become crucial decision-making years in the system of differentiated education. At the end of standard five a choice regarding the type of high school has to be made and towards the end of standard seven a final subject choice is required of the pupil.

Verwey and Wolmarans (1980; p.5) in the manual for the JAT define aptitude as follows:

> Aptitudes may be regarded as specific potential abilities, inherent as well as acquired, which the person possesses at a certain stage and which enable him to develop certain skills and proficencies. Aptitudes, together with other personality characteristics such as interest, attitude and motivation, as well as training and instruction, will determine the level of skill and proficency which it will be possible to attain.

Behr (1983) emphasises that the aptitudes discussed above relate to the proficency possible, with training, in certain general vocational fields.

The JAT measures specific mental abilities, not general intelligence. These specific abilities may be identified, in terms of factor analysis, with `primary mental abilities' or `group mental factors' (Verwey and Wolmarans, 1980). One of the aims of the Junior Aptitude tests was that they be constructed to measure broad dimensions of intelligence which could be used to predict proficiency or achievement. Like other tests, the JAT cannot assert factorial purity because of the difficulty in isolating proficencies acquired prior to the time of testing and because of the difficulty involved in designing an aptitude test which measures only one mental factor.

Description of the Junior Aptitude Test

The JAT consists of ten tests which are contained in one bilingual test booklet. As this study only employs two of the ten tests, only the tests used will be discussed as well as the aptitudes which they measure.

Test 8: Memory (Paragraphs)

This test consists of six related prose paragraphs. Before the administration of Test 7, the testee is given five minutes to memorize these paragraphs, after having been told that he will be asked questions on their content. After Test 7 the testee must answer the questions on the paragraphs (Huysamen, 1988). Verwey and Wolmarans (1980: p.11) refer to Cattell in commenting upon the aim of this test:

> The test requires the ability to memorize meaningful material and measures the Memory factor, M. The factor can be identified as the "basic ability to memorize and remember irrespective of the meaningfulness or intricacy of the material" (Cattell, 1971: p.30).

Test 9: Memory (Words and Symbols)

The test is in two sections. In the first of these sections word pairs are given. Each of these word pairs consists of a` foreign' word and a familiar one. The testee is given three minutes in which to memorize these pairs. Immediately after the learning period the testee is presented with each of the` foreign' words and has to choose, from five possible alternatives, the word which was paired with that` foreign' word. In the second section the procedure is similar except that here the pairs consist of an unknown symbol and a Roman capital letter.

The compilers of the manual describe the aptitude involved in this test as:

> ... the ability to memorize meaningless material associatively. The test also measures the Memory factor, M.
>
> (Verwey and Wolmarans, 1980: p.13)

Standardization of the Junior Aptitude Tests

The norms for the standard seven group (relevant for this study) were obtained by an application of the final form of the JAT in August 1974. The application involved schools from all the provinces in the Republic of South Africa, as well as schools in South West Africa (now Namibia). In total 921 Afrikaans standard seven children and 447 English standard sevens were tested to establish the norms for this group.

For both Test 8 (Memory: Paragraphs) and Test 9 (Memory: Words and Symbols) combined norms for language and sex group were established.

Statistical Characteristics of the Junior Aptitude Tests

Reliability

The Kuder-Richardson formula 20 was used to determine the internal consistency of the tests (Huysamen, 1988). The results, relevant for this study, are given for the standard seven group:

Test 8 (Memory: Paragraph)	0,78
Test 9 (Memory: Words and Symbols)	0,85

Standard Deviation

The standard deviations for the two JAT tests used in this study (standard seven group) are:

Test 8 (Memory : Paragraph)	4,48
Test 9 (Memory: Words and Symbols)	5.70

The Standard Error of Measurement

Given in stanines, the standard error of measurement for the standard seven group is:

Test 8 (Memory: Paragraph)	0,911
Test 9 (Memory: Words and Symbols)	0,749

Validity

Predictive validity of the JAT tests was calculated by correlating the December 1974 examination results with the JAT scores from the August 1974 norm establishment group .

The Test 8 (Memory: Paragraph) scores for English standard seven boys correlated significantly at the 0,01 level with all the school subjects examined, except for German and Woodworking.

The Test 9 (Memory: Words and Symbols) scores correlated at the 0,01 level for all the school subjects examined, except for English (First language), where the correlation was only significant at the 0,05 level, and German and Woodworking where no significant correlations were obtained.

Based on research carried out with the Senior Aptitude Tests, the compilers of the JAT manual suggest that the tests may be grouped together into six wider fields of aptitude. In terms of the groupings Memory (Paragraph) would fall under 'Verbal Aptitude' while both Memory (Paragraph) and Memory (Words and Symbols) would be grouped under 'Memory'.

Very little research has been carried out using the Junior Aptitude Test and for that reason no criticism of the test could be found.

7.3.3 Examination Results

Examination results from the November 1988 examinations were used as a criterion of academic performance in the current research. These examinations took place within two months of the administration of the NSAGT. Average percentage over the seven academic subjects taken by each pupil was used as the indication of academic performance.

Each pupil took six of the same subjects as every other pupil with the seventh subject being a choice which the pupil had made at the end of standard six. A complicating factor was that a number of pupils wrote Afrikaans First Language Higher Grade as opposed to the majority who wrote Afrikaans Second Language Higher Grade. However, the greater difficulty level of Afrikaans First Language Higher Grade was compensated for by the fact that those who wrote it, wrote out of an extra 100 marks.

A measure of uniformity of marking was possible because the heads of departments of the subjects moderated a selection of individual scripts marked by each teacher and, if necessary, adjusted that teacher's marks.

7.4 Procedure

The subject pool consisted of a group of standard seven pupils who were routinely tested on the NSAGT and JAT (see chapter 1 for discussion of the significance of this testing). The pupils were tested during a week in September 1988 by two teacher-counsellors who were familiar with the administration and scoring of both instruments.

Test procedures were strictly adhered to, including the breaks allowed to the testees. Both NSAGT and JAT answer sheets were hand-scored using stencils. Each tester checked the scoring of the other tester, so that in effect each answer sheet was scored twice.

The subjects were then assigned to one of three groups described in section 1 of this chapter (p.113).

7.5 Statistical Analysis

In order to measure the relationship between general retention ability (rote memory [JAT test 8] and associative memory [JAT test 9]) and academic performance over the whole sample, the Pearson 'r' between the variables will be calculated. A correlation matrix of these variables for the whole sample can then be constructed.

To control for the effect of full-scale IQ scores in the three IQ groups described in section I of this chapter (p.113), subjects in each of the three groups were to be matched on full-scale IQ. However, on cursory inspection of the mean IQ scores of the three groups (see Table 8.1: p.143) the researcher found that they were similar and that the standard deviation of the mean full-scale IQ for each group was also similar. To test this similarity of the mean IQ scores, a single-factor analysis of variance was conducted (see Table 7.2 below) which showed at the .01 level of probability that these three means did not differ significantly and could be regarded as coming from the same population. Full-scale IQ is therefore not a confounding variable in the present research.

Table 7.2

ANALYSIS OF VARIANCE FOR THREE GROUP MEAN IQ SCORES

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQ	F-VALUE	PROB(TAIL)
EQUALITY OF CELL MEANS	2	109.5487	54.7743	0.3139	0.7311
ERROR	136	23728.6797	174.4756		

For each group the significance of the correlation between the mean memory and academic performance scores will be calculated by looking at the homogeneity of the regression lines for the two variables. Throughout the testing of hypotheses in this research the .05 significance level will be used.

In order to investigate whether there are any significant differences in the relationship of general retention ability (rote and associative memory scores) and academic performance (average examination percentage) between the three IQ groups a single-factor analysis of variance (ANOVA) will be conducted across the three groups.

Comparison of the mean general retention scores (JAT tests 8 and 9) across the three groups will again involve the analysis of variance technique. The ANOVA will also be used when testing research postulate 4 (comparing the means of the academic performance scores across the three groups: see Table 8.12 p.158).

The ANOVA will be used because it enables the means of each of the dependent variables to be compared across the three groups. Thus it will enable a null hypothesis of no difference between the means of the various groups to be tested. One of the important assumptions to be met when using the ANOVA is that the variance of the dependent variables in each of the subgroups should be homogenous. As will be seen in the following chapter, this assumption has been met. Also, the group sizes have to be reasonably alike when an ANOVA is used. This requirement will also be seen in the following chapter to have been satisfied.

Downie and Heath (1974, p.207) summarize the nature of the ANOVA as follows:

> The heart of analysis of variance lies in the following fact: If the groups are random samples from the same population, the two variances, within and between, are unbiased estimates of the same population variance. We can test for the significance of the difference of the two types by use of the F test.

Kerlinger (1986: p.208) provides a similar assessment of analysis of variance:

> The method of analysis of variance uses variances entirely, instead of using actual differences and standard errors, even though the actual difference-standard error reasoning is behind the method. Two variances are always pitted against each other. One variance, that presumably due to the experimental (independent) variable or variables, is pitted against another variance, that presumably due to error or randomness.

CHAPTER 8

RESULTS

8.1 General

The proposition underlying this research is that general retention ability is significantly related to Type I discrepancies on the New South African Group Test and that there are academic correlates of such discrepancies.

The New South African Group Test (NSAGT) and the Junior Aptitude Tests (JAT) were administered to 139 standard 7 pupils. As only the rote memory (JAT test 8) and associative memory (JAT test 9) tests of the JAT battery were needed for this research, the data from the other tests of the JAT will not be reported.

On the basis of their NSAGT scores the testees were divided into the following groups:

- non-Verbal IQ 10 points or more higher than Verbal IQ (Type I discrepancies) (Group A)
- non-Verbal IQ 1-9 points higher than Verbal IQ (Group B)
- Verbal IQ equal to or greater than non-Verbal IQ (Group C)

The descriptive data for the three groups is given in Table 8.1 (below).

Table 8.1

COMPARISON OF GROUP MEANS AND STANDARD DEVIATIONS FOR NSAGT NV,V & TOTAL IQ; JAT TESTS 8 AND 9; ACADEMIC PERFORMANCE

	GROUP I: NV>V BY 10 IQ POINTS OR MORE		GROUP 2: NV>V BY 9 OR FEWER IQ POINTS		GROUP3:V⩾NVIQ	
	(N=54)		(N=44)		(N=41)	
VARIABLE	X	SD	X	SD	X	SD
AGE (MONTHS)	180.407	5.500	178.182	4.453	178.537	4.220
NV IQ	123.426	12.608	117.500	14.016	109.854	11.966
V IQ	105.500	12.236	112.136	14.128	114.732	12.075
TOTAL IQ	114.556	12.464	115.455	14.674	113.195	12.486
JAT TEST 8	16.037	4.621	16.795	3.945	16.683	4.401
JAT TEST 9	24.167	4.559	24.545	4.516	23.317	5.012
ACAD. PERF.	58.241	12.072	61.364	10.541	59.073	11.021

8.2 General Retention Ability and Academic Performance

Although this section only deals with the above relationship, a correlation matrix including the three IQ measures will be provided in Table 8.2 in order to facilitate discussion in the following chapter.

Table 8.2

CORRELATION MATRIX FOR THE COMPLETE SAMPLE

	NV IQ	VIQ	TOT IQ	J8	J9	ACAD.PERF.
NV IQ	1.0000					
V IQ	0.6996	1.0000				
TOT IQ	0.9120	0.9292	1.0000			
J8	0.3519	0.4248	0.4238	1.0000		
J9	0.4425	0.3583	0.4309	0.2741	1.0000	
ACAD.PERF.	0.5296	0.5842	0.6062	0.5293	0.4120	1.0000

Research Postulate 1

There will be a significant relationship between general retention ability, as measured by Junior Aptitude Tests 8 (rote memory) and 9 (associative memory), and academic performance (as measured by examination results) for the total group of pupils studied.

Null Hypothesis 1.1

There will not be a significant relationship between rote memory, as measured by Junior Aptitude Test 8, and academic performance (as measured by examination results) for the total group of pupils studied.

Table 8.2 indicates a moderate correlation of .529 between rote memory score (JAT test 8) and academic performance. In order to ascertain the significance of the relationship between these two variables, and thereby test null hypothesis 1.1, an analysis of variance was conducted. The results of this ANOVA are presented in Table 8.3.

Table 8.3

ANALYSIS OF VARIANCE FOR VARIABLES ROTE MEMORY (JAT TEST 8) AND ACADEMIC PERFORMANCE: TOTAL SAMPLE

	SUM OF SQUARES	DF	MEAN SQUARE	F-RATIO	P(TAIL)	S/NS
REGRESSION	4932.7852	1	4932.7852	53.322	0.0000	<0.05
RESIDUAL	12673.8770	137	92.5100			

Table 8.3 indicates that the moderate relationship between rote memory score (JAT tést 8) and academic performance over the total sample is significant. Therefore null hypothesis 1.1 is rejected and research postulate I supported as regards rote memory.

Null Hypothesis 1.2

There will not be a significant relationship between associative memory, as measured by Junior Aptitude Test 9, and academic performance (as measured by examination results) for the total group of pupils studied.

Table 8.4

ANALYSIS OF VARIANCE FOR VARIABLES ASSOCIATIVE MEMORY (JAT TEST 9) AND ACADEMIC PERFORMANCE: TOTAL SAMPLE

	SUM OF SQUARES	DF	MEAN SQUARE	F-RATIO	P(TAIL)	S/NS
REGRESSION	2988.5005	1	2988.5005	28.008	0.0000	<0.05
RESIDUAL	14618.1621	137	106.7019			

The moderate correlation of .412 (see Table 8.2: p.144) between associative memory (JAT test 9) and academic performance is, therefore, significant and null hypothesis 1.2 can accordingly be rejected. With respect to associative memory, research postulate I is supported.

Considering research postulate 1 in its entirety, then, it appears that its postulate can be accepted and that for the total sample general retention ability (JAT tests 8 and 9) is significantly related to academic performance.

8.3 General Retention Ability and Academic Performance over the three IQ groups

Once more, in order to place the testing of the following postulate in context and to make the discussion of the relationship of IQ measures to both memory variables and academic performance easier, the correlation matrices of the three IQ groups will be presented in full:

Table 8.5.1

CORRELATION MATRIX FOR GROUP NV > V BY 10 OR MORE IQ POINTS

	NV IQ	VIQ	TOT IQ	J8	J9	ACAD.PERF.
NV IQ	1.0000					
V IQ	0.8721	1.0000				
TOT IQ	0.9622	0.9702	1.0000			
J8	0.4819	0.5435	0.5326	1.0000		
J9	0.3969	0.3178	0.3653	0.3140	1.0000	
ACAD.PERF.	0.6781	0.7641	0.7534	0.6959	0.2612	1.000

Table 8.5.2

CORRELATION MATRIX FOR GROUP NV > V BY 9 OR FEWER IQ POINTS

	NV IQ	VIQ	TOT IQ	J8	J9	ACAD.PERF.
NV IQ	1.0000					
V IQ	0.9825	1.0000				
TOT IQ	0.9936	0.9955	1.0000			
J8	0.2151	0.1912	0.2106	1.0000		
J9	0.5070	0.5189	0.5117	0.1071	1.0000	
ACAD.PERF.	0.5785	0.5849	0.5874	0.2809	0.4212	1.0000

Table 8.5.3

CORRELATION MATRIX FOR GROUP V $\geqslant$ NV IQ

	NV IQ	VIQ	TOT IQ	J8	J9	ACAD.PERF.
NV IQ	1.0000					
V IQ	0.9349	1.0000				
TOT IQ	0.9811	0.9841	1.0000			
J8	0.5431	0.5290	0.5370	1.0000		
J9	0.4706	0.3484	0.4136	0.3854	1.0000	
ACAD.PERF.	0.5019	0.3789	0.4375	0.4968	0.6033	1.0000

Research Postulate 2

The relationship between general retention ability, as measured by Junior Aptitude Test 8 (rote memory) and 9 (associative memory), and academic performance (as measured by examination results) will differ significantly between those pupils who have significant Type I discrepancies (as measured by the New South African Group Test) and those pupils who do not have these significant discrepancies.

Null Hypothesis 2.1

There will be no significant difference in the relationship of rote memory (as tested by Junior Aptitude Test 8) and academic performance (as measured by examination results) between those pupils who have significant Type I discrepancies (as measured by the New South African Group Test) and those pupils who do not have these significant discrepancies.

The testing of null hypothesis 2.1 will proceed in two phases. The first phase will involve the establishing of significance levels for the correlation co-efficient between JAT test 8 (rote memory score) and academic performance in each of three IQ groups. The second phase entails the analysis of variance of the regression co-efficients over the three IQ groups to determine whether these co-efficients differ beyond chance.

Table 8.6

COMPARISON OF CORRELATIONS BETWEEN JAT TEST 8 AND ACADEMIC PERFORMANCE FOR THE THREE IQ GROUPINGS

Group	r	DF	P(TAIL)	S/NS
NV>V (10 OR MORE IQ POINTS)	.696	52	0.0000	<0.05
NV>V (9 OR FEWER IQ POINTS)	.281	42	0.0647	>0.05
V≥NV IQ	.497	39	0.0010	<0.05

From the above table it is apparent that the high correlation of .696 between rote memory and academic achievement is significant for the 'NV>V (10 or more IQ points)' group.

The relatively low correlation of .281 for rote memory (JAT test 8 score) and academic performance in the 'NV>V (9 or fewer IQ points)' group is not significant, although the F-ratio just fails to reach significance at the .05 level.

For the 'V≥NV IQ' group the moderate correlation of .497 between JAT test 8 score (rote memory) and academic performance is significant at the .05 level.

The second phase in testing null hypothesis 2.1 involves the analysis of variance of the regression coefficients over the above three IQ groups in order to determine whether they differ significantly ie. whether the relationship between JAT test 8 scores and academic performance varies significantly between the three IQ groups:

Table 8.7

ANALYSIS OF VARIANCE OF REGRESSION CO-EFFICIENTS FOR ROTE MEMORY (JAT TEST 8) AND ACADEMIC PERFORMANCE OVER THE THREE IQ GROUPS

	SUM OF SQUARES	DF	MEAN SQUARE	F-RATIO	P(TAIL)	S/NS
REGRESSION OVER GROUPS	629.190	4	157.298	1.737	0.14555	>0.05
RESIDUAL WITHIN GROUP	12044.687	133	90.562			

The F-ratio is not significant at the .05 level, therefore the researcher failed to reject null hypothesis 2.1. However, an inspection of the three groups reveals a fluctuation between the high correlation of JAT test 8 scores (rote memory) and academic achievement for the significant discrepancy IQ group and the low corresponding correlation in the 'NV>VIQ by 9 or fewer points' group, which fails to reach significance. The fluctuation is continued in the moderately significant correlation between rote memory score (JAT test 8) and academic achievement in the V>NV IQ group. This alternation will be discussed in some detail in the following chapter.

Null Hypothesis 2.2

There will be no significant difference in the relationship of associative memory (as tested by Junior Aptitude Test 9) and academic performance (as measured by examination results) between those pupils who have significant Type I discrepancies (as measured by the New South African Group Test) and those pupils who do not have these significant discrepancies.

As the testing of null hypothesis 2.2 will proceed in the same way as that of null hypothesis 2.1, no further introduction to this testing will be given.

Table 8.8

COMPARISON OF CORRELATIONS BETWEEN JAT TEST 9 AND ACADEMIC PERFORMANCE FOR THE THREE IQ GROUPINGS

Group	r	DF	P(TAIL)	S/NS
NV>V (10 OR MORE IQ POINTS)	.261	52	0.0564	>0.05
NV>V (9 OR FEWER IQ POINTS)	.421	42	0.0044	<0.05
V≥ NV IQ	.603	39	0.0000	<0.05

According to Table 8.8 the low correlation of .261 between JAT test 9 (associative memory score) and academic performance fails to reach significance at the .05 level for the ‘NV>V (10 or more IQ points)’ group. It should be noted, however, that the F-ratio just failed to reach this significance level.

For the ‘NV>V (by 9 or fewer IQ points)’ group the moderate .421 correlation between JAT test 9 (associative memory score) and academic performance is significant at the .05 level.

The moderately high correlation of .603 between associative memory (JAT test 9 score) and academic performance (V≥NV IQ group) is significant at the .05 level.

Table 8.9

ANALYSIS OF VARIANCE OF REGRESSION CO-EFFICIENTS FOR ASSOCIATIVE MEMORY (JAT TEST 9) AND ACADEMIC PERFORMANCE OVER THE THREE IQ GROUPS

	SUM OF SQUARES	DF	MEAN SQUARE	F-RATIO	P(TAIL)	S/NS
REGRESSION OVER GROUPS	400.509	4	100.127	0.937	0.44488	>.05
RESIDUAL WITHIN GROUPS	14217.653	133	106.900			

The F-ratio is not significant at the .05 level, therefore the researcher failed to reject null hypothesis 2.2. Inspection of

Table 8.8 reveals that there is a trend for correlation coefficients of JAT test 9 (associative memory score) and academic performance to increase fairly uniformly from the 'NV>V (by 10 or more IQ points)' through the 'NV>V (by 9 or fewer IQ points)' to the V⩾NV IQ group.

The failure to reject null hypothesis 2.1 and 2.2 suggests that the relationship between general retention ability (JAT tests 8 [rote memory] and 9 [associative memory]) and academic performance does not differ significantly between the three IQ groupings.

8.4 General Retention Ability and IQ Groupings

Research Postulate 3

General retention ability, as measured by Junior Aptitude Tests 8 (rote memory) and 9 (associative memory), will differ significantly between those pupils who have a significant Type I discrepancy (measured by the New South African Group Test) and those pupils who do not have this significant discrepancy.

Null Hypothesis 3.1

There will be no significant difference between the rote memory scores (as measured by Junior Aptitude Test 8) of those pupils who have a significant Type I discrepancy (measured by the New South African Group Test) and those pupils who do not have this discrepancy.

In order to test null hypothesis 3.1 a single-factor analysis of variance was conducted on the three mean JAT test 8 scores (see Table 8.1: p.139) of the IQ groupings.

TABLE 8.10

ONE-WAY ANALYSIS OF VARIANCE FOR MEAN JAT TEST 8 SCORES

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	F-VALUE	P(TAIL)	S/NS
EQUALITY OF CELL MEANS	2	16.6414	8.3207	0.4393	0.6454	>.05
ERROR	136	2575.9634	18.9409			

There was thus no significant difference between the mean JAT test 8 scores of the three groups. The researcher failed to reject null hypothesis 3.1. No consistent trend between the three mean JAT Test 8 scores could be discerned.

Null Hypothesis 3.2

There will be no significant difference between the associative memory scores (as measured by Junior Aptitude Test 9) of those pupils who have a significant Type I discrepancy (measured by the New South African Group Test) and those pupils who do not have this significant discrepancy.

For the testing of null hypothesis 3.2 a one-way analysis of variance was conducted on the three mean JAT Test 9 scores (see Table 8.1: p.143) of the IQ groupings.

Table 8.11

ONE-WAY ANALYSIS OF VARIANCE FOR MEAN JAT TEST 9 SCORES

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	F-VALUE	P(TAIL)	S/NS
EQUALITY OF CELL MEANS	2	33.5330	16.7665	0.7643	0.4676	>.05
ERROR	136	2983.2876	21.9359			

There was thus no significant difference between the mean JAT test 9 scores of the three IQ groupings. The researcher failed to reject null hypothesis 3.2. No consistent trend between the three mean JAT Test 9 scores could be discerned.

Research postulate 3 cannot, then, be supported. The levels of general retention ability of the three IQ groupings do not differ significantly.

8.5 Academic Performance for the three IQ groups

Research Postulate 4

There will be a significantly lower academic performance (as measured by examination results) for pupils who have a significant Type I discrepancy (measured by the New South African Group Test) in comparison with pupils who do not have this significant discrepancy.

Null Hypothesis 4

There will be no significant difference in academic performance (as measured by examination results) between those pupils who have a significant Type I discrepancy (measured by the New South African Group Test) and those pupils who do not have this significant discrepancy.

In order to test null hypothesis 4 a one-way analysis of variance was performed for the three mean academic performance scores (see Table 8.1: p.143) of the IQ groupings.

Table 8.12

ONE-WAY ANALYSIS OF VARIANCE FOR THREE MEAN ACADEMIC PERFORMANCE SCORES

SOURCE OF VARIATION	DF	SUM OF SQUARES	MEAN SQUARE	F-VALUE	P(TAIL)	S/NS
EQUALITY OF CELL MEANS	2	245.8301	122.9150	0.9629	0.3844	>.05
ERROR	136	17360.8359	127.6532			

The present investigator thus failed to reject null hypothesis 4. It can thus be stated that there is no significant difference between the mean academic performance scores of the three IQ groupings.

CHAPTER 9

DISCUSSION

9.1 Introduction

The present research into the relationship of general retention ability to significant non-Verbal/Verbal IQ discrepancies on the New South African Group Test (NSAGT) takes place against the background of debate concerning both the conceptual and factorial validity of the division of the NSAGT into non-Verbal and Verbal scales (see chapter 6: p.99).

The current study has attempted to determine whether there is a differential relationship between general retention ability and academic performance for those pupils with significant Type I discrepancies on the NSAGT and those pupils without such significant discrepancies. In addition, the present investigation has examined the level of general retention ability of the pupils with and without these significant discrepancies. Finally, the current research sought to test Robbertse's (1962) finding that those pupils who had a Type I discrepancy of 10 points or more had a lower level of academic performance when compared with those pupils who had a significant Type 2 discrepancy or who showed no significant discrepancy.

The results of the present study must be interpreted cautiously, as the population which was used had very specific characteristics. All subjects were standard seven males who spoke English as their home language and came from middle to upper-middle-class socio-economic backgrounds. Their mean total IQ score of 114 is considerably higher than that found by van Eeden and Grobbelaar (1967) who, working with a similar age group to that used in the present study, found that the mean total IQ score for English boys was 105.9. Since their study was based on the standardization sample of the NSAGT (senior series), their mean total IQ score can be taken as more representative of the general population.

As such, then, the population used in the present study is restricted with respect to the above subject characteristics. Thus the results of this study cannot be generalized too broadly. Rather, the results should be viewed as suggestive and need to be tested using a much larger sample which is more representative of the total population. Bearing in mind these reservations, the results of the present investigation will be discussed.

9.2 Findings

9.2.1 General Retention Ability and Academic Performance

The confirmation that both measures of general retention ability were significantly related to academic performance over the whole sample (Tables 8.3 and 8.4: pp.145 and 146) was a prerequisite for more detailed investigation in the current study. These moderate correlations of .529 (rote memory) and .412 (associative memory) with academic performance could have been anticipated on the basis of data presented by Verwey and Wolmarans (1980) in the manual for the Junior Aptitude Tests. This data demonstrated moderate correlations between rote memory and academic performance as well as between associative memory and academic performance over a range of school subjects.

Whether the moderate correlations between general retention ability measures and academic performance are the result of a third variable, such as intelligence, is an issue that will be speculatively addressed in section 3 of this chapter (see p.174), although the nature of the Pearson `r' precludes statements about causation.

Inspection of Table 8.2 (see p.144) in the preceding chapter indicates a correlation of .274 between JAT test 8 scores (rote memory) and JAT test 9 scores (associative memory), suggesting that for the sample as a whole these two variables are not even moderately correlated and casting some doubt on the present experiment's employment of them (on the basis of Hakstian and Cattell's (1978) work) as synonymous measures of `goodness of retention', differing only in terms of the way material is committed to memory.

While the finding that level of general retention ability did not differ significantly between the three groups contradicted the expectation, expressed in chapter 6, that a deficit in general retention ability could be a factor in the weaker academic performance of Type I discrepancy pupils, the possible differential employment of rote and associative memories in the three groups proved to be of interest.

9.2.2 Rote Memory Ability and Academic Performance over the three IQ groups

Although the analysis of variance tabulated in Table 8.7 (see p.151) showed there was not a significant difference over the three IQ groupings in the relationship of rote memory (JAT test 8 score) to academic performance, marked intra-group trends were observed. Thus the high correlation of .696 between rote memory and academic performance for the significant Type I discrepancy group is significant at the .05 level. In contrast (see Table 8.6: p.150), the corresponding co-efficient in the 'NV>V IQ by 9 or fewer IQ points' group is only .281 and just fails to reach the .05 significance level.

The correlation co-efficient of .497 between rote memory score (JAT test 8) and academic performance for the 'V≫NV IQ' group reflects a moderate relationship, one which is significant at the .05 level (see Table 8.6: p.150).

The question to be answered, quite obviously, is: 'What factors contribute to these intra-group trends in the relationship of rote memory score to academic achievement over the three groups?' Logically, these trends cannot simply be explained as experimental artifacts, by-products of the fact that rote memory has a higher correlation with Verbal than with non-Verbal intelligence and that the three groups differ on mean Verbal IQ scores.

If this were the reason, then one would expect that as mean Verbal IQ increased from the first group through to the third, the correlation between rote memory scores and academic performance would increase, as Verbal IQ has a higher predictive validity than non-Verbal IQ for academic performance (Eysenck, 1979). This is not the case.

One possible explanation for the high correlation between rote memory score and academic performance in the significant Type I discrepancy group is partially based on Kruger's (1967) assertion that a depressed Verbal IQ score (relative to non-Verbal IQ) indicates a <u>relative</u> failure to move from the concrete to the abstract.

If Kruger's assertion is accepted, then it is reasonable to surmise that those pupils with the depressed Verbal IQ, such as those in the significant Type I discrepancy group, may make more use of a concrete learning strategy, such as rote memory, which Jensen (1974: p.99) defines as:

> ...the capacity to register and retrieve information with fidelity... characterized essentially by a <u>relative lack of transformation, conceptual coding, or other mental manipulation intervening between information input and output</u> (present writer's emphasis).

This is an alternative explanation to the one proffered later on in this section where the suggestion is made that rote memory might be a Level II ability for the significant Type I discrepancy group owing to the moderate correlation between intelligence measures and rote memory ability in this group. However, the possibility exists that rote memory ability is a genuine Level I ability, as defined above by Jensen (1974), for the 'NV> V IQ (10 or more points) 'group and that the correlation between IQ measures and rote memory ability reflects the more intelligent pupil's possession of a more effective (and possibly more extensive) repertoire of <u>non-conceptual</u> rehearsal skills, such as primary rehearsal. Only further research will indicate which of these options is correct.

The possible <u>differential use</u> of rote memory relative to academic performance must be carefully distinguished from the overall level of rote memory ability possessed by the three groups. Table 8.10 of the previous chapter (see p.155) indicates that there is no significant difference between the three groups in rote memory ability. Nor are the mean academic performance scores of the three groups significantly different (see Table 8.12: p.158). However, the high and significant correlation between rote memory score and academic performance would suggest that, in comparison with the other two groups, the significant Type I discrepancy pupils tend to employ rote memory more in their achievement of academic results.

Considering the previous research indicating that pupils with Verbal IQs significantly lower than their non-Verbal IQ achieve poorer academic results than those without such a significant discrepancy or those with significant Type 2 discrepancies (eg. Gundersen and Feldt, 1960; Robbertse, 1962; Whittington, 1988), it is plausible to argue that with a moderately high mean total IQ score of 114 (not significantly different from the means of the other two groups) the significant Type I discrepancy group in the present study have compensated for relatively inferior Verbal IQ abilities through the use of rote memory.

However, there does not seem to be a pattern to the fluctuation of rote memory's correlation with academic performance over the three groups. Here Jensen's (1982: pp.870-871) modification of his earlier views regarding the status of the Mm (Meaningful

Memory) primary is helpful.

> Moreover, none of the Mm tests is really typical of Level I in terms of its core definition but are more typical of those tests used in past studies that either behaved as Level II with respect to SES (and race) or were ambiguous, shifting in characteristics depending on the age of the subjects...

The phenomenon of the Mm test (rote memory) shifting in characteristics from a Level I to a Level II test could in the present study be a function of the relative balance of mental abilities (non-Verbal and Verbal), rather than age, as Jensen (1982) suggests for the studies which he reviewed.

One way of ascertaining whether rote memory is shifting from a Level I to a Level II ability, depending on the IQ grouping, is to examine the relationship between rote memory score and the three IQ measures (non-Verbal IQ, Verbal IQ and total IQ) for each of the groups. This will give an indication of the extent to which JAT test 8 (rote memory) scores are independent of IQ and therefore are typical of Level I abilities.

For the 'NV>VIQ (by 10 or more points)' group the three measures of IQ correlate moderately and significantly (see Appendix A, Table i) with the rote memory scores. This finding is not compatible with the argument in chapter 6 and in the present chapter that rote memory, as an indication of simple retention, should be relatively independent of both fluid and crystallized intelligence.

The fact that both the non-Verbal (fluid) and Verbal (crystallized) scales of the NSAGT load heavily on the `g' factor (Batt, 1989; Cudeck and Claassen, 1983) would seem to indicate that for this large-discrepancy group rote memory is not a simple retention skill but that it involves reasoning and conceptual strategies. This may explain why the correlation between rote memory ability and academic performance for this large-discrepancy group is so high. If rote memory ability is regarded as a Level II ability for this group, then academic performance and rote memory ability should correlate as both employ conceptual skills. Rephrased, it appears that for the significant Type I discrepancy group rote memory ability (JAT test 8 score) is not independent of intelligence but varies with it. However, the alternative explanation for the correlation between intelligence measures and rote memory ability, given earlier on in this section, should be borne in mind.

In contrast, in the `NV>VIQ (by 9 or fewer points)' group none of the low correlations between the three IQ measures and mean rote memory score (JAT test 8) reached significance at the .05 level (see Appendix A, Table ii). Thus it appears that for this group rote memory is more independent of IQ and may act more like a Level I ability where transformation between input and output is minimal.

If this is so, then the low, non-significant relationship between rote memory (JAT test 8 score) and academic performance in this group is more comprehensible as the JAT test 8 score for these pupils does not reflect abstract or 'g' abilities, but only simple retention, which should have a relatively low correlation with academic performance, as the latter involves more than just simple retention and retrieval.

The picture regarding the 'V≥NV IQ' group is not as clear. For this group the moderate correlations between the three IQ measures and rote memory are marginally higher than those for the significant Type I discrepancy group and all are significant at the .05 level (see Appendix A, Table iii).

Here, then, it would appear, as for the significant Type I discrepancy group, that rote memory is behaving as a Level II ability and varies significantly with IQ. Another interpretation, however, would be that higher measured intelligence in the 'V≥NV IQ' group is associated with more efficient use of rote memory, perhaps due to better non-conceptual rehearsal strategies. The latter interpretation requires experimentation in order to verify it.

The tentative speculation about the vacillating nature of rote memory ability and the assertion that rote memory can act as a

Level II ability can be put into theoretical perspective by an appeal to an hierarchical model of cognitive functioning such as that of Royce (1977). Royce has conceived of the general psychological functioning of the individual in terms of six linked subsystems, one of which is the cognitive hierarchy:

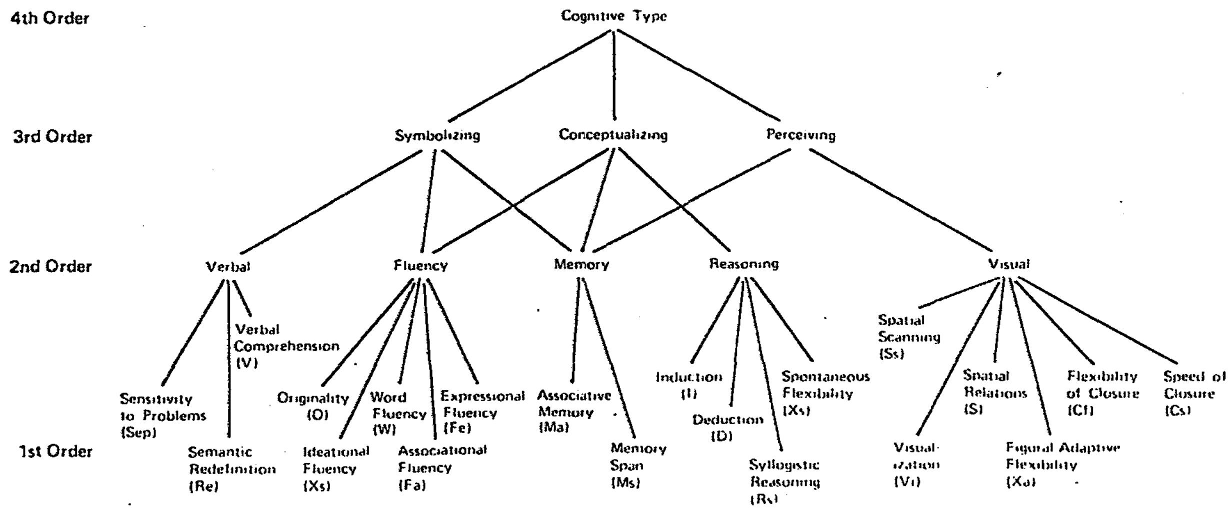

Fig. 9.1, The hierarchical structure of the cognitive system (From 'Genetics, environment and intelligence' by A. Oliverio (ed.), 1977: p.244).

This scheme indicates seven '1st order' abilities (defined by tests) which are similar to Thurstone's 'primary abilities'. Although rote memory is not indicated as such it would, in terms of Jensen's definitions, either be situated at the `1st order' as a Level I ability or at the second order as a Level II ability which interacts with higher order abilities such as `symbolizing' and `conceptualizing'.

In essence some individuals may have cognitive profiles (of which the non-Verbal/Verbal balance is an aspect) in which the abilities demonstrated on such a rote memory test would partially be the expression of abstract higher-order factors such as `symbolizing' and `conceptualizing'. For other individuals these higher-order abstract abilities may play a minor rôle in the skills tested in the rote memory test.

9.2.3 Associative Memory Ability and Academic Performance over the three IQ groups

One of the salient features of this investigation is the observation that while both rote memory (JAT test 8) and associative memory (JAT test 9) scores have fairly similar correlations with IQ measures and academic performance for the complete sample (see Table 8.2: p.144), they vary in these relationships <u>within</u> the three IQ groupings (see Table 8.5 (a), (b) and (c): pp 147 and 148). This variation is obviously associated with the low correlation (.274 - see Table 8.2: p.144), mentioned earlier in this chapter, between the two memory measures over the whole sample.

Thus while the relationship of the associative memory scores (JAT test 9) to academic performance does not differ significantly over the three IQ groupings (see Table 8.9: p.153), there is a strong trend for the correlation between associative memory and academic performance to increase from the `NV>VIQ (10 or more points)' through the `NV>VIQ (9 or fewer IQ points)' to the `V≥NV IQ' group. This increase is not a function of the increase in mean Verbal IQ as associative memory has its loading on fluid intelligence (Hakstian and Cattell, 1978).

In the significant Type I discrepancy group while the high correlation between rote memory score (JAT test 8) and academic performance was significant, the low correlation of associative memory (JAT test 9 score) and academic performance just fails to reach significance at the .05 level (see Tables 8.6 and 8.8: pp.150 and 152). This would seem to suggest a differential pattern in the type of memory associated with academic performance.

The pattern is reversed in the `NV>VIQ (9 or fewer points)' group where rote memory score's low correlation with academic performance is not significant while associative memory's correlation with academic performance is significant (see Tables 8.6 and 8.8: pp. 150 and 152). For this group associative memory would appear to be the more important strategy used in learning.

For the V>NV IQ group both types of memory score are significantly and moderately correlated with academic performance (see Tables 8.6 and 8.8: pp. 150 and 152).

The pattern of differential memory employment in the first two groups cannot simply be explained on the basis of the non-Verbal/Verbal IQ balance of the groups. As mentioned earlier, as the VIQ component increases we would expect rote memory (JAT test 8) score, not associative memory score (JAT test 9), to become more dominant, as rote memory is correlated more highly with Verbal IQ. Perhaps the observation made by Drewnowski (1980), alluded to in chapter 5 (p.86), might be helpful in understanding this apparent paradox.

Drewnowski made the point that even simple memory span tasks involve the ordering of attributes by the subjects. This 'ordering of attributes' relates to the 'encoding specificity' proposed by Craik and Lockhart (1972) (see chapter 5: p.86) whereby the amount of intellectual effort invested in processing information is reflected in the durability of the memory code established, as well as in the availability of the information for retrieval.

According to Montague, Adams and Kiess (1966) associative learning of paired nonsense syllables does involve differential involvement of intellectual effort of a verbal nature. Thus these researchers found that subjects who used verbal mediators in learning pairs of nonsense syllables retained and retrieved these pairs better than did those subjects who didn't make use of verbal mediators. Their conclusion was that the elaboration involved in the use of verbal mediators facilitated transfer of information to long-term memory. In addition, they found that the more nonsense syllables resembled meaningful words, the greater the tendency for verbal mediators to be introduced and the better learning took place.

These findings are of particular applicability to the learning of the word pairs in the first half of JAT test 9. Here a familiar word is paired with a 'foreign' word, making the likelihood of the use of verbal mediators high, as the first word in the pair is certainly 'meaningful' and the second word is not difficult to endow with meaning. Thus the increase in the correlation of associative memory score and academic performance with increasing Verbal IQ over the three groups might be a reflection of the use of verbal strategy (verbal mediators). However, it is unlikely that this line of reasoning applies to the second section of JAT test 9 where an unknown symbol, often resembling a geometric design, is to be linked up to a capital letter.

The reasoning in the previous paragraph is strengthened when it is observed that unlike the case for JAT test 8, associative memory scores are consistently moderately and significantly (see Appendix B, Tables i-iii) related to the three IQ measures over all groups. This would seem to suggest that for these three groups associative memory is acting as a Level II ability and varies with intelligence, the same kind of postulate suggested in the preceding paragraph.

9.3 IQ measures and Academic Performance

No research postulate was formulated concerning the relationship between IQ measures and academic performance over the three groups. While both mean total IQ and mean academic performance were not significantly different between the groups, a discernible trend between IQ measures (non-Verbal, Verbal and total IQ) and academic performance was apparent over the three groups. Thus an ANOVA was run on the latter relationships and Appendix C tabulates the results.

The inter-group differences in the relationship of total IQ and academic performance just failed to reach significance at the .05 level (see Appendix C Table vi). However, the relationship between non-Verbal IQ and academic performance differed significantly over the three groups (see Appendix C Table ii) as did that between Verbal IQ and academic performance (See Appendix C Table iv).

Thus, while all the IQ measures were significantly related to academic performance in each of the three groups (see Appendix C, Tables i,iii and v), the between-group differences in these relationships were significant for non-Verbal IQ and Verbal IQ, and nearly significant for total IQ (see Appendix C, Tables ii, iv and vi).

There is a strong trend for the correlations between the three IQ measures and academic performance to decrease from the `NV>V IQ (10 or more points)' though the `NV>V IQ (9 or fewer IQ points)' to the `V≥NV IQ group'. This is particularly noticeable for Verbal IQ's correlation with academic performance which decreased to the extent that in the third group it is lower than the correlation of non-Verbal IQ with academic performance. Quite obviously these trends cannot simply be a function of the grouping principle for the three groups as both non-Verbal and Verbal IQ are involved in this tendency.

From one perspective these trends can be interpreted as suggesting that the predictive validity of IQ measures for academic performance decreases over the three groups, a finding which runs counter to previous research (e.g. Robbertse, 1962; van Eeden and Grobbelaar, 1967). Predictive validity is a relevant concept here because the IQ measures were taken 2 months before the examinations.

From another perspective, it appears that for the `NV>V IQ (10 or more points)' group IQ measures explain more of the variance in academic performance than for the other two groups. This point of view may be helpful in trying to make sense of the fact that academic performance for the 'NV>V IQ (10 or more points)' group is on a par with that of the other two groups, a finding running counter to most of the research conducted in the area (e.g. Gunderson and Feldt, 1960; Whittington, 1988).

Perhaps the reason for the equal academic achievement of the significant Type I discrepancy group lies in their compensation for a 'depressed' Verbal IQ through the use of rote-memory strategies. This was discussed in section 2.2 (see p.164) of the present chapter and the observation made that the group's mean IQ, relatively high when compared with the normal population, could have led to this compensatory strategy. Indeed, as is pointed out in the same section, for the 'NV>V IQ' (10 or more points) group the three IQ measures are moderately and consistently correlated with rote memory scores, which in turn have the highest correlation with academic performance of any of the groups.

The decreasing efficiency of the IQ measures as predictors of academic performance over the three groups suggests that increasingly in the 'NV>VIQ' (9 or fewer points)' and 'V≥NV IQ' groups other factors, presumably non-intellective, play a rôle in academic achievement.

9.4 Conclusion and Recommendations

Since it was found in the present research that significant non-Verbal/Verbal IQ discrepancies of Type I nature do not have significantly weaker academic performance as a correlate, the question arises as to the relevance of such discrepancies at all.

Here a few points must be made. Firstly, such discrepancies do appear, on the basis of the present investigation's findings, to indicate appreciably different methods of committing material to memory. One area of research which deserves further attention is whether the significant Type I discrepancy group's compensation by the use of rote memory will enable them to continue to achieve academically on a par with other pupils who do not have significant Type I discrepancies, especially as the material to be committed to memory becomes more abstract and greater in volume with the pupil's progress through the secondary school.

Ideally, an experiment similar to the present one, but involving a far more heterogeneous population and larger numbers, should be conducted using pupils when they are, for example, in standard 7 and then later when they are in standard 9. Such an experiment might clarify whether rote memory decreases in efficiency as a compensatory mechanism as the higher standards are reached.

Secondly, the present experiment involved a small, relatively homogeneous population. The use of a more heterogeneous population would presumably result in more normal IQ means for the various groups and it would then be anticipated that the 'NV>VIQ' (by 10 or more points)' group would not be able to compensate for their relatively lower Verbal ability by using their general intellectual abilities or by using a greater repertoire of non-conceptual rote memory skills.

Further experimentation in the direction of the present study is essential as, if it is established that rote memory no longer acts as a compensatory learning strategy for pupils with significant Type I discrepancies when the senior standards of the secondary school are reached, this will be valuable information for teacher counsellors and other school personnel.

This information might prevent crucial decisions being made on the basis of what appears to be satisfactory academic performance in standards 6 and 7. Thus the rôle of rote memory in such academic performance should be assessed before encouraging the pupil to take highly abstract subjects which demand far more than memorisation ability.

Future research should concentrate on whether pupils with significant Type I discrepancies are utilising learning strategies which become increasingly inappropriate and ineffectual as the pupil progresses in the secondary school.

This might enable early identification of such pupils on the basis of IQ discrepancy so that they might be taught to use alternative methods.

The present study utilised a 10-point discrepancy between non-Verbal and Verbal IQ as the minimum significant difference. This was chosen on the basis of the studies of Robbertse (1962), Kruger (1972) and van der Merwe (1978). However, statistically, 10 points is not a significant discrepancy, as was discussed in chapter 7 (see p.108). Thus it is possible that, statistically speaking, the three groups are actually not distinct as regards NV/V IQ discrepancy, although the trends and differences observed render this possibility unlikely. Subsequent research which uses statistically significant NV/V IQ differences and which includes a significant Type 2 discrepancy group might well find that the strong trends reported in this research reach significance.

The limitations of the population used in the present study (discussed earlier on in this chapter) preclude any definite statement being made about the value of the non-Verbal and Verbal distinction on the NSAGT. However, from a theoretical point of view (see chapter 6: p.99) the validity of this distinction has been questioned. It may be conjectured that if there was less confounding of Verbal items on some of the 'non-Verbal' tests of the NSAGT, the results of the present research would have been different inasmuch as trends might have become significant differences.

As regards the Junior Aptitude Tests 8 (rote memory) and 9 (associative memory), more substantial observations and recommendations can be made. The present study has suggested that the blanket definition of rote memory ability, measured by test 8 of the JAT, as a simple measure of retention (Verwey and Wolmarans, 1980) needs to be questioned. It appears that rote memory, as measured by JAT test 8, varies between being a Level I and a Level II ability, this variation quite possibly depending on the non-Verbal/Verbal IQ balance of the pupil.

The definition of associative memory, as measured by JAT test 9, as a simple retention ability also deserves close examination. All IQ measures were moderately and significantly correlated with JAT test 9 (associative memory) scores, indicating that associative memory, as measured by JAT test 9, is not a Level I ability but a Level II ability, involving transformation of the original input. The possible rôle of verbal mediators in this transformation was discussed in the previous section as being a possible explanation for the correlation between IQ measures and JAT test 9 scores.

The identification of rote memory ability (JAT test 8 score) and associative memory ability (JAT test 9 score) as measures of simple retention ability which only differ in terms of the method used to commit material to memory, needs to be re-examined as the present research yielded low correlations between the two.

A further area for future consideration involves the differential effect of interference on the learning for JAT tests 8 and 9. After test 8 (rote memory) has been learned another test, albeit one of dissimilar content (three-dimensional spatial ability), is interposed before the material of test 8 is tested. Here, then, the possible effects of retroactive interference must be considered whereas for JAT test 9 material (associative memory) testing takes place immediately after each section is learned. Thus for JAT test 9 the chance of interference occurring is negligible. The testing of the material of JAT test 8 (rote memory) thus approximates the school learning situation more closely inasmuch as material/learning experiences are interposed between the original learning and the testing.

The method of testing for both JAT tests 8 and 9 involves recognition, using a multiple-choice format. Travers (1982) draws attention to the finding that recognition involves a perceptual analysis of presented material and then a comparison of that material to what is stored in memory. He adds that recognition may take place on the basis of very fragmentary information whereas recall requires detailed information to have been stored in memory. Thus recall is a far more difficult process than recognition and requires a more complete retention.

On the basis of Craik and Lockhart's (1972) 'levels of processing' model recall would require the processing of more levels or attributes of the material than recognition.

However, school examinations, although they do have sections which use the multiple-choice format, operate largely on recall. Thus both JAT test 8 and 9 have limited application to the school situation. This limitation is obviously associated with the fact that the Junior Aptitude Test is a group test and cannot test recall (as opposed to recognition). It would appear that other memory tests are required, tests which would test recall of material which could be conceptually grouped.

Although such tests would, in all likelihood, reflect the intellectual ability of the testee, they could, in comparison with the testee's IQ score, isolate instances where the testee has the intellectual ability to organize material into conceptual groupings, but lacks the familiarity with conceptual grouping and rehearsal skills. As a number of researchers (e.g. Bower, 1969; Byrd and Gholson, 1985) have shown, rehearsal strategies can be taught.

Clearly, as Thurstone subsequently realized, rote memory and associative memory abilities are more complex than the relatively independent primary memory ability which he initially posited in 1938 (Visser and Jenks, 1979). Jensen (1982) has commented that very few studies have succeeded in isolating a memory factor which is independent of `g'. However, the trends observed in the present study would seem to suggest that further research is required into the relationship of memory and academic performance for children with different cognitive profiles. The present study suggests that such research could yield information upon which educationalists might base differential teaching strategies.

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APPENDIX A

TABLE i

CORRELATIONS BETWEEN IQ MEASURES AND JAT TEST 8 SCORES (ROTE MEMORY ABILITY): GROUP `NV>VIQ (10 OR MORE POINTS)'

	ROTE MEMORY SCORE (JAT TEST 8)	DF	P(TAIL)	S/NS
NON-VERBAL IQ	.482	52	0.0002	<0.05
VERBAL IQ	.544	52	0.0000	<0.05
TOTAL IQ	.533	52	0.0000	<0.05

TABLE ii

CORRELATIONS BETWEEN IQ MEASURES AND JAT TEST 8 SCORES (ROTE MEMORY ABILITY): GROUP `NV>VIQ (9 OR FEWER POINTS)'

	ROTE MEMORY SCORE (JAT TEST 8)	DF	P(TAIL)	S/NS
NON-VERBAL IQ	.215	42	0.1608	>0.05
VERBAL IQ	.191	42	0.2138	>0.05
TOTAL IQ	.211	42	0.1701	>0.05

TABLE iii

CORRELATIONS BETWEEN IQ MEASURES AND JAT TEST 8 SCORES (ROTE MEMORY ABILITY): GROUP `V$\geqslant$NVIQ'

	ROTE MEMORY SCORE (JAT TEST 8)	DF	P(TAIL)	S/NS
NON-VERBAL IQ	.543	39	0.0002	<0.05
VERBAL IQ	.529	39	0.0004	<0.05
TOTAL IQ	.537	39	0.0003	<0.05

APPENDIX B

TABLE i

CORRELATIONS BETWEEN IQ MEASURES AND JAT TEST 9 SCORES (ASSOCIATIVE MEMORY ABILITY): GROUP 'NV>VIQ'(10 OR MORE POINTS)'

	ASSOCIATIVE MEMORY SCORE (JAT TEST 9)	DF	P(TAIL)	S/NS
NON-VERBAL IQ	.397	52	0.0030	<0.05
VERBAL IQ	.318	52	0.0192	<0.05
TOTAL IQ	.365	52	0.0066	<0.05

TABLE ii

CORRELATIONS BETWEEN IQ MEASURES AND JAT TEST 9 SCORES (ASSOCIATIVE MEMORY ABILITY): GROUP 'NV>VIQ'(9 OR FEWER POINTS)'

	ASSOCIATIVE MEMORY SCORE (JAT TEST 9)	DF	P(TAIL)	S/NS
NON-VERBAL IQ	.507	42	0.0004	<0.05
VERBAL IQ	.519	42	0.0003	<0.05
TOTAL IQ	.512	42	0.0004	<0.05

TABLE iii

CORRELATIONS BETWEEN IQ MEASURES AND JAT TEST 9 SCORES (ASSOCIATIVE MEMORY ABILITY): GROUP 'V≥NVIQ'

	ASSOCIATIVE MEMORY SCORE (JAT TEST 9)	DF	P(TAIL)	S/NS
NON-VERBAL IQ	.471	39	0.0019	<0.05
VERBAL IQ	.348	39	0.0256	<0.05
TOTAL IQ	.414	39	0.0072	<0.05

APPENDIX C

TABLE i

COMPARISON OF CORRELATIONS BETWEEN NON-VERBAL IQ AND ACADEMIC PERFORMANCE FOR THE THREE IQ GROUPINGS

GROUP	r	DF	P	S/NS
NV>V (10 OR MORE IQ POINTS)	.678	52	0.0000	<.05
NV>V (9 OR FEWER IQ POINTS)	.578	42	0.0000	<.05
V≥NVIQ	.502	39	0.0008	<.05

TABLE ii

ANALYSIS OF VARIANCE OF REGRESSION CO-EFFICIENTS FOR NON-VERBAL IQ AND ACADEMIC PERFORMANCE OVER THE THREE IQ GROUPS

	SUM OF SQUARES	DF	MEAN SQUARE	F-RATIO	P(TAIL)	S/NS
REGRESSION OVER GROUPS	1682.262	4	420.565	5.091	0.00075	<0.05
RESIDUAL WITHIN GROUPS	10986.193	133	82.603			

TABLE iii

COMPARISON OF CORRELATIONS BETWEEN VERBAL IQ AND ACADEMIC PERFORMANCE FOR THE THREE IQ GROUPINGS

GROUP	r	DF	P	S/NS
NV>V (10 OR MORE IQ POINTS)	.764	52	0.0000	<.05
NV>V (9 OR FEWER IQ POINTS)	.585	42	0.0000	<.05
V≥NVIQ	.379	39	0.0146	<.05

TABLE iv

ANALYSIS OF VARIANCE OF REGRESSION CO-EFFICIENTS FOR VERBAL IQ AND ACADEMIC PERFORMANCE OVER THE THREE IQ GROUPS

	SUM OF SQUARES	DF	MEAN SQUARE	F-RATIO	P(TAIL)	S/NS
REGRESSION OVER GROUPS	1079.939	4	269.985	3.414	0.01082	<0.05
RESIDUAL WITHIN GROUPS	10518.516	133	79.087			

TABLE v

COMPARISON OF CORRELATIONS BETWEEN TOTAL IQ AND ACADEMIC PERFORMANCE FOR THE THREE IQ GROUPINGS

GROUP	r	DF	P	S/NS
NV>V (10 OR MORE IQ POINTS)	.753	52	0.0000	<.05
NV>V (9 OR FEWER IQ POINTS)	.587	42	0.0000	<.05
V≥NVIQ	.438	39	0.0042	<.05

TABLE vi

ANALYSIS OF VARIANCE OF REGRESSION CO-EFFICIENTS FOR TOTAL IQ AND ACADEMIC PERFORMANCE OVER THE THREE IQ GROUPS

	SUM OF SQUARES	DF	MEAN SQUARE	F-RATIO	P(TAIL)	S/NS
REGRESSION OVER GROUPS	737.142	4	184.285	2.357	0.05683	>0.05
RESIDUAL WITHIN GROUPS	10398.514	133	78.184			