AN INQUIRY INTO RELATIONSHIPS BETWEEN CERTAIN PERSONALITY FACTORS AND ATTITUDES TO MATHEMATICS IN SOME SELECTED SCHOOLS IN THE RANGE STANDARDS THREE TO FIVE

by

DAVID LEON LIGHT

Thesis
submitted in part fulfilment of the requirements
for the degree of

MASTER OF EDUCATION
OF
RHODES UNIVERSITY

March 1984

CONTENTS

LIST OF TABLES AND FIGURES

ACKNOWLEDGEMENTS

I wish to express my sincere gratitude to the following persons for their assistance and support.

I am very grateful to Prof. A. Noble whose quiet, dignified and sincere interest and assistance at all times were most helpful. His many suggestions were most welcome.

The permission of the Cape Education Department to conduct the study in the schools, and the co-operation of the principals, teachers and pupils concerned, are also much appreciated.

My thanks also goes to Mrs Ena Reinecke for the many hours which she so willingly gave to typing this dissertation. Her cheerful readiness to make alterations and correct errors are much appreciated.

The constant good wishes and encouragement of some of my colleagues added inspiration and a determination to succeed.

Finally I am especially grateful to my family for their encouragement and support. They have accepted the closed study door with magnanimity. A special gratitude must be extended to my toddler son David, who though he could not

understand, oft came knocking at my study door
and had to contend that I'd ignore
that which he so loudly came to implore
- my attention.

INTRODUCTION

If there is a true issue in research on attitude, as evidenced by published, contested points of view as reported by Aiken, 1970 and Neale, 1969, it is this most basic of issues: Are mathematics attitudes important? The generally low correlation between attitude and achievement is the most often cited evidence (Kulm, 1980) that attitudes may not matter too much in explaining achievement. There are, he says, high achievers in mathematics who do not have high scores on mathematics attitude tests.

Noble (1974) has reason to believe however, that attitudes may be important in mathematics learning and this present study concerns itself with an investigation into relationships between certain factors and attitudes to mathematics in urban English-medium primary schools of the middle and upper socio-economic group and confines itself to standards three, four and five.

The purpose of this cross-sectional study (discussed under under Chapter 6.2) is an attempt to find reasons for surprising phenomena which became evident at the Standards 4 and 5 levels in the research of Noble (1974) and Ilsley (1977) when the former set out:

(i) in a cross-sectional study to compare the attitude to and attainment in mathematics, throughout the age-range 9 - 17 years inclusive, of 1 430 boys and 754 girls in Grahamstown;

(ii) to investigate changes with age, in certain personality factors pertaining to these pupils;

(iii) to investigate the correlates between these personality factors and mathematical attainment for this same school population;

and the latter also in a cross-sectional study who investigated the same research area with 501 boys and 464 girls in the Cape Town area among pupils in the age range Standards 2 to 6 in a similar middle and upper socio-economic group.

Noble and Ilsley found (See graphical representations p. 7 - 10) that correlations between certain personality factors (e.g. intelligence, conscientiousness) and mathematical attainment in the school range Standards 2 to 10, suffered disruptions at the Standards 4 and 5 levels and this disruption varied for boys and girls, e.g. positive correlations between intelligence and Mathematical attainment changed to either negligible or negative correlations in Standards 4 and 5.

Noble (1974) and Ilsley (1977) have given reasons which they suspect are responsible for these disruptions. I suspect

that puberty must play a role and I therefore set out to ascertain whether my suspicion was worthwhile and whether there were indeed, other reasons.

CHAPTER 1

THE PROBLEM AREA

1.1 Motivation

As I have already indicated the purpose of this study seeks reasons why Noble and Ilsley found that correlations between certain personality factors (e.g. intelligence, conscientiousness, emotional stability) and mathematical attainment in the school range Standards 2 to 10, suffered a disruption at the Standard 4 and 5 levels and this disruption varied for boys and girls, e.g. positive correlations between intelligence and Mathematical attainment change to either negligible or negative correlations in Standards 4 and 5.

Both Noble and Ilsley used Cattell's Personality Questionnaire, the CPQ, which yields fourteen first-order factors and from which Cattell derived his second-order factors of extraversion-intoversion and neuroticism-stability. Ilsley used the S.A. Standardised version of the CPQ. Although Noble did not use the same standardised version, as it had not yet been standardised for South African conditions the findings of both Noble and Ilsley showed such similarities as to be significant. The S.A. standardised version of the CPQ differs little from the original CPQ.

1.2 Children's Personality Questionnaire (CPQ)

The following is a brief description of the first-order factors and the type of person they describe:

THE FOURTEEN CPQ FACTORS

Low Sten Score	Factor	High Sten Score
RESERVED (Schizothymia) reserved, critical, cool, aloof, resists adult direction, prone to sulk or cry.	A (Sociability)	OUTGOING (Cyclothymia) easy-going, warmhearted, co-operative, sociable casual, trustful, adaptable, attentive to people.
LESS INTELLIGENT low general mental capacity	B (Intelligence)	MORE INTELLIGENT high general mental capacity
EASILY AFFECTED BY FEELINGS (weakness) emotionally unstable, easily upset, excitable, changeable, worrying, gets emotional when frustrated.	C (Ego-strength)	EMOTIONALLY STABLE (strength) emotionally mature, calm, placid, realistic, stable in attitudes, does not easily get into difficulties.
PHLEGMATIC (Placidity of temperament) placid, self-sufficient, not easily jealous, constant, not easily reckless, deliberate.	D (Excitability)	EXCITABLE (excitable) demanding, impatient, attention-getting, prone to jealousy, self-assertive, egotistical, undependable, shows nervous symptoms.
SUBMISSIVE(Submissiveness) dependent, kindly, soft-hearted, expressive, conventional, self-sufficient.	E (Assertion)	DOMINANT (dominance) assertive, self-assured, independent-minded, hard, stern, solemn, rebellious, attention-getting, unconventional.
SOBER (desurgency) serious, silent, introspective, depressed, brooding, concerned, uncommunicative, languid, sticks to inner values.	F (Enthusiasm)	HAPPY-GO-LUCKY (surgency) talkative, cheerful, serene, frank, expressive, quick, alert.
EXPEDIENT (super ego weakness) frivolous, quitting, fickle, demanding, impatient, undependable, relaxed, indolent, disregards obligations to people.	G (Conscientiousness)	CONSCIENTIOUS (super ego strength) persevering, responsible, determined, emotionally mature, conscientious, consistently ordered, attentive to people and rules.
SHY (threctia) withdrawn, aloof, cold, self-contained, careful, considerate, restrained, retiring in presence of opposite sex.	H (Adventurousness)	VENTURESOME (parmia) likes meeting people, genial, responsive, friendly, carefree, impulsive, and frivolous, overt interest in opposite sex.
TOUGH-MINDED (harria) realistic, expects little, self-reliant, taking responsibility, hard, practical, logical.	I (Sensitivity)	TENDER-MINDED (premsia) demanding, impatient, dependent, seeking help, kindly, gentle, sensitive, intuitive, frivolous, attention-seeking.

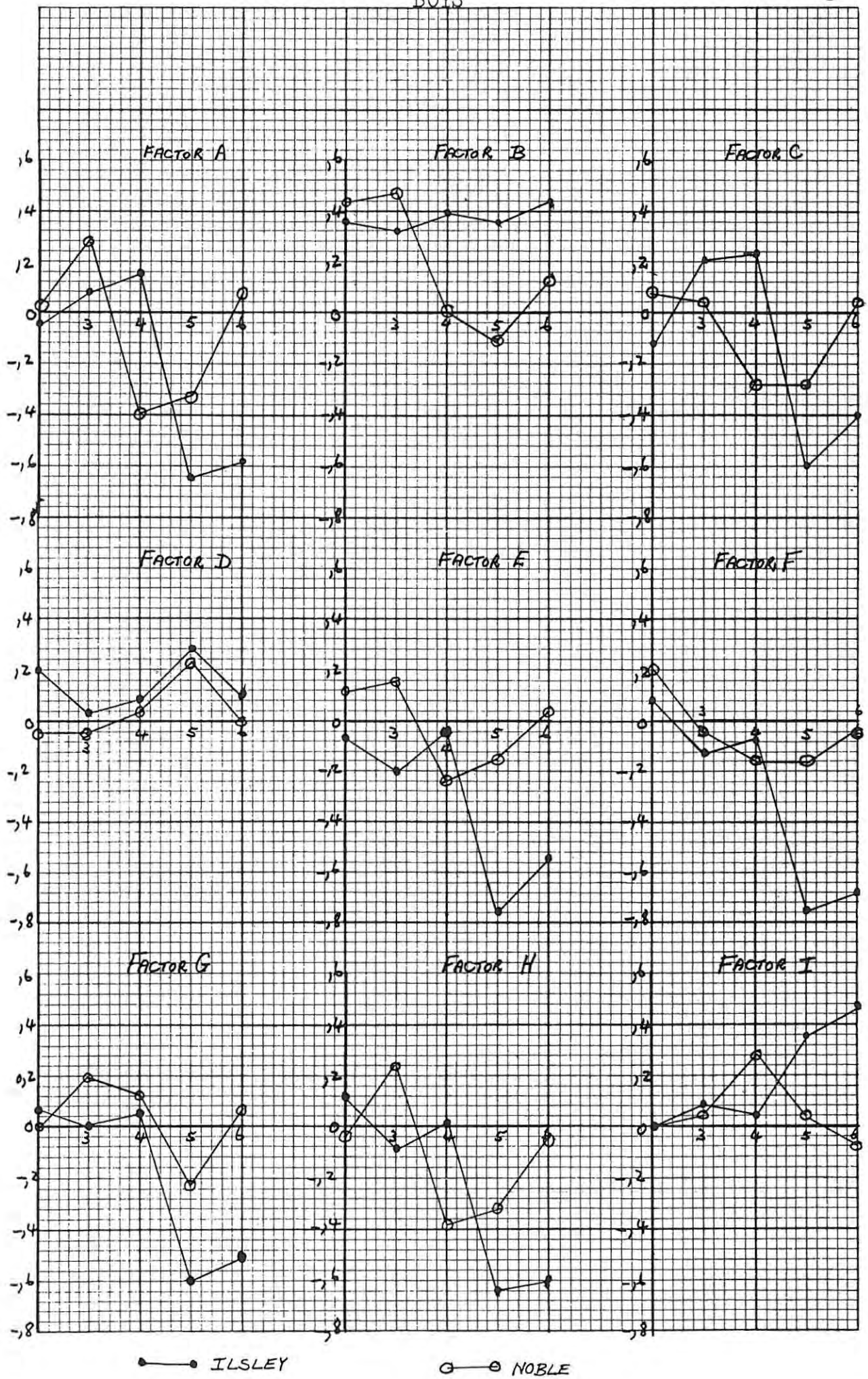
VIGOROUS (zeppia) likes to go with the group, likes attention, acts, accepts common standards.	J (Passive individualism)	DOUBTING (coasthenia) internally restrained, acts individualistically, self-sufficient, unwilling to act, evaluates intellectually.
NAIVE (naiveté) simple, naive, socially inalert, vague and sentimental, company-seeking, lacking self-insight.	N (Shrewdness)	SHREWD (shrewdness) shrewd, socially skilful, exact and realistic, cool, aloof, insightful regarding others and self.
PLACID (unperturbed adequacy) complacent self-confident, cheerful, resilient, tough, expedient, no fears, given to simple action.	O (Guilt-proneness)	APPREHENSIVE (guilt proneness) self-reproaching, guilt-prone, worrying, anxious, depressed, cries easily, sensitive, tender, exacting, fussy, moody, lonely, brooding, phobic symptoms, strong sense of duty.
UNDISCIPLINED SELF-CONFLICT (weak self-sentiment) lax, prone to undisciplined self-conflict, lack of integration, careless of protocol.	Q_3 (Self-control)	CONTROLLED (strong self-sentiment) self controlled, self-disciplined, socially precise.
RELAXED (low ergic tension) composed, relaxed, tranquil, unfrustrated.	Q_4 (Tension)	TENSE (high ergic tension) over-tense, driven, frustrated, over-wrought.

1.2.1 Graphic results of correlation disruptions

The following graphical representations of the Correlation Coefficients between these Personality Factors and Mathematical attainment versus School standard will give a clearer picture of the findings of Noble and Ilsley.

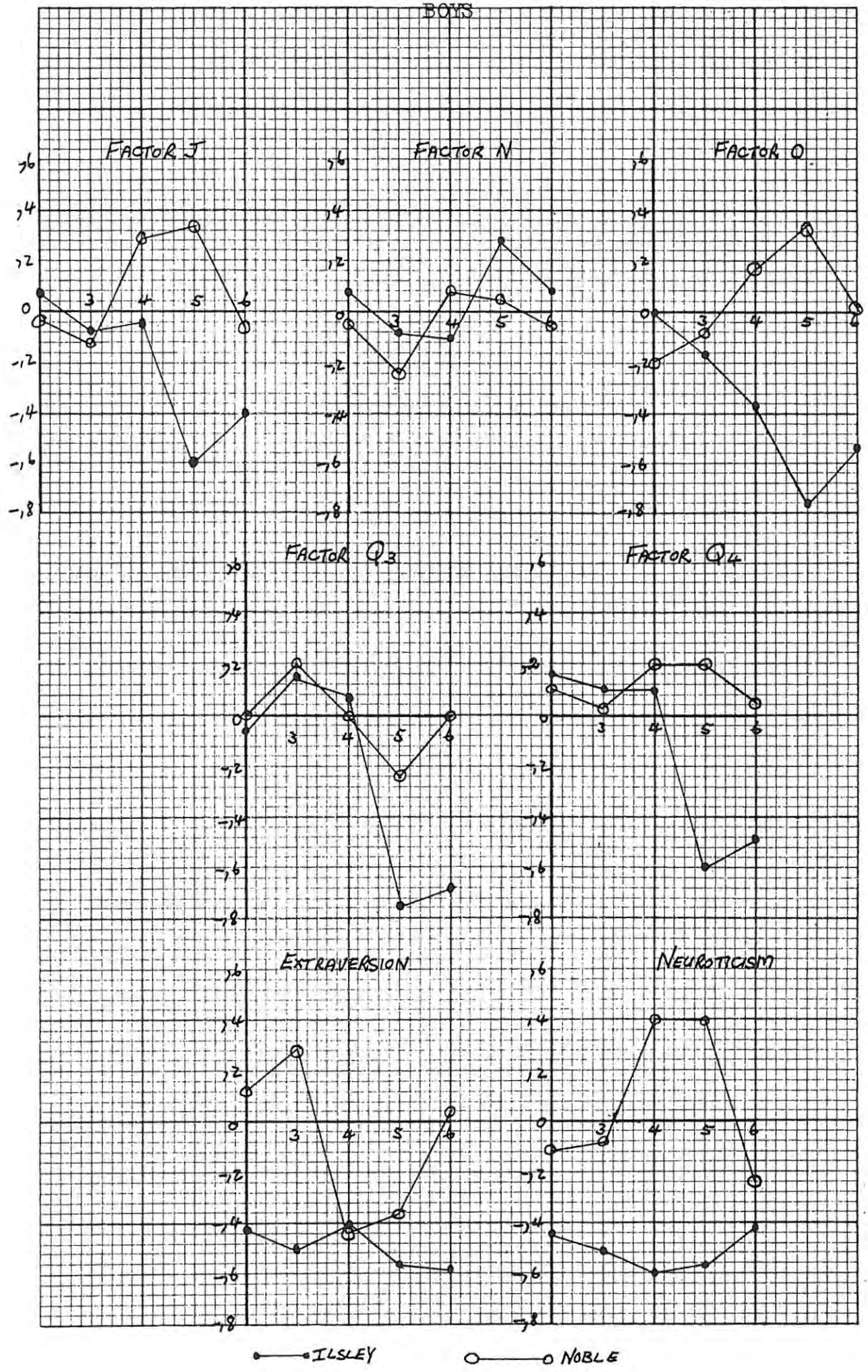
CORRELATION COEFFICIENTS BETWEEN PERSONALITY FACTORS AND MATHEMATICAL ATTAINMENT VERSUS SCHOOL STANDARD. Figure 1

BOYS



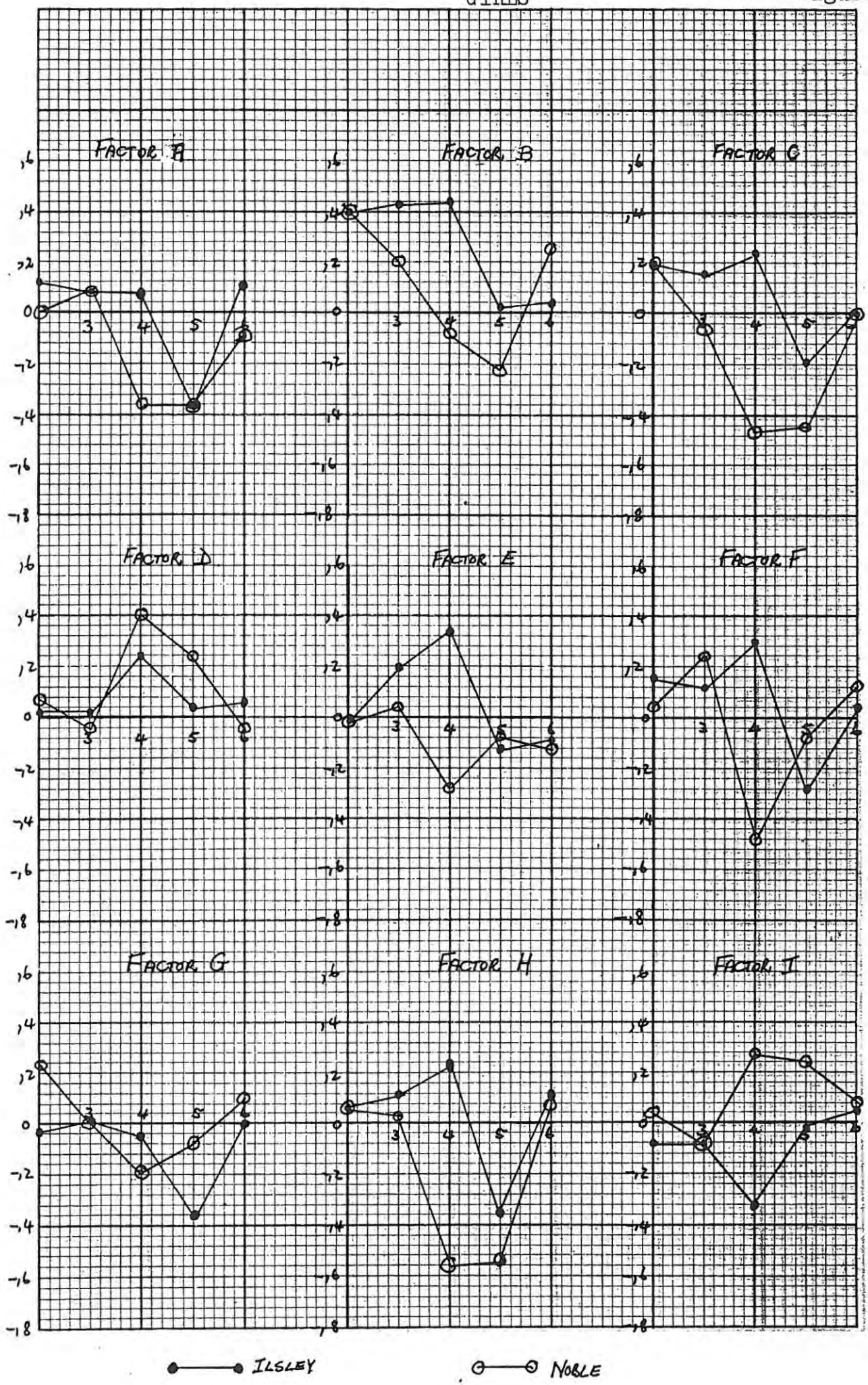
CORRELATION COEFFICIENTS BETWEEN PERSONALITY FACTORS AND MATHEMATICAL ATTAINMENT VERSUS SCHOOL STANDARD.

BOYS

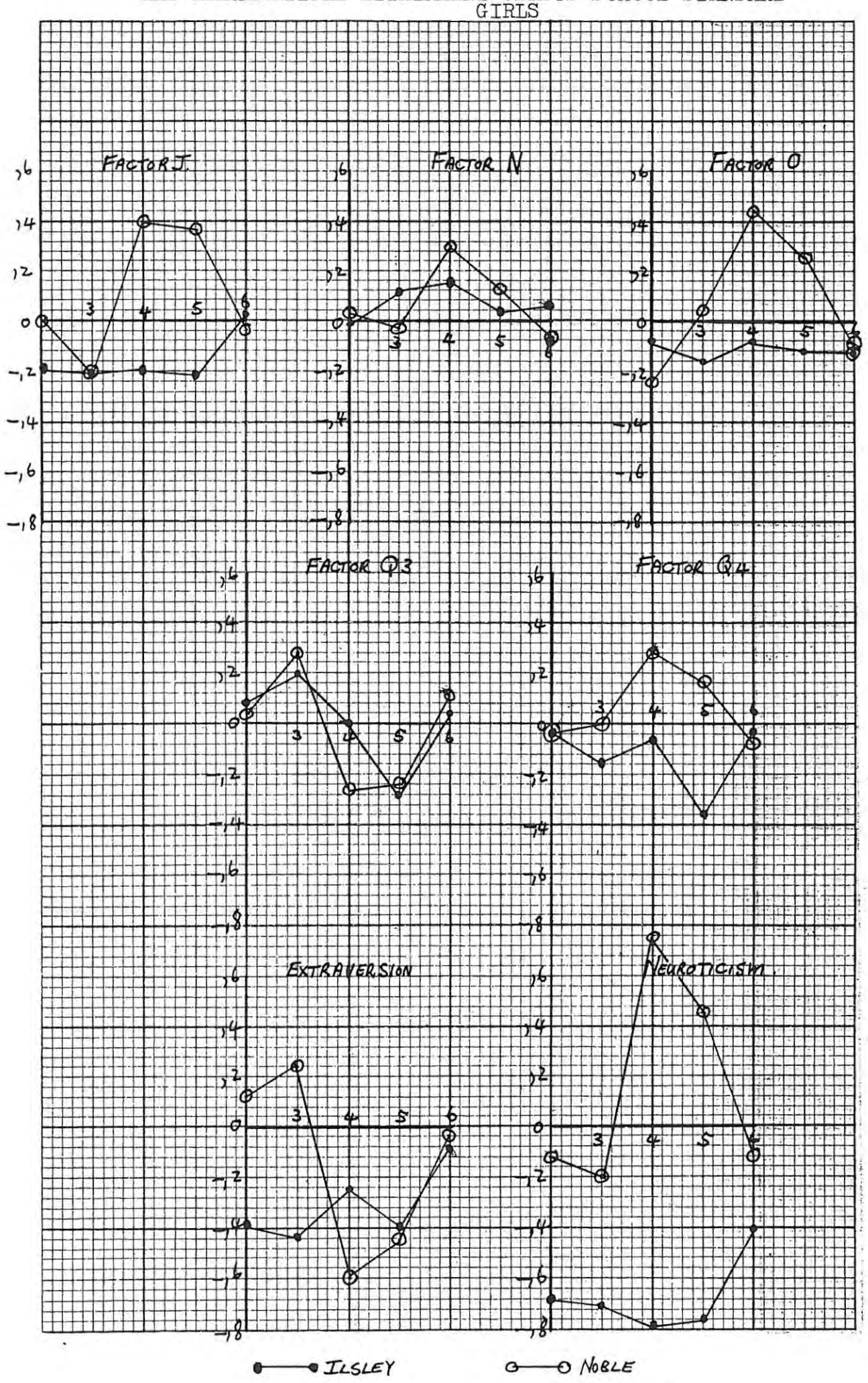


CORRELATION COEFFICIENTS BETWEEN PERSONALITY FACTORS AND MATHEMATICAL ATTAINMENT VERSUS SCHOOL STANDARD
GIRLS

Figure 2



CORRELATION COEFFICIENTS BETWEEN PERSONALITY FACTORS AND MATHEMATICAL ATTAINMENT VERSUS SCHOOL STANDARD
GIRLS



1.3 Attacking the problem

In my attempt at seeking reasons for these disruptions three approaches were used:

1.3.1 Study of the literature since 1977

Noble and Ilsley appear to have consulted the available and relevant literature on this subject up to 1976/77. (Lynn (1957); Biggs (1963); Child (1964); Cattell, Sealey and Sweeney (1966); Warbuton (1968); Entwistle and Cunningham (1968); Eysenck and Cookson (1969); Finlayson (1970); Entwistle (1972); Elliot (1972); Lewis (1973); Noble (1974); Orpen (1976).

Related literature has been consulted from 1977 to the present date. It would appear that no significant study of a similar nature has been undertaken since 1977. To date I have found no research undertaken or reports published to indicate any findings which contradict the results provided by Noble and Ilsley or which supply additional information on this problem.

1.3.2 Attitude survey

The children's attitudes to Mathematics was assessed by means of an attitude questionnaire. Individual responses were added together for each standard, boys and girls separately and thereafter totals were obtained for all the schools for each item on the questionnaire. Thereafter χ^2 was calculated for each item on the questionnaire to assess significant sex differences. These are supplied in Appendix 3.

1.3.3 Interviews with teachers

The teachers responsible for teaching Mathematics in Standards 3, 4, 5 at each of the schools were interviewed on two occasions for $\frac{1}{2}$ an hour each time after school hours.

The purpose of the first meeting was to inform the staff of the findings of Noble and Ilsley. They were then requested to give the matter some thought and to express their views at the second "brainstorming" interview when possible reasons for the disruptions would be sought and, if time permitted, discussed.
With the permission of these teachers, recordings were made at these discussion sessions for clarification purposes afterwards.

CHAPTER 2

RELATED RESEARCH

The general question asked by current researchers is "what is the strength of relationship between attitudes and achievement?" Although the answer to the question appears to indicate a low positive correlation (Crosswhite, 1972; Noble 1974;), researchers continue to ask the question. Apparently, the commonsense feeling that achievement ought to depend heavily on attitudes, stimulates the search for a clear, simple relationship between these variables - often, the hypothesis is that the relationship is causal, so that attitudes are investigated as predictors of achievement.

Noble (1974) set out among other things, to investigate the changes, with age, in Personality factors of school pupils and to investigate the correlates between these personality factors and mathematical attainment for this same school population. In this regard he quotes the findings of Cattell and Cattell (1969) who found that "although these factors (fourteen primary and four secondary) persist across the age levels, some of them change in magnitude according to age and sex."

Wade (1981) quotes Entwistle as pointing out that in the past "there has been much speculation about the relationship between instability and attainment. Research findings

have tended to show low negative relationships at Primary School level although there are indications of an age-related change which takes place in the later years of Secondary schooling."
Seddon (1977) suggests that interactions involving chronological age do appear to operate in the case of achievement.

Aiken (1970) however, makes a number of critical comments about previous research concerned with the determiners and effects of attitudes towards Mathematics.

The structure of attitudes towards Mathematics is unquestionably complex, and although achievement appears to be a major factor, there are 'other' factors that may mediate the way that attitudes form or change. A discussion of the findings of this study looks at these 'other' factors. (Chapters 5, 7.)

The measurement of attitude in Mathematics is done almost exclusively through the use of self-report scales. Although the increased use of well-developed scales by several researchers (as far back as Thurstone (1929) and more recently to Aiken (1972)) offers a common basis for comparing results; the lack of other approaches to measurement represents an area in obvious need of development. (Kulm, 1980)

The use of scales that claim to measure a concept as broad

as "Mathematics attitude" or "enjoyment of Mathematics" runs the risk of overlooking important attributes of Mathematics attitude and researchers need to be mindful of this when analysing the findings of such scales.

Bernstein (1964) maintained that if certain feelings are experienced for a time they will lead to a particular self-image on the part of the pupil - a self-image which will influence his expectations of future performance and affect his actual performance.

A teacher's low opinion of the student's ability is likely to result in an unwillingness to interact with, or to give help to, this particular student because neither course of action promises to help him cope with the problem. (Lorenz, 1982; Aiken, 1970).

The students' self-concept of their Mathematics ability seems to be a crucial construct in explaining differences not only in performance (Bloom, 1971) but also in their perception of task-relevant characteristics such as nervousness, motivation and classroom participation. (Lorenz, 1982; Wade, 1981). Mathematics self-concept, like any self concept, is formed by previous achievement and by the teachers' evaluation expressed explicitly or implicitly by his interaction mode.
"The motivational consequences of student's self-concept leading to a self-fulfilling prophecy are well known and

extensively examined by follow-up studies to the Pygmalion-effect research. (Brophy and Good, 1972, 1974.) Lorenz, 1982.) Although the methodology of research into "labelling" has been criticised, the practice of "labelling" nevertheless seems to be undesirable.

The attitude of parents would appear to be an extremely important factor in determining childrens' attitudes and achievement.

The Scottish Council for Research in Education Newsletter (May 1980) in discussing 'Some Dilemmas of Cognitive Development' points out just how important the role of parents is in determining their children's attitudes to cognitive growth.

1. "The first problem is that parents want their children to develop very different qualities. Some parents, who form a higher proportion of high socio-economic status than of low socio-economic parents, are much more likely than others to emphasise the importance of their children's developing intellectual abilities and interests ..."

2. " ... fostering the development of the other qualities valued by "successful" parents would, in general, seem to have more to do with the home than with the school ... it would not seem to be an over-statement to suggest that the values actually espoused by most schools are much closer to those of the parents who do not particularly value intellectual activity than they are to those of the parents who value independence, originality, and questioning authority ...."

3. " ... it would seem to be that the well-known correlation between children's life chances and their socio-economic backgrounds is more likely to be explained by the variation in the emphasis the parents place on developing these wider components of competence than to the variation in the emphasis placed on school work ... it would seem that parents are their children's most important educators ..."

Researchers quoted by Kulm (1980) have found the preschool aspirations and the influence of parental expectations and interest are potentially greater factors in guiding student success or failure than any single factor with the possible exception of intellectual ability.

Although it is certainly unfair to indict teachers too strongly as creators of negative student attitudes towards Mathematics, the results of research have suggested that the teacher perhaps even more than the parents, is an important determiner of student attitudes.

> "Whether a pupil found Mathematics interesting or boring, liked or disliked it, often depended upon his or her understanding of the subject. The teacher, and in particular the ability of the teacher to explain well, were of paramount importance."
>
> (Kiryluk, 1980)

Banks (1964) wrote

> "An unhealthy attitude toward arithmetic may result from a number of causes. Parental attitude may be responsible ... Repeated failure is almost certain to produce a bad emotional reaction to the study of arithmetic. Attitude of his peers will have their effects upon the child's attitude. But by far the most significant contributing factor is the attitude of the teacher. The teacher who feels insecure, who dreads and dislikes the subject, for whom arithmetic is largely rote manipulation, devoid of understanding, cannot avoid transmitting her feelings to the children ... On the other hand, the teacher who has confidence, understanding, interest, and enthusiasm for arithmetic has gone a long way toward insuring success."

Noble (1974) adds this thought from Warburton (1969) "The ignorance of educationists in the field of personality is in striking contrast to their ability to estimate educational and intellectual capacity", thereby confirming the thoughts of Behr (1979), that knowledge of the psychology underlying the formation of mathematical concepts (which includes personality and attitudes), in children is important.

Looking at High School and University level numerous researchers (Furneaux, 1962; Entwistle, 1972; Saville and Blinkhorn, 1976) all came to the same conclusion that introversion (i.e. low extraversion) is related to academic success. Banreti-Fuchs, (1972, 1975, 1976) has demonstrated significant relationships between various attitudinal, situational and mental health factors on the one hand and levels of academic achievement on the other. The results of these studies did not support the claims of Furneaux (1976), that there was a positive relationship between neuroticism and academic achievement, but the personality

picture of the achievers did confirm the findings of Lavin (1965); Entwistle and Entwistle (1970); Entwistle and Brennan(1971); and Entwistle (1972) who described achievers as essentially stable introverts. This contradicts Ilsley's (1978) remark that "there isn't any really contrary evidence presented but that a few Kline and Gale (1971) Cowell and Entwistle (1971) report no conclusive evidence for any relationship at all." One can safely accept that the older research must make way for the findings of the later research.

Entwistle (1972) presents a table which condenses Warburton's (1968) summaries of studies which have been done using Cattell's inventories. Warburton finds the same age trend noted by Eysenck and confirmed by Orpen (1976) and Wade (1981) that stable extraversion is positively related to academic achievement and success in the senior primary phase and that a change at approximately fourteen to a positive correlation with introversion occurs. (Anthony, 1977.)
Noble (1974) found poor mathematics attainment for extroverts in standards four and five (See p. 7 - 10) which is a surprising result in light of the above.

Wade (1981) reports on a study carried out in conjunction with cognitive tests of English, Mathematics and Reading. Results showed higher levels of attainment for highly anxious, highly motivated pupils (an inferred coping strategy of approach) than for highly anxious low

motivated pupils (an inferred coping strategy of avoidance).

In reviewing this section Behrens and Vernon (1978) have this to say:

> "Throughout the years there have been innumerable investigations of the correlations, either of achievement, or of achievement discrepancy scores with measures of emotional stability or neuroticism, positive or negative self-concept, anxiety; aggression, introversion, etc. (cf. Cattell et al., 1966; Entwistle and Entwistle, 1970). The correlations are usually small, and often contradictory. Sometimes, for example, the more unstable or anxious students achieve less well; but in other studies, anxiety is associated with superior achievement. The results differ with the age group concerned, and with sex, with socio-economic class, and with different intelligence and personality measures. Thus we are left with the conclusion that personality factors are important in determining children's achievement, but that there is little or no consensus as to which factors."

Noble and Ilsley's findings, however, clearly showed up very definite personality factors which are related to achievement. (See pp 5 - 10) Behrens and Vernon (1978 continue:

> "In almost all studies self-report personality or attitude questionnaires have been applied, and their susceptibility to social desirability and other response sets or distortions is well known (cf. Vernon, 1964). Teachers' ratings of student characteristics are even more unsatisfactory on account of halo effects."

CHAPTER 3

ATTITUDES

3.1 The Concept Attitude

3.1.1 Introduction

Gordon Allport (1897 - 1967) probably the most influential trait theorist, in his review of personality theories provided the basis for much subsequent theorizing about traits. His definition of traits as the basic units of personality organization became a classic. Defined in this manner as generalized dispositions to respond in the same way to similar stimuli, traits seemed to explain consistency in behaviour. More complex combinations of traits were called attitudes.

He considers attitudes as "probably the most distinctive and indispensable concept in contemporary American social psychology. No other term, "he says"appears more frequently in experimental and theoretical literature." (Kramer and Ullman, 1973.)

Allport points out that the reason for this popularity is that the concept of attitude is all things to all men. We need to take a closer look at the concept now and to explicate what the writer understands by the term attitude and its usage in this text.

3.1.2 The Nature of Attitudes

An attitude can be thought of as consisting of three basic components:

+ a belief
+ an emotion
+ an action-tendency.

3.1.2.1. The belief component

The belief component of attitudes may consist of sound factual arguments, generalizations, stereotypes, rationalizations of the person's previous actions, totally unfounded notions that were suggested by someone else, or even assumptions of which the person is unaware.

Bem (Krech, D. et al, 1974) has suggested that a helpful way to describe belief structures, presumably any belief structure, is in terms of their vertical and horizontal structures.

Vertical structure refers to the presence or absence of premises supporting the belief. For example: One should drink at least one glass of milk per day. This statement may be unquestioningly accepted as true and important. Such a belief is called a primitive belief. It is so called because it is not based on other, more explicit beliefs, but is given to the believer by someone whose authority is accepted. Primitive beliefs have no supporting premises - no vertical structure. A higher-order belief is based on a vertical structure of supporting premises and could be as follows:

Persons need about 0,8 grams of calcium per day to have strong teeth and bones.
Milk is extremely rich in calcium; a large glass of milk contains about 0,6 grams of calcium. Therefore, one should drink at least one glass of milk a day.

Because many of the beliefs held by young children are primitive, a rational attempt to dissuade the child of his/her beliefs cannot be effective; the arguments and reasoning are simply not relevant to the child's beliefs. Many attitudes held by adults are also primitive!

Horizontal structure refers to the presence or absence of independent and parallel premises supporting the same belief. That is, the same surface belief may have not only one but many different sets of vertical supporting arguments.

With the passage of time, higher-order beliefs may revert to primitive beliefs, well-reasoned premises on which they were originally based may fade from memory or lose their validity as new knowledge confounds old, leaving only the embraced conclusion.

3.1.2.2 The emotional component

Both positive and negative attitudes, almost by definition, involve our feelings and emotions. The emotional components of our attitudes may be learned through first- or second-hand experience with the objects of those attitudes or even through purely fortuitous associations between the

objects and other completely irrelevant events e.g. A child who has a frightening experience the first time he goes to school may learn to fear schools, and this may colour all the components of his attitudes toward school; his fear is based on his own immediate, direct experience with the object of his attitude.

Krech, D. et al (1974) show that we can acquire positive or negative feeling tones about entire ethnic groups through sheer, simple, meaningless juxtapositions and associations.

The emotional component can sometimes be the major determinant of the attitude, overriding all else. A striking illustration of this is found in an experiment conducted by Valins(1966) and reported by Krech D. et al(1974), which seems to indicate that a person's judgment can be led astray by misleading cues as to his own emotions. Even when someone is 'conned' into an emotional state, that emotional state takes over his judgment.

3.1.2.3 The action-tendency component

It is generally true that a change in beliefs and feelings about someone is usually accompanied by a change in behaviour toward that person. Just as a person may hold several incompatible beliefs and harbour irrational and indefensible feelings about objects, so can his behaviour be inconsistent with other behaviour tendencies or with his beliefs, feelings and emotions - in a word, with his attitudes.

It must be remembered that concrete behaviour with respect to a specific object results from the conveyance of many, different, and incompatible beliefs that accrue to the object, the many different, and sometimes contradictory feeling tones about the object; and the particular, momentary situation in which the behaviour occurs.

One of the first scales used to measure attitudes of pupils toward arithmetic was based on techniques invented by L.L. Thurstone. This scale developed in 1951 was widely used. The Likert-type scale was only used for Psychology and the Social Sciences. Dutton(1968) reports on the pioneering use of the Likert-type test on attitudes to mathematics.

The Primary School syllabus of the Cape Education Department for Mathematics makes provision in its aims for the development of affective goals of instruction in Mathematics. In this regard Aiken(1972) asked the question:

- How can these attitudes be measured?
- How is it related to individual differences in personality?
- How is it related to the attitudes of parents and teachers?
- How can it be realized?

The results of several studies (Journal for Research in Mathematics Education, Vol. 5 (1974) have led Aiken to conclude that there is a psychological dimension of 'enjoyment of mathematics' which encompasses not only liking for

mathematics problems, but also a liking for mathematical terms, symbols and routine computations. To this end he developed an attitude scale (M.A.S.) which measures the affective dimension fairly well. In it he evaluated children's enjoyment of mathematics (E scores) and value of mathematics (V scores).

Although a great variety of different aspects of attitude have been studied, it is possible to identify several categories that have received attention. These are:

a) relationships between attitude and achievement,
b) factors related to attitudes,
c) relationships between parent, teacher and student attitudes,
d) approaches to improving attitude,
e) various aspects of the attitudes of pre-service teachers and in-service teachers.

Reviews by Aiken (1970, 1976) and Fennema (1974) provide an excellent summary of the results of investigations in these areas.

3.1.3 The Relationship of Attitudes to Personality and Social factors.

3.1.3.1 Anxiety and attitude

Attitudes are affective variables, so some relationship between a measure of attitude and a measure of anxiety toward a particular school subject should not be unexpected. Anxiety and attitude may be either general or specific, pertaining to only one situation or event or to many.

Aiken(1970) says that in a number of studies during recent years, researchers (McGowan(1960); Reese(1961) have related scores on the Children's Manifest Anxiety Scales (Castaneda et al(1956)) - to performance in mathematics. Typically, these researchers found small but statistically significant negative correlations between manifest anxiety and achievement; these correlations were usually somewhat smaller in absolute value than the correlations between attitudes and achievements.

3.1.3.2 Intellectual factors

Although it has been observed that general ability to learn is associated with liking for mathematics (Brown and Abell, 1965), measures of anxiety and attitudes towards school subjects typically have rather low correlations with measures of intellectual ability. (Aiken, 1963; Dreger and Aiken, 1957; Lindgren et al, 1964); Banreti-Fuchs, 1978.)

3.1.3.3 Social factors

One possible social determiner of attitude towards mathematics is the attitude of one's peers. Shapiro's (1962) findings indicated that peer attitudes in elementary school

may indeed be influential, especially in the case of girls.

The fact that negative attitudes toward mathematics are not restricted to a small-school system is documented by McDermott (1956) in Aiken (1970), who found that the backgrounds of students who were afraid of mathematics ranged from one-room rural schools to large-city school systems.

Lindgren et al (1964) reported an essentially zero correlation between socio-economic status and Carey's (1958) measure of problem-solving attitudes. There is some evidence that higher mathematics achievement goes with a higher socio-economic environment (Cleveland, 1962) although higher socio-economic status is associated with higher intelligence levels.

According to Aiken (1970), Karas (1964) maintained that the home environment has a greater effect on performance in more verbal subjects than in subjects such as mathematics that are more highly loaded with less familiar symbolic material. Considering the positive relationship between attitude and achievement, one may perhaps generalize from Karas's findings that socio-economic status and perhaps other home factors have less effect on attitude towards mathematics than an attitude toward more verbal subjects.

3.1.3.4 Parental influences

Parents affect the child's attitude and performance in three ways:

1) by parental expectation of the child's achievement:- high and unrealistic expectations cause anxiety which in turn leads to a negative attitude, whilst low or no expectations can result in the child feeling that his parents do not care about his achievement.

2) by parental encouragement - which acts positively on the child's attitude to mathematics.

3) by parents' own attitudes - the attitudinal example which the parent sets for the child is important in determining the child's attitude.

Poffenberger and Norton (1959) found that students' attitudes toward mathematics were positively related to how they rated their fathers' attitude towards mathematics. The students' attitudes were also related to their reports of the level of achievement in mathematics which their fathers and mothers expected of them.

3.1.3.5. Sex differences

The results of the aforementioned investigations (e.g. Aiken and Dreger, 1961; Rees, 1961) suggested that measures of attitudes and anxiety may be better predictors of the achievements of females than of males. More specific to sex differences in attitudes towards mathematics are Dutton's findings (1968) that girls and boys who had studied "new math" were about equal in their liking for mathematics. Noble (1974) found positive and significant linear relationships between Mathematical ability and attitude for 14 - 17

year-olds. For 14 and 15 year-olds, the relationships between mathematical and arithmetical ability and attitude were greater for girls than boys and in some instances the differences were significant.

Furthermore, Noble (1974) found that boys (ages 14 - 15 years) show themselves to be superior in Algebra, Geometry and Graphs and that the relationship between attitude and ability is greater for girls than for boys for these sections of the syllabus in this age group.

3.1.3.6 Teacher characteristics, attitudes and behaviour
It is generally held, says Aiken (1970), Banks (1964), that teacher attitude and effectiveness in a particular subject are important determinants of student attitudes and performance in that subject.

It is also true that students who do not do well in a subject may develop negative attitudes toward that subject and blame their teachers for their failures, even when the teachers have been conscientious. The findings of Aiken and Dreger, (1961) support this.

There appears to be consensus, (Wilson, 1961; Clarke, 1961; Bernstein, 1964,) that

> "children are often confronted in school with situations which few adults would tolerate. Day in and day out there is repetition of meaningless expressions, terms, and symbols.

> Eventually, many children come to dislike arithmetic. Lack of understanding and skills is associated with personality maladjustments and delinquent behaviour, including truancy and incorrigibility."

Lyda and Morse (1963) noted positive changes in attitudes toward arithmetic and significant gains in computation and reasoning when a 'meaningful method' of teaching rather than rote learning the subject was employed. Long-term motivation and realistic levels of aspiration are heavily dependent upon success in Mathematics - so often lacking.

CHAPTER 4

RESEARCH DESIGN AND EXPERIMENTAL PROCEDURES

4.1 General Aims

This research was concerned with boys and girls from standards three, four and five. Their results were analysed separately so that possible sex differences could be detected for all aspects of the investigation. The purpose of this study was to:

(i) determine the polarity (either positive or negative) of the attitudes that the sample had toward mathematics as measured by the modified attitude questionnaire based on that of C.A. Riedesel and P.C. Burns (1977).

(ii) attempt to find reasons for the disruption at the Standard 4 and 5 level in the correlation pattern between certain personality factors and mathematical attainment for boys and girls as found by Noble (1968) and Ilsley (1977) by analysing the responses to particular test items.

4.2 Descriptive Research

The term longitudinal is used to describe a variety of studies that are conducted over a period of time. Some short-term investigations may take several weeks or months; a long-term study can extend over many years.

Where different respondents are studied at different points in time, the study is called cross-sectional.

In education, cross-sectional studies involve indirect measures of the nature and rate of changes in the cognitive, affective and psycho-motor areas of development of samples of children drawn from representative age levels. Furthermore, a cross-sectional study is one that produces a 'snapshot' of a population at a particular point in time.

> "The single 'snapshot' of the cross-sectional study provides the researcher with data for either a retrospective or a prospective enquiry." (Cohen and Manion, 1980).

In this study, it was more convenient to do a cross-sectional study as Ilsley also did due to:

(i) the time factor involved in a longitudinal study

(ii) cross-sectional studies are cheaper

(iii) there was the problem of sample mortality. It was not possible to locate the members of the original samples used by Noble (1974) and Ilsley (1977).

(iv) Using a cross-sectional study provided findings more quickly.

(v) It was important to gauge the attitudes of pupils to mathematics in a particular age group. Using a longitudinal study such information from this age group was not possible.

It should be noted that cross-sectional studies make the assumption that when two groups, one of which is on average a year older than the other, are studied - that the younger group would behave as the older group presently does if the younger group were studied one year later.

4.3 Sample

Convenience sampling was used in an attempt to explicate the earlier studies by Noble and Ilsley. English-medium pupils in Port Elizabeth of similar socio-economic, language and cultural backgrounds to these earlier studies were chosen. Like Ilsley's study, this study used children from both single-sex and co-educational schools but supplies information only on the co-educational schools. All of the schools are primary provincial schools and all have English as their medium of instruction. By consulting the list of primary provincial schools in Port Elizabeth these criteria resulted in an initial 9 schools being chosen.

The final numbers of pupils involved in all phases of the testing were as follows:

Table 1

Distribution of Sample

	Standard						
	3		4		5		
School	B	G	B	G	B	G	
1	45	42	46	39	32	36	
2	18	23	24	17	21	16	
3	51	55	45	61	68	45	
4	14	12	21	5	14	7	
5	14	20	37	29	25	21	
6	64	49	56	45	46	56	
7	-	68	-	81	-	86	Not included in the totals or discussions
8	-	62	-	67	-	64	
9	104	-	114	-	104	-	
Totals	206	201	229	196	206	181	

Sample Total boys + girls = 641 + 578 = 1 219

4.4 Questionnaire

In this study preference was given to a Likert-type scale rather than a Thurstone-type or a Semantic Differntial type because:

1) It was easier to construct;
2) Most researchers appear to give preference to it as a more reliable instrument. (Aiken and Dreger, 1961; Aiken, 1963; Adams and Von Broek, 1967; Shaw and Wright, 1967; Dutton and Blum, 1968.)

As a basis, the Riedesel Inventory of Children's attitudes toward Mathematics (RICATM)(1977) was used. Adaptations were made to suit the circumstances of this study. No standardised South African attitude tests for Mathematics appear to exist. At least none are listed in the HSRC catalogue.

The revised questionnaire (Appendix 1) as administered in the classrooms is concerned with various factors that have an effect on children's outlook concerning mathematics. In the words of Kulm (1980) " ... the researcher must identify and define clearly the characteristics to be measured."

Categories of attitude measured by the Pupils Questionnaire

1. Overall attitude toward mathematics. Part A: Items 1
2. General attitude toward school mathematics. 53 - 62
3. Specific attitudes toward mathematics.
   - 3.1 Liking for mathematics 8, 12, 22, 25, 27, 29, 33, 45, 49.
   - 3.2 Usefulness of mathematics 4, 15, 19, 23, 26, 31, 37, 39, 44, 50.
   - 3.3 Anxiety concerning mathematics 3, 10, 18, 24, 32, 35, 40, 46, 48, 52.
   - 3.4 Interest in mathematics 5, 9, 16, 21, 41.
   - 3.5 Ability and achievement in mathematics 7, 13, 20, 30, 34, 36, 38, 43, 47, 51.
   - 3.6 Understanding of mathematics 6, 14.
   - 3.7 Preferences 2, 11, 17, 28, 42. Part C.
4. Other variables
   - 4.1 Peers Part B: Items 1 - 5
   - 4.2 Methods and Materials 6 - 14
   - 4.3 Family variables 15 - 22

The questionnaire is in three parts. Responses on Part A are of the Likert type.

In the response section allowance was made for only four responses instead of the usual five which occur in a Likert-type questionnaire. The middle response 'uncertain' or 'have no opinion' was excluded. This was done to ensure

that the pupils showed either a liking or dislike for each particular item and did not avoid the issue by choosing the "Uncertain" option.

Part B responses are either true or false, whilst Part C responses which aimed at ascertaining preferences and attitudes to specific section of the syllabus were of the Likert-type again.

4.5 Refining the questionnaire

The initial modification of the RICATM was administered to one class of each of Standards 3, 4 and 5 at one school. In each case the class teacher assisted the writer to check on the time required for each subtest in the classes and to record any queries which the pupils might have had. Where more than 5% of any class queried the same statement, this was noted and such items were replaced with differently worded statements to "overcome problems of readibility and interpretability." (Riedesel, 1972.)
Verbal comment was obtained on the presentation of the questionnaire.

It was felt that the size of the print was sufficiently large for Standard 3, 4, and 5 and if any changes were effected it could be reduced somewhat. The general consensus was that the questionnaire should be reduced in length - from 10 pages to about 5 pages. To achieve this it was decided to slightly reduce the size of the print and to type across the width of the paper rather

than across the length of the paper.

4.6 Application of the questionnaire

4.6.1 The pupils

All testing was done during the latter part of August and the early part of September 1983. Schools were supplied with the required number of questionnaires to give each pupil in Standard 3, 4 and 5 a copy. Teachers would conduct the test. This was so arranged for the following reasons:

(i) to complete the testing in as short a time as possible in the light of the sample size;

(ii) to ensure that my presence would not act as an inhibiting factor on the pupils' responses;

(iii) class teachers are aware of the individual differences of children in their classes (e.g. reading problems, immigrants with language problems, etc.) and would probably be in a better position to cope with the testing.

4.6.2 The teachers

Class teachers were each given a printed set of instructions for the administration of the questionnaire. (Appendix 2) This was done to ensure as far as possible, uniformity of application throughout the sample. They were requested to

apply the questionnaires as early in the day as possible but outside of school hours. This was done in order to make allowance for fatigue among pupils and to keep the test conditions as similar as possible for all schools. Schools agreed to administer the tests before the school day started to comply with the instructions of the Education Department.

4.7 Interviews with Teachers

The total number of teachers interviewed were in the sex ratio 1:1 and had predominantly Teacher College qualifications to teach mathematics. They represented middle class society and were therefore akin in this respect to the pupil sample of this study. Most displayed enthusiasm for the study and co-operated willingly. Interest in the outcome of this study has been expressed by most of them.

Teachers were interviewed on two occasions after the questionnaire had been administered. Both interviews were held after school hours and only teachers of the standard 3, 4 and 5 classes were involved. This was done to ensure that the routine academic day was not disturbed and to cause little general disturbance to the school's extra-mural programme.

At the first session of 30 minutes, I briefed the teachers on the disruptions in the patterns of the correlation coefficients between certain personality factors and

mathematical attainment which Noble (1974) and Ilsley (1977) had found in their research and that I was attempting to find trends and reasons for these pattern disruptions. Teachers were requested to think about this matter in the light of the response patterns to the pupils' questionnaire they had administered. Questions were answered as far as it was possible to do so.

At the second interview also of 30 minutes a brainstorming session was held. I took the chair at these sessions and in each school the entire session was tape-recorded. This was done with the permission of the staff present and to ensure that I could refer back authoritatively to the discussions when reviewing and analysing the session.

4.8 Scoring

4.8.1 The questionnaire

"Strongly agree" and "agree" were taken as the same response. Totals were obtained for both the "agree" side and the "disagree" side for each sentence.

(a)
Each sentence was classified as either positive or negative. High "agree" scores on the positive sentences and high "disagree" scores on the negative sentences were to be seen as a positive attitude to mathematics (Part A and B) whilst high "disagree" scores on the positive sentences and high "agree" scores on the negative sentences were to

be seen as a negative attitude to mathematics (Part A and B). Each item on Part C would be assessed as having either a positive or negative acceptance by the pupils for each standard.

The scores of boys and girls were kept separate to indicate possible sex differences. χ^2 calculations were made for each sentence to ascertain the degree of significant sex differences. A short computer programme was written to facilitate these calculations. (Appendix 4). This was based on the formula:

a = boys agree

b = boys disagree

c = girls agree

d = girls disagree

N = a + b + c + d.

$$\chi^2 = \frac{N(ad-bc)^2}{(a+b)(c+d)(a+c)(b+d)}$$

e.g. (p88 - item 1)

	Boys	Girls	Total
Agree	202	161	363
Disagree	27	35	62
TOTAL	229	196	425

$$= \frac{425\ (7070 - 4347)^2}{(229)(196)(363)(62)}$$

$$= 3,12$$

The totalled results of the pupils' answers are given in Appendices 3.1 - 3.4 on pages 84 to 94 inclusive.

Thereafter the χ^2 readings were read off on Fishers Tables.

(b)

Then each questionnaire item was related to the CPQ.

This was done as follows:

A panel of 7 teachers (a convenience sample) who were prepared to assist were each given a copy of the Personality factors as listed in Chapter 1 and a copy of the Questionnaire. They were then asked to link each Questionnaire item to a Personality factor without any discussion. Thereafter the group came together and compared their results. After discussion, consensus was reached. The final consensus product is shown as Appendix 5 on page 98 - 100.

In the light of this relationship and the significance of the sex differences on the responses as evidenced by the magnitude of the Chi-square, comment and some explanation could sometimes be made on the findings of Noble and Ilsley. Comments are recorded in Chapter 5.

CHAPTER 5

RESULTS OF THE ATTITUDE SURVEY

5.1 Initial suspect areas

After total scores (pages 85 to 95) had been found in each standard for each item the results either on the "agree" or "disagree" side were examined. In most cases the responses were as hoped for, namely that there would be a majority response for a positive statement and a minority response for a negative statement.

This, of course, was not true in all cases. The findings on the following items at first glance appeared suspect because there was a predominance of responses to a negative statement or a dearth of responses to a positive statement. These suspect areas were considered prior to the calculation of χ^2.

In the following discussions the reader is referred to pages 7 - 10 when either Noble or Ilsley are mentioned.

Part A - item 2 was linked to factor G. (See p. 98). Ilsley found a change to negative and significant correlations for standard five boys and girls. Noble found a change to negative and significant correlations for Standard 5 boys and standards 4 and 5 girls.

The questionnaires revealed that girls in standards three, four and five favoured the softer option of easy problems rather than long interesting ones. The χ^2 calculations

revealed highly significant sex differences in the three standards combined, at better than the 0,1% level of possibility.

Part A - item 5 was also linked to factor G. Ilsley's findings for standard five boys and girls and Noble's findings for standard five boys appear to confirm the findings of this study that boys and girls in standard five (See Table 2. p. 51) generally do not work extra mathematics problems either for enrichment or their own edification, if not assigned by their teachers. The teachers' comments (schools C, D, G) probably supply the reason for this - "volume of work expected of these pupils in standard five is too great."

Part A - item 13 was linked to factor B on which Noble found a negative break in the correlations in standards four and five for boys and girls, and Ilsley who found a negative break in the correlations in Standard five for girls only. Here all the groups (boys and girls in all three standards) responded contrary to expectation. On the χ^2 calculations a significant sex difference at the 5% level of probability was only found in Standard four. (See Table 2. p. 51). What emerges as interesting, however, is the fact that these responses contradict part C of the questionnaire where preference is given to all sections of the syllabi and which negates the teachers' feelings (schools D, E, F, G) that the syllabi are too difficult for the respective age groups.

Part A - item 16 was linked to factor F on which Noble found a negative break in the correlations for standards four and five boys and girls and Ilsley who found a negative break in the correlations for standard four boys; a positive break for standard four girls and a negative break for standard five girls. On the χ^2 calculations significant sex differences were found at the 1% level in standard four and at the 5% level in standard five. This seems to agree with the findings of Noble and Ilsley. No significant sex differences were found in Standard three. In all cases the majority of pupils disagree that Mathematics receives more interest than other school subjects. The teachers (schools A, B, C, G) have highlighted the differences in approach and attitude and enthusiasm to Mathematics at primary school level between female and male teachers which in turn influences the attitudes of the pupils. It seems that in many schools female teachers with a negative orientation are found in charge of standards four and five.

Part A - item 20 was also linked to factor B. Here the findings of Noble and Ilsley both confirm the responses of the Standard four and five girls. Further confirmation comes from the χ^2 calculations where highly significant sex differences were found in standard four at the 0,1% level of probability and in standard five at the 5% level. On the raw scores the majority of girls only in Standards four and five agreed with this statement. Mathematics merely lowered their aggregates. This is confirmed by item 36 where the majority of pupils in standards four and five reported that their mathematics marks are lower than the marks for other subjects. (Table 2. p.51.)

One can speculate that this is due to a self-fulfilling prophecy, to poor teaching or other reasons.

Part A - item 30 was also linked to factor G. Significant sex differences were found in standard four at the 1% level of probability and in standard five at the 0,1% level of probability which correlates well with the findings of the former studies. This attitude of despairing or expediency was expressed by the majority of boys and girls in all the standards. Teachers (schools A, C, D, F) blame this defeatist attitude respectively on:

- incorrectly practised differentiation or no differentiation at all;
- poor attitudes in standards four and five are the results of incorrect practices in the lower standards;
- attitudes of the pupils are directly related to the attitudes of the parents;
- self-fulfilling prophecy which comes from the generally held stereotype that girls cannot do mathematics.

Part A - item 36 was also linked to factor B. Here significant sex differences were found in standards three and four at the 1% level and in standard five at the 5% level of probability. These findings seem to agree with those of Noble and Ilsley.

Part A - item 42 was also linked for factor F. The significant sex differences in standard four at the 5% level of probability is confirmed by the findings of Noble and Ilsley. It is interesting to note that in all cases, except for the standard four boys, there is no desire to

belong to a mathematics club. By implication then, they feel no need for the stimulation, specialization, socialization or challenge that such a club can provide. Is it possible that this is a sign of complacency? And that complacency leads to poor mathematics attainment?

Part A - item 43 was again linked to factor B where the highly significant sex differences in standard three and four at the 0,1% level of probability confirms the break Noble found among standard four boys and girls. The results show that in all three standards, the girls especially report a need to work hard at Mathematics which indeed confirms the break in the correlations which Noble found.

Part A - item 49 was again linked to factor F. It is interesting to note the highly significant sex difference at the 0,1% level of probability in standard four and which seems to confirm the results of both Noble and Ilsley for this factor. The raw responses indicated that the majority of girls in both standards four and five do not consider Mathematics to be one of their favourite subjects despite the χ^2 for standard five not indicating any significant sex difference. At this stage the question invariably starts emerging: "Does the attitude or decision among girls to dropping Mathematics as a subject at the end of standard seven not have it's foundations here in standard four?"

Part A - item 52 was linked to factor C. Highly significant sex differences were found in standards four and five at the 0,1% level of probability. These differences seem to corroborate the findings of Noble in standards four and five and of Ilsley in standard five. By implication then the majority of standard four and five girls feel uncertain about working Mathematics. Again the inevitable question arises as in the previous item:
"Does this attitude lead to girls dropping Mathematics as a subject at high school?"
An affirmative answer was given by the teachers at schools E and F.

Part A - item 59 was also linked to factor C. From the raw scores the majority of boys in standard five said that schoolwork does cause tension for them. Highly significant sex differences were found in standard five at the 0,1% level of probability. This result ties up in part only with Noble and Ilsley who also found correlation breaks in standard five. The teachers ascribe this to:

- pubertal disturbances (School C)
- outside pressures e.g. extra-murals etc. (School B)
- parental responses to children e.g. "I cannot help you." (School D)
- motivation (School D)
- distractions (School G)

Part B - item 4 was linked to factor F. Here the responses of the children corroborate the findings of both Noble and Ilsley. Significant sex differences were found in standard five only at the 5% level of probability. The pupils view mathematics as not being one of the favourite subjects of their friends. This means that pupils especially girls do not see Mathematics as being a favourite subject for themselves (Part A - item 49) or of their friends. Hence a general sentiment that Mathematics is not a favourite subject.

Part B - items 6 and 7 Both were linked to factor J. The significant sex differences in standards four and five at the 5% level of probability confirms the results of both Noble and Ilsley for this factor. From these results it becomes abundantly clear that very little group work is being done in standards three, four and five. Furthermore there is a need for more class discussion as reported by both boys and girls in all three standards. These factors endorse, I believe, the fact that mainly classical teaching is being done in these schools and this belief together with the suggestion of school A that "we are not feeling the true effects of differentiation yet" must indeed be seen as a factor responsible for the breaks in the correlations. The teachers themselves have confirmed by their admissions regarding these matters that they:

- have insufficient time for preparation as there are too many demands on their time. (School A)

- there is too little time to cover the great volume of the syllabus. (School C)
- group work is not done - the teachers assume too much about the children's capabilities. (School D)
- slavish use of the textbook. (Schools E and F)
- lack of adequate teacher training. (Schools F and G)

Part B - item 11 was also linked to factor J. Sex differences were only found in standard four at the 5% level of probability although the responses indicated that there are problems in standards 3, 4, 5 among both boys and girls in regard to the use of the textbook. There is a clear indication that the mathematics being taught in these schools is text-book orientated and certainly links up with the remarks of items 6 and 7 above.

Part B - items 21 and 22 were both linked to factor N. No significant sex differences were found. However, the responses indicate a definite shift in assistance from the mother (for both boys and girls) in standard three to greater help from the father in standard four. By standard five, parental assistance both from father and mother has diminished considerably to a negligible degree. This is also confirmed by the teachers:

- parental assistance ceases in standard three (School B.)
- parents are unable to help - their "old methods" confuse the children. (School D.)

- parents use "old terminology" (School E.)
- working parents - no time to help. (School F.)
- 'weaning' of parents in standards four and five - unable to assist any longer.

5.2 Further possible problem areas

(See annexures 3.1 to 3.4 on pages 85 - 95 inclusive) These areas have not been discussed under 5.1 above and represent items which indicate sex differences at significant levels of probability.

5.2.1

TABLE 2

Summary of the significant levels of probability of Sex Differences in the responses of parts A and B of the pupils' Questionnaire.

5%				1%				0,1%			
Item:	in standard	3,	4, 5	Item:	in standard	3,	4, 5	Item:	in standard	3,	4, 5
Part A -	3		5	Part A -	7	3		Part A -	3	3	
	4	3			10		4		4		5
	6		5		12		5		9		5
	7		4		16		4		10		5
	8	3			18		4		11		4
	9	3			33		4		14	3	
	11	3			44		4		18	3	
	16		5		50	3			21		4
	19		5		56	3			22		4
	21	3			62		4		25		4
	24		5	Part B -17			4		27		4 5
	25	3			18		4		28		4
	26	3							32		4
	28	3							33	3	
	32	3							38		4
	37	3	5						45	3	4
	38	3							46	3	
	40	3	4						47	3	
	46		4						53	3	5
	55		5						56		4 5
	57		4						57	3	
Part B	1	3							61		5
	8		4					Part B -	3		4
	12		4						9		4
	19		4						10	3	
									17		5
									18		5
									19		5
									20		5

From the above summaries it becomes adequately clear that there are sufficient items (covering the spectrum of the personality factors linked to these items) to indicate significant and highly significant sex differences in Mathematics between the boys and girls of this sample and that these sex differences bear on the sex differences found by Noble and Ilsley in their correlations.

5.2.2 Summary of the significant levels of probability of sex differences in the responses to Part C of the Pupils' Questionnaire.

TABLE 3

	5% level		1% level		0,1%	
	Item No	Description	Item No	Description	Item No	Description
STANDARD THREE	6	Money				
	8	Length				
	14	Common Fractions				
	15	Geometric Shapes				
STANDARD FOUR	5	Multiplication	4	Subtraction	14	Graphs
	6	Division				
	8	Length				
	9	Common Fractions				
	11	Perimeter				
STANDARD FIVE	2	Addition			18	Area
	8	Notation and Place Value			19	Points and lines
	11	Multiples			20	Angles
	15	Ratio and Proportion			22	Scaling
	17	Perimeter				
	21	Circle				

Although only significant at the 5% level of probability it is interesting to note that the sex difference is indicative of common fractions being a problem area in both standards three and four (confirmed by schools A, D, F, G) and that the basic operations present a problem in standards four and five together with a basic concept like notation and place value. It would seem from the teachers' comments that all these problem areas are probably due to a lack of a concrete-operational approach in the lower classes. (Schools A, B, C, D, E, F, G). Teachers are assuming that the children have been "doing the basic operations" since sub-standard A and have therefore mastered the concept and do not need the concrete when learning more advanced procedures of these concepts. It would be fallacious to accept that a concrete-operational approach is being used in all classes below standard 1 when new concepts are taught - such children will therefore need a concrete-operational approach in the higher standards, and if this is not done then problems will and do occur. The need for a concrete-operational approach depends upon the particular topic being studied but the change from concrete-operational to formal-operation thinking probably takes place later than is generally accepted by teachers and is task dependent. (See figure 3, p. 69 .)

CHAPTER 6

RESULTS OF INTERVIEWS WITH TEACHERS

6.1 Introduction

The following discussion must be seen as the personal, subjective remarks, thoughts and opinions of the teachers who were interviewed. Many of the arguments they raised can be seen as generalizations and are probably very debatable and will need empirical verification. However, these are the suggested reasons for the disruption in the correlation coefficients (between Personality factors and Mathematical attainment versus School Standard) by the people at the "chalkface" and need consideration.

These discussions are available in unedited form on the original tapes in the possession of the writer. If interested researchers send four 60 minute tapes to me, I can copy the tapes for them. Where quotations are given in this chapter they are referenced as follows:

The initial letter refers to the school and the digits following refer to the counter number on the tape machine e.g. "Teachers follow the sequence of the textbook and not the sequence of the syllabus." (C. 39 $\longrightarrow$) The arrow following the reference indicates the commencement of a discussion either preceding, following or encompassing the quotation.

6.2 Previous explanation

Ilsley and Noble have listed some possible explanations (not in order of importance) of the breaks in the patterns as follows:

6.2.1 "A change from the class-teacher to a subject specialist usually occurs at the standard four or five stage and with the exception of all-girls' schools this very often means a change from a female to a male teacher."

The interviews showed that teachers who specialised in a subject were probably chosen to teach the subject because of their interest and ability in and enjoyment of the subject. Because of this, such teachers probably placed great emphasis upon achievement and success in the subject. The feeling was expressed that male teachers were inclined to take the understanding of concepts and procedures for granted while female teachers were generally more helpful and inclined to "mothering". They "carry" the children. Adapting to this shift in approach can be unsettling for the children. Discipline exercised by the male teachers is probably more restrictive and inhibiting as well.

6.2.2 "The mere fact that they are the top of the class and seniors in the school, must work itself out in their attitude to school and schoolwork in one way or another."

Teachers felt that children appeared to display a shift in their attitudes during the standard five year. Initially they are self-confident, even "bossy", precocious to a degree and then towards the fourth term they display a certain hesitancy and doubt about the following year. "Some even fear the unknown of Standard six." (B. 40 ⟶) Three schools felt that girls' attitudes particularly at the end of standard four seems to affect all work and not only mathematics. Is it because they are looking ahead to their future role in life?

6.2.3 "Possibly they have simply reached a stage where they question for the first time the value of what they are doing, and perhaps the 'glamour' of school is receding and thus leads to this marked alteration in attainment for the various personality types."

The teachers who were interviewed reported that children do sometimes question the validity of Mathematics. They have a need to know how the Mathematics they are learning about, can be applied to their lifeworld experiences. The children are mature enough to reason thus. Confirmation of this can be seen in their responses. (Questionnaire: Pt. A; Items 4, 9, 15, 19, 23, 37, 44, 50, 62, etc.)

6.2.4 "Standard five is the last year in the primary school and most pupils must feel somewhat uncertain about the unknown senior school career that lies ahead and this could have some effect on their attitude towards schoolwork, and Mathematics in particular ..."

This explanation has been confirmed by the teachers whom I interviewed. (See 6.2.2 above.)

6.2.5 "At the Standard four or five level it is common for the class averages for Mathematics and other subjects to be reduced by the schools in an attempt to bring the primary school allocation and awarding of marks 'into line' with those of the high school. This could of course have a disturbing effect as the pupils might tend to feel thwarted in their scholastic attempts."

The teachers felt that this indeed led to a lowering of children's expectations for themselves. A self-fulfilling prophecy which resulted in lowered achievements.

6.2.6 "Noble (1974) feels that possibly parental attitude changes at about this age level and that "Parental interest in schoolwork can

> decrease in Standard four as changing syllabus content and teaching methods make it increasingly difficult for parents to coach their children at home. At the same time parents are granting more independence and freedom to their children, while demanding a greater sense of responsibility from them."

Teachers confirmed that parental assistance ceases in standard three or four. This is also confirmed by the children's responses on the questionnaire (Pt. B items 21 22). The reasons for this are that parents are unable to assist the children because the different methods and terminology used by the parents and teachers are confusing.

Then there are the working parents who are physically absent from home for most of the day and who are unable to assist.

Parental expectations of children, at this age particularly of the eldest child, are often unrealistic and demanding. Furthermore pressures are placed on children to live up to stereotypes and to achieve at mathematics, often beyond their capabilities to "succeed in life", or "for acceptance at such-and-such a high school". This situation is aggravated by the middle and upper socio-economic pressures in society to succeed and achieve.

The reaction and attitudes of parents towards their children during puberty also affects the children's academic progress. The teachers feel that the parents' attitudes directly influence the children's attitudes and that "the quality of time spent together is far more beneficial than the quantity of time spent together."

6.2.7 "The imminence or onset of puberty is a factor which is fairly likely to have an effect on scholastic attainment. If this is so, then it would be expected that girls would exhibit this tendency earlier. With the present study this is exactly what was found, as the breaks in the pattern of the correlation coefficients occurred earlier for girls than for boys in six of the factors ... "

This trend as reported by Ilsley was confirmed by the interviewees. Where they noted pubertal disturbances, these were earlier for girls than boys; e.g. A particular trend like passing notes in class was noticed among Standard four girls and only among boys at the end of Standard five. Some teachers reported that these changes came suddenly rather than gradually e.g. "One day I suddenly realised that Mary was "lustig and lastig" (C. 306,5) Allowance must be made for cases where the teachers' perception suddenly sharpened.

Family crises seem to reflect more obviously on the child emotionally at puberty. The child seems to become supersensitive and introverted. The children's reactions at this stage then vary tremendously - They do not ask questions in class about work they are uncertain of nor do they wish to draw any attention to themselves and their academic progress suffers. The parental expectations of the child at this stage seem to him/her to be too great or demanding - this causes frustration and anger.

One school felt that any form of motivation would probably negate these pubertal distress reasons.

6.2.8 "Noble (1974) quoting Skemp, feels that as far as the content of the primary Mathematics syllabus is concerned, " ..... the order of presentation of material can present psychological difficulties in learning Mathematics."

Ilsley has taken this thought a step further in referring to Bruner who stresses the need for a theory of instruction being concerned with:

- the nature of the knowledge to be learned
- the nature of the learning process
- the individual children

and that the interaction of these three factors is likely to be so complex that "every learning situation for every child must be regarded as unique."

The teachers have reported that they see the syllabi as being

- too comprehensive
- too difficult.

They feel that the school year is much too short to cover the entire, prescribed syllabus and that work is often skimped and neglected "to get through the syllabus." Teachers often assume children 'know' things and rush on to new work causing frustration, anxiety and a sense of incompetence. The prescribed items are often too difficult for the children to understand. Regarding the sequencing of items it appears that teachers slavishly follow the textbooks with a general disregard for logic e.g. that 'money'

should follow 'decimals'. This is not so in the Standard three syllabus of the Cape Education Department and some Standard three text books. - (e.g. Swartz, J.F.A., et al. Mathematics 3. Nasou Ltd, Goodwood, 1980.)
There appeared to be differences of opinion for example on when an item like fractions should first be introduced. Some teachers feel that a child in the sub-standards needs to know what a half is - he needs it in his daily lifeworld experiences; other teachers felt fractions are a difficult concept to master and should only be introduced much later. Haim Ginott is quoted as saying that fractions ought not to be taught before the age of 12.

6.2.9 " ... is the possibility that the general development of the child might follow the patterns as described above. The breaks in pattern that were found, recurred for eleven and twelve year old children, and this is precisely the stage at which, according to Piaget's theory of cognitive development, they change from the concrete operations to the formal operations stage ..."

Here the teachers examined their own approaches to teaching the subject and their comments revealed that general teaching methods are very possibly a major cause of the disrupted correlations. The reasons behind the faulty teaching methods are discussed later in this chapter. Teachers are not taking cognizance of Piaget's theory of cognitive development in their preparation and presentation of Mathematics.
They report that "difficult to understand" concepts are presented in a for too abstract manner.

"Concrete aids are not used and nobody is going to enjoy something that is abstract all the time." (A. 10)

"Differentiation is not practised in the upper standards.

Group work is needed to give a one-to-one relationship which introverts need." (B175 ⟶)

"Lack of group work in the lower standards leads to poor attitudes which only surface in Standards four and five." (C. 230 ⟶ and D. 169 ⟶)

"I'm having to work from a book more or less to try to get through the syllabus, whereas I would much rather do more concrete stuff like experiments around the school."

This was said by a teacher in charge of a Standard five gifted class. (E. 68 ⟶)

One teacher referred to the research done by the Concepts in Secondary Mathematics and Science (CSMS) team under K.M. Hart and based at Chelsea College, University of London. (Hart, 1981) This team aimed at developing a hierarchy of understanding in Mathematics which could provide information for teachers and other developers of curriculum.

This teacher quoted Hart as saying that there are still children at age 16 who are in the counting stage, and "we are expecting children at age 13 to do abstract work." (D. 242)

Hart writes: "Fifty percent of our secondary child population ..... can cope with new terminology and first operations in elements e.g. addition of fractions. They can deal with problems that require only one or two steps for a solution, but any demand for abstraction or even the formulation of a strategy for solution is beyond them."

At this stage we need to consider very briefly recent criticisms of Piaget as the C.S.M.S. team were influenced by Piaget.

Cohen (1983) accuses Piaget:

(i) of placing too much emphasis on the cognitive at the expense of the affective which is also necessary in the mathematics classroom.

(ii) Furthermore he has this to say about Piaget:

"It is also telling that, after 1940, Piaget concentrated so much on thinking and on perception largely related to problem-solving. To read Piaget is sometimes to be left feeling that all a child does is to think and think about problems."

(iii) Piaget leaves little scope for unconscious or imaginative thought in his work on children.

(iv) Initially Piaget seemed to believe that the highest level of thinking consisted of sifting through a known set of logical possibilities, even though much of his later work reported discoveries from the history of Science. Discovery learning is certainly something that will come through the use of concrete aids in

the mathematics classroom.

(v) In his early book Judgement and Reasoning in the Child Piaget did at one point concede that "Many adults are still egocentric in their way of thinking. Such people interpose between themselves and reality an imaginary or mystical point of their world, and they reduce everything to this individual point of view."

But, says Cohen, Piaget wrote on as if that point had never been made, and only much later, in 1972 conceded again that not everyone might graduate to formal operations.

6.3 Further possible explanations

The teachers interviewed proffered many more possible reasons for the correlation breaks and these are given under the following headings:

5.3.1 Syllabus

Teachers do not always stress the meaningfulness and applications of syllabus items. They do not relate these to the child's life-world. The children therefore fail to see the relevance and need of mathematics in their lives. In this regard the question was raised: **"How practical are the requirements of the syllabus?"** Concepts are often not taught. Teachers assume too readily that the pupils know basic concepts and this is probably the reason why teachers feel that the "leaps from

standard to standard" in the syllabi needs attention. This was countered with a feeling that the syllabus does always motivate the children. Some areas are seen as a drudgery.

Some felt that the Education Department allows too much freedom in the interpretation of the syllabus. While others felt the syllabus was too prescriptive.

6.3.2 Teachers

Here the interviewees asked many questions regarding teacher adequacy and by implication were saying that teachers were indeed, not fully capable and qualified to teach Mathematics. e.g.

Are teachers in Standards four and five well-trained mathematically? (Aiken, 1970)

Do they possess an adequate methodology?

All the schools reported a need for improved teacher training both at basic and in-service level:

* "We were not shown at Teachers' College how to deal with problems that you will encounter in the schools."

* "The syllabus at College has nothing to do with the syllabus you are going to teach in the schools."

* "Didactics come from someone who is not a didactician at college or university level."

This leads to teacher uncertainty which is easily transmitted to the pupils and affects their achievements.

* The institution must not strive to turn out Mathematicians ... but teachers of mathematics ... at primary level."

Obviously institutions must ensure that they train teachers to be both mathematicians and teachers of Mathematics - but the point this interviewee was making was that more emphasis must be placed upon subject method during training than he felt is being done at present.
It was suggested that very often teachers in the lower standards did not take Mathematics as a subject at high school and therefore lacked insight. On the other hand the standard four or five teacher might have deeper insight and if this were so then such a teacher delves deeper and therefore taxes the pupils more - which may lead to the break in the correlations. Conversely the standard four or five teacher may also have a very limited knowledge of Mathematics and is unable to convey important basic concepts to the child - "he hashes things up" - and this leads to breaks in the correlations.

6.3.2.1 Method:
Differentiation was introduced into the schools to cope with, and make provision for different ability groups in each classroom. "We are not yet feeling the true effects

of differentiation in these findings." (A. 212,5)
Differentiation has only been 'in vogue' for a relatively short while, certainly after Noble did his study (1968) and it was just making a hesitant start when Ilsley did his study (1974). Judging by the reports of the teachers of this study and the responses of the children to the questionnaire (Pt. B; items 4, 6, 7, 11) some schools today are not yet practicing differentiation, which I believe must be seen as an influencing variable on the results of this study.

From this, the question arises: If Noble and Ilsley found these correlation breaks from results in group context, would they have found the same results had differentiation been commonly practiced by their sample schools? The teachers do not believe this would be so.
This then leads us to the next question: Can differentiation affect attitudes? The teachers believe that where differentiation is practised, the children are motivated because they succeed. We are led then to believe that differentiation on mathematical ability must probably counter negative attitudes and the correlation breaks found by Noble and Ilsley. However, this needs further investigation of a longitudinal type.

6.3.2.2 Attitudes:
Teachers sometimes expect pupils to complete extra Mathematics exercises as punishment. This causes poor

attitudes to Mathematics in the lower standards and the condition probably only surfaces at Standard four or five level. "Attitudes toward mathematics as a school subject peak in early adolescence and decline through high school." (Encyclopedia of Educational Research, 1982)
The value of mathematics needs to be emphasized early, if possible, even in sub. A. In this way pupils gain insight into the relevance of Mathematics. If this is not done throughout the child's school life, then poor attitudes towards Mathematics develop. "Positive attitudes towards mathematics and the perceived usefulness of mathematics are highly correlated with mathematics course participation." (Encyclopedia of Educational Research, 1982.) Time limits on tests and examinations can lead to a defeatist attitude with some personality types, the teachers felt. (Lorenz, 1982.)

6.3.2.3 Expectations from the children:
Due to the teachers' ignorance of the syllabus content pupils are often expected to do work which is not in the syllabus just because it is in the textbook e.g. (Swartz, J.F.A., et al, Mathematics 3. Nasou: Goodwood, 1980.) deals with Square, Rectangle and Triangle while only the Circle is required by the syllabus.
Where the expectation is beyond the child's mental and developmental capability frustration sets in. This situation is frequently aggravated by parental pressures and peer group pressures.

Then teachers frequently assume that children know certain basic concepts. As one teacher put it "What does the concept <u>million</u> mean to a Standard four child?" It was

suggested that the breaks in the correlations could occur because of this reason too, and that the Standard six teacher again adopted a more helping, understanding role and assumed less - hence the return to expected correlations in Standard six again e.g. Factor B for Boys; Factor G for boys and girls (See graphs in Chapter 1.).

6.3.2.4 Pressures on teachers

Teachers felt that pressures of varying kinds affected the quality and quantity of their teaching: extra-curricular activities leave little time for reflection, preparation and discussions. The volume of marking is often so great and so time-consuming and frequent that regular feedback, which is a strong motivator, is lacking.

6.3.3 Sex differences

Teachers were in agreement that boys are more "cognitive" in their thinking whilst girls are more "affective" and that affectivity leads to a lack in logic and therefore a drop in mathematical achievement. Further to this idea, the teachers feel that because girls are led by their hearts rather than their heads they often rationalize their situation by saying: "I'm not going to need Mathematics - I'm going to be a typist, or a housewife or whatever." Girls do not appear to grasp the value of Mathematics. This stereotype, however, is not confirmed by any significant sex differences in the responses of the pupils on the questionnaire. (See 7.2.2 on p.72.)

6.3.4 Maturity

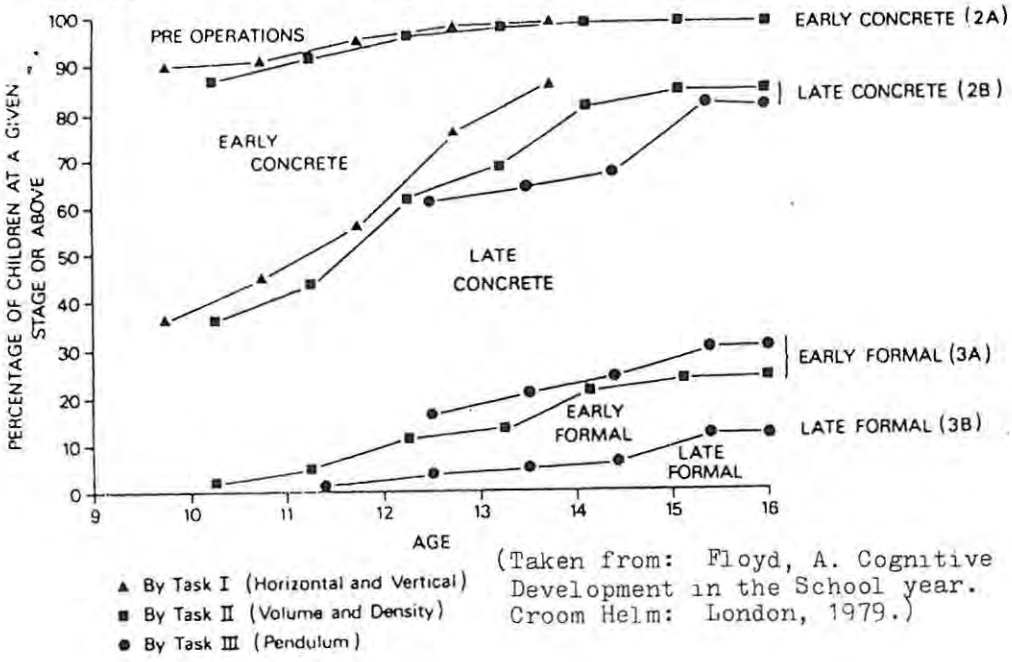
Because classes comprise children of varying ages there are necessarily those pupils who are often as much as six months younger than their classmates. Some teachers felt that these younger children, with some exceptions, usually struggle to 'keep up' with the rest of the class. (Anthony, 1977.)

Some teachers expressed this thought as follows:

"Children in Standards three, four and five are all maturing at different levels and we are expecting them academically to be at the same maturity level. We are teaching different concepts that can only be grasped by some, expecting them all to understand - meanwhile only some are grasping."

Figure 3: Phases of Cognitive Development

(D. 142,5 ⟶)



(Taken from: Floyd, A. Cognitive Development in the School year. Croom Helm: London, 1979.)

Moving from the Concrete Operational stage to the Formal Operational Stage takes place more slowly than is generally realised and is dependent upon the task being done.

6.3.5

Probably the most important problem area here is the slavish use of the textbook by teachers with no regard for the syllabus content. The pupils confirm (Questionnaire: Pt. B; item 11, 12, 13, 14) that teachers often use only the textbook, which teachers have seen as poorly presented - often too abstract, too uninteresting, inappropriate and displaying misplaced emphasis. This, they feel, is sufficient reason too for pupils to perform poorly at Mathematics. (Aiken 1970.)

6.3.6 Other reasons

6.3.6.1 Peers

Depending upon the socio-economic status of the child, peers place great stress upon children. Middle and upper economic-groups appear to be far more achievement-orientated than the lower groups. This aggravates the competition element which so often exists among children.

6.3.6.2 Additional responsibilities

Prefectship, for example is often a responsibility which children in Standard five find difficult to handle. They frequently need to make decisions which are traumatic for them. The concomitant emotional climate can affect their schoolwork. It also takes up a great deal of their time.

CHAPTER 7

SUMMARY, CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

7.1 The purpose of this study was to:

(i) determine the polarity (either positive or negative) of the attitudes that the sample had towards Mathematics as measured by the modified attitude questionnaire based on that of C.A. Riedesel and P.C. Burns (1977),

(ii) comment on the disruptions at the standard four and five level in the correlational pattern between certain personality factors and mathematical attainment for boys and girls as found by Noble (1974) and Ilsley (1977), by analysing the responses to particular test items.

The responses of 1219 English speaking pupils (641 boys and 578 girls) from six schools in Port Elizabeth were analysed separately and sex differences were determined by χ^2 calculations. The pupils were drawn from similar socio-economic and cultural backgrounds to those tested by Noble and Ilsley.

Thereafter the teachers at the schools in the sample were interviewed and their discussions were analysed and

related to the results of the pupils' questionnaire.

7.2 Briefly the findings were:

7.2.1 The total pupil sample responded positively to the questionnaire except on the 20 items discussed in Chapter 5.1) where their response was negative and contrary to expectation. It would be safe to say that in the main these pupils displayed a positive attitude towards Mathematics as measured by the modified attitude questionnaire.

7.2.2

χ^2 calculations of the total responses on the questionnaire revealed significant sex differences on some items. (See Appendix 3.1 - 3.4, pp. 85 - 95). The pattern of differences which emerged seemed to correlate very closely with the patterns which emerged from the studies of Noble and Ilsley. By linking the questionniare items to personality factors of the CPQ comment on the earlier findings of Noble and Ilsley could be made.

7.2.3

Discussions with the teachers confirmed in many cases the implications which emerged from the pupils' questionnaire.

7.3 Further discussion and recommendation:

7.3.1

Noble (1974) emphasized the need in attempting to explain

the correlation disruptions, to ascertain the effects of recent changes in content and methods of teaching Mathematics. From the pupils' questionnaire responses and the teachers comments at the interviews (tapes) it is abundantly clear that many teachers do not correctly follow the prescribed syllabus; do not practise differentiation; do no group work; are textbook bound and are quite rigid in their presentation. The need therefore still remains to ascertain whether the attitudes of pupils to Mathematics in particular would not be more positively influenced by changes in methods of teaching. An experimental study would, I believe, reveal this.

7.3.2

The children's responses and teachers' remarks confirm that "the practice in some of the schools ... of forcing the pace at which Mathematics is taught, so that from the middle of the primary stage, pupils are doing work which is a year ahead of the South African norm" (Noble, 1974) does indeed influence the pupil's attitude towards and achievement in Mathematics. While this remark was said of the Grahamstown private schools in the early '70s, I notice a similar trend in some Port Elizabeth Primary Schools. The teachers themselves expressed the need, which exists, for teachers generally to consider the value of:

7.3.2.1 - the developmental theories of Piaget, Bruner, Kohlberg and others and the remarks of Hart (1981) and Behr (1979) when planning and presenting new concepts in Mathematics.

7.3.2.2 - knowledge of the psychology underlying the formation of mathematical concepts in children being important.

"Since Mathematics involves cognitive processes based on concepts, teachers ought to know something about the formation of concepts and their integration into schemas. (Behr 1979)

According to Lovell (1968) concepts enable words to stand for whole classes of objects, qualities, or events, and are of enormous help to us in our thinking. Farrel and Farmer (1980) see a concept as a "classification of objects, object properties, or events into a set by the process of abstraction. Lovell continues, "It seems that different children arrive at the same concept in different ways." Lovell (1980) appears to support the Piagetian view and concludes that there is a degree of age-related constraints on children's thinking and concept formation.

This thought has been extended in the research of the CSMS (1974-1979) (Hart, 1981) where the relationship between personality and cognitive development also received much attention.

The traditional view of concept-formation is that to be able to form a concept, a child must be able to discriminate or differentiate between the properties of the objects or events before him, and to generalize his findings in respect of any common feature he may find.

A concept is therefore exercised as an act of judgment. Concepts seem to arise out of perceptions, out of actual acquaintance with objects and situations, and through undergoing experiences and engaging in actions of various kinds.

Concept formation is likely to be aided by memories and images.

Language and mathematical symbols certainly play a part in concept formation for they enable the individual to pin down and clarify concepts, or act as a frame of reference.

Lovell also points out that that environmental conditions are of importance in speeding-up concept formation. He underwrites the commonly held thought that the child essentially moves from the concrete to the abstract in its intellectual development but that this does not necessarily hold in all cases.

However, he quotes E.M. Churchill (1958) as showing that infant children who had had opportunities to play with certain materials might develop certain mathematical concepts quicker than a control group who were not given such opportunities.

7.3.3

Teachers are aware of numerous shortcomings in their method training background and its application. They talk

freely about it, rationalize about it, realize its effects on the pupils' attitudes and attainment in Mathematics, but do nothing about it. In their defence, teachers face difficulties in being specialists in all subjects in the primary school.

7.3.4

For teachers the volume of extra-murals they are expected to cope with (seen as a reason for ineffective planning, preparation and teaching) does appear to be a factor in the case of the pupils, particularly in standards four and five when excessive attention to sport for example first starts. Television as an attitude influencer or attention distractor was not mentioned at all. A comparative study might reveal the relevance of distractions to attitude and achievement.

7.3.5

Teachers need to consider ways of improving the attitudes of their pupils towards Mathematics, particularly in the areas that showed up in this study. (See 8.2.1.) This self-examination is called for by Aiken (1970) as well when he says: One must question how general these negative attitudes are, what causes them, and what can be done to make them positive." (See appendix 6.1 and 6.2)

7.3.6

Remarks by the teachers and feedback from the pupils indicate a need for an investigation into the amount

of time spent on didactical training of teachers at in-service and pre-service level. Lorenz (1982) refers to the therapeutic value while Aiken (1970) and Kulm (1980) discuss the further merits of such action.

7.4 Unanswered questions:

From the study two further questions have arisen -

7.4.1

It seems that girls more than boys generally tend to drop Mathematics as a subject at the end of standard seven. (Noble, 1974). A study to be completed soon confirmed this in East London. At what stage does this inclination commence? Is it possibly in standard four? (See discussion on Questionnaire part A - item 49 in Chapter 5 as an example.) More specific research would reveal the answer and possibly a solution to the question.

7.4.2

Would the above findings be applicable to other subjects as well, or are they unique to Mathematics? A comparative study would provide a conclusive answer. Behrens and Vernon (1978) report on a Canadian study where English and Mathematics achievement were taken as variables and correlated with personality factors.

7.4.3

A separate paper on the development of the sub-scales in attitudes over the standards 3, 4, 5 will be written at a later stage.

APPENDIX 1

INVENTORY OF ATTITUDES TOWARD MATHEMATICS

Sex: Boy Girl PART A.

Date:

Age :

School Standard: 3 4 5

Below are some sentences that describe how people might feel about mathematics. Place a tick (✓) in the column which best describes how you feel about each sentence.

SENTENCE	Strongly agree	Agree	Disagree	Strongly Disagree
1. I like mathematics.				
2. I'd rather work a short easy problem than a long interesting one.				
3. It scares me to have to take mathematics.				
4. Mathematics is very useful to everyone.				
5. Sometimes I work extra mathematics problems.				
6. I usually understand what we are talking about in mathematics class.				
7. Mathematics is easy for me.				
8. It's fun to work with mathematics.				
9. I would like a job that doesn't use any mathematics.				
10. It makes me nervous to even think about doing mathematics.				
11. I like to solve new problems in mathematics.				
12. I don't like to study mathematics.				
13. I have trouble with some of the terms and symbols used in mathematics.				
14. No matter how hard I try, I cannot understand mathematics.				
15. Mathematics is important in everyday life.				
16. I am more interested in mathematics than in most other school subjects.				
17. I am not willing to study mathematics any more than I have to do.				
18. I feel relaxed and happy when working with numbers.				
19. There is very little need for mathematics in most jobs.				

SENTENCE	Strongly agree	Agree	Disagree	Strongly disagree
20. My marks in mathematics have usually been lower than my marks in other school subjects.				
21. I think that mathematics is a very dull subject.				
22. I have always enjoyed mathematics.				
23. Mathematics is not very important for most people.				
24. Mathematics makes me feel worried and confused.				
25. I have a good feeling about mathematics.				
26. You need mathematics in order to get a good job.				
27. I don't like mathematics very much.				
28. Mathematics is very interesting to me.				
29. I have a bad feeling about mathematics.				
30. I often think "I can't do it" when a mathematics problem seems hard.				
31. Most of what we learn in mathematics class is not useful.				
32. I feel calm and confident when doing mathematics.				
33. I have never enjoyed studying mathematics				
34. Word problems in mathematics have always been difficult for me.				
35. Mathematics makes me feel nervous and uncomfortable.				
36. My mathematics marks have usually been higher than my marks in other subjects.				
37. Mathematics helps in other subjects.				
38. I am good at working mathematics.				
39. To most people mathematics is less important than other subjects.				
40. I feel at ease in mathematics classes.				
41. I find mathematics very boring.				
42. I would like to belong to a mathematics club.				
43. I am able to work mathematics without trying very hard.				

SENTENCE	Strongly agree	Agree	Disagree	Strongly disagree
44. Mathematics is not very important to me.				
45. I just don't like mathematics.				
46. I am not frightened or afraid of mathematics.				
47. I feel I could do better in mathematics if I tried harder.				
48. I feel anxious when someone talks about mathematics.				
49. Mathematics is one of my favourite subjects.				
50. Mathematics is a very worthwhile and necessary subject.				
51. I remember most of the things I learn in mathematics.				
52. I feel sure of myself when working mathematics.				
53. I like school very much.				
54. I don't like to study school subjects.				
55. I have never enjoyed studying.				
56. I have always enjoyed going to school.				
57. There is very little need for going to school for most jobs.				
58. Schoolwork makes me feel worried and confused.				
59. I feel relaxed and happy when doing schoolwork.				
60. School is very interesting to me.				
61. I think that school is very dull.				
62. You need to go to school in order to get a good job.				

Place a tick (✓) under True if you feel the sentences are true and a tick (✓) under False if you feel the sentences are false.

PART B.

SENTENCE	True	False
1. I like mathematics because my friends do.		
2. Most of my friends don't do very well in mathematics.		
3. My friends think mathematics is important.		
4. Mathematics is not a favourite subject of most of my friends.		
5. I do not like mathematics because my friends do not like it.		
6. We do a lot of small-group work in mathematics class.		
7. I would like more class discussion in mathematics than we have now.		
8. I think we have too much homework in mathematics.		
9. The homework we have is usually interesting.		
10. I like to use objects and other real materials when studying mathematics.		
11. We use many materials other than the textbook in our mathematics class.		
12. I don't like the textbook we use in mathematics.		
13. I think our mathematics books are too difficult.		
14. I think our mathematics books are too easy.		
15. My father likes mathematics.		
16. My mother likes mathematics.		
17. My mother expects me to pass in mathematics.		
18. My father expects me to pass in mathematics.		
19. My mother expects me to do well in mathematics.		
20. My father expects me to do well in mathematics.		
21. My mother helps me with my mathematics homework.		
22. My father helps me with my mathematics homework.		

Place a tick (✓) in the column which best describes how you feel about each of the following:

PART C. 3
STANDARD 3

SECTION	Dislike very much	Dislike	Like	Like very much
1 Tables				
2 Addition				
3 Subtraction				
4 Multiplication				
5 Division				
6 Money				
7 Length				
8 Mass				
9 Capacity				
10 Time				
11 Counting numbers				
12 Notation and Place Value				
13 Decimal fractions				
14 Common fraction				
15 Geometric shapes				
16 Sets				
17 Graphs				
18 Terminology				
19 Mathematical Signs				

Place a tick (✓) in the column which best describes how you feel about each of the following:

PART C. 4
STANDARD 4

SECTION	Dislike very much	Dislike	Like	Like very much
1 Counting numbers				
2 Notation and Place Value				
3 Addition				
4 Subtraction				
5 Multiplication				
6 Division				
7 Decimals				
8 Money				
Length				
Mass				
Capacity				
Time				
9 Common fractions				
10 Geometric concepts				
11 Perimeter				
12 Area				
13 Sets				
14 Graphs				
15 Terminology				
16 Mathematical Signs				

Place a tick (✓) in the column which best describes how you feel about each of the following:

PART C. 5
STANDARD 5

SECTION	Dislike very much	Dislike	Like	Like very much
1 Terminology				
2 Addition				
3 Subtraction				
4 Multiplication				
5 Division				
6 Sets				
7 Graphs				
8 Notation and Place Value				
9 Decimal System				
10 Factors				
11 Multiples				
12 Vulgar fractions				
13 Decimal fractions				
14 Percentages				
15 Ratio and proportion				
16 Concrete quantities (Money, Weights, Measures, Square measurement etc.)				
17 Perimeter				
18 Area				
19 Points and lines				
20 Angles				
21 Circle				
22 Scaling				
23 Averages				

APPENDIX 2

ATTITUDE QUESTIONNAIRE

To the Class Teacher:

Instructions for applying the questionnaire.

1. Each pupil requires a sharp pencil and an eraser.
2. The time allowed for this questionnaire is 30 minutes for all three parts.

   Allow 20 minutes for Part A (62 items)
   5 minutes for Part B (22 items)
   5 minutes for Part C (Std 3 : 19 items; Std 4: 16 items; Std 5 : 23 items)

3. All pupils must commence each part together. If there are pupils who have not completed a part at the expiration of the allotted time, they must leave the unanswered sentences and proceed to the next part so as to start with the rest of the class.
4. If pupils have any questions or problems they must put up their hands and not call out; this disturbs the rest of the group and may influence their responses to the sentences. Please assist them at their desks when problems occur e.g. explaining the meaning of words or sentences.
5. Part A. Page 1.

   Sex : Boy Girl. Pupils encircle the relevant word.
   Date: Pupils write the date of the test e.g. 1983-08-31.
   Age : In completed years only as at the date of the test.
   School standard: 3 4 5. Pupils encircle the relevant number.
   No names of schools or pupils are required.

6. Before pupils start responding to the questionnaire, please ensure that they clearly understand how to make their responses in one of the 4 columns according to their attitude to each particular sentence.
7. It is important that they place a tick in only one of the of the columns each time.
8. Please do not allow any discussion among the pupils.
9. Please assure them that only honest responses are needed and that there will be no recriminations for such responses.
10. They must not see this as a test; but as helping me to ascertain whether pupils, like themselves like or dislike mathematics.
11. If any issues arise during the testing, please record these on a sheet of paper and return to me with the test responses.

Thank you for you very kind cooperation and assistance.

D.L. LIGHT

APPENDIX 3.1

TOTAL RESPONSES OF SAMPLE SHOWING SEX DIFFERENCES, χ^2 AND DEGREES OF SIGNIFICANCE IN STANDARD THREE

PART A.

SENTENCE	BOYS			GIRLS			χ^2	SIGNIFICANCE
	AGREE	DISAGREE	TOTAL	AGREE	DISAGREE	TOTAL		
1. I like mathematics.	180	26	206	169	32	201	0,92	
2. I'd rather work a short easy problem than a long interesting one.	99	107	206	129	72	201	10,71	+++
3. It scares me to have to take mathematics.	17	189	206	37	164	201	9,05	+++
4. Mathematics is very useful to everyone.	194	12	206	178	23	201	4,06	+
5. Sometimes I work extra mathematics problems.	112	94	206	116	85	201	0,46	
6. I usually understand what we are talking about in mathematics class.	181	25	206	164	37	201	3,11	
7. Mathematics is easy for me.	154	52	206	125	76	201	7,47	++
8. It's fun to work with mathematics.	167	39	206	143	58	201	5,53	+
9. I would like a job that doesn't use any mathematics.	50	156	206	71	130	201	5,90	+
10. It makes me nervous to even think about doing mathematics.	24	182	206	35	166	201	2,76	
11. I like to solve new problems in mathematics.	166	40	206	142	59	201	5,45	+
12. I don't like to study mathematics.	56	150	206	61	140	201	0,49	
13. I have trouble with some of the terms and symbols used in mathematics.	119	87	206	110	91	201	0,38	
14. No matter how hard I try, I cannot understand mathematics.	21	185	206	51	150	201	16,01	+++
15. Mathematics is important in everyday life.	192	14	206	181	20	201	1,32	
16. I am more interested in mathematics than in most other school subjects.	100	106	206	89	112	201	0,73	
17. I am not willing to study mathematics any more than I have to do.	55	151	106	67	134	201	2,09	
18. I feel relaxed and happy when working with numbers.	156	50	206	120	81	201	11,97	+++
19. There is very little need for mathematics in most jobs.	54	152	206	38	163	201	3,08	
20. My marks in mathematics have usually been lower than my marks in other school subjects.	76	130	206	87	114	201	1,72	
21. I think that mathematics is a very dull subject.	39	167	206	57	144	201	5,03	+
22. I have always enjoyed mathematics.	153	53	206	135	66	201	2,46	
23. Mathematics is not very important for most people.	55	151	206	57	144	201	0,14	
24. Mathematics makes me feel worried and confused.	47	159	206	60	141	201	2,63	
25. I have a good feeling about mathematics.	161	45	206	135	66	201	6,22	+
26. You need mathematics in order to get a good job.	194	12	206	176	25	201	5,34	+
27. I don't like mathematics very much.	55	151	206	72	129	201	3,63	
28. Mathematics is very interesting to me.	154	52	206	130	71	201	4,95	+
29. I have a bad feeling about mathematics.	42	164	206	44	157	201	0,12	
30. I often think "I can't do it" when a mathematics problem seems hard.	111	95	206	114	87	201	0,33	
31. Most of what we learn in mathematics class is not useful.	35	171	206	33	168	201	0,02	
32. I feel calm and confident when doing mathematics.	146	60	206	122	79	201	4,74	+
33. I have never enjoyed studying mathematics	35	171	206	61	140	201	10,09	+++

\+ Significant at the ,05 level
++ Significant at the ,01 level
+++ Significant at the ,001 level

	BOYS			GIRLS			χ^2	SIGNIFICANCE
	AGREE	DISAGREE	TOTAL	AGREE	DISAGREE	TOTAL		
34. Word problems in mathematics have always been difficult for me.	75	131	206	76	125	201	0,09	
35. Mathematics makes me feel nervous and uncomfortable.	40	166	206	55	146	201	3,61	
36. My mathematics marks have usually been higher than my marks in other subjects.	122	84	206	91	110	201	7,94	++
37. Mathematics helps in other subjects.	142	64	206	119	82	201	4,19	+
38. I am good at working mathematics.	148	58	206	121	80	201	4,11	+
39. To most people mathematics is less important than other subjects.	90	116	206	107	94	201	2,71	
40. I feel at ease in mathematics classes.	150	56	206	123	78	201	6,19	+
41. I find mathematics very boring.	40	166	206	39	162	201	0,00	
42. I would like to belong to a mathematics club.	95	111	206	87	114	201	0,33	
43. I am able to work mathematics without trying very hard.	120	86	206	64	137	201	28,82	+++
44. Mathematics is not very important to me.	34	172	206	39	162	201	0,55	
45. I just don't like mathematics.	39	167	206	79	122	201	20,46	+++
46. I am not frightened or afraid of mathematics.	169	37	206	125	76	201	19,99	+++
47. I feel I could do better in mathematics if I tried harder.	180	26	206	139	62	201	19,85	+++
48. I feel anxious when someone talks about mathematics.	76	130	206	71	130	201	0,11	
49. Mathematics is one of my favourite subjects.	131	75	206	103	98	201	6,38	+
50. Mathematics is a very worthwhile and necessary subject.	192	14	206	170	31	201	7,73	++
51. I remember most of the things I learn in mathematics.	182	24	206	166	35	201	2,76	
52. I feel sure of myself when working mathematics.	156	50	206	133	68	201	4,49	+
53. I like school very much.	132	74	206	157	44	201	9,77	+++
54. I don't like to study school subjects.	48	158	206	57	144	201	1,33	
55. I have never enjoyed studying.	54	152	206	65	136	201	1,82	
56. I have always enjoyed going to school.	122	84	206	144	57	201	6,89	++
57. There is very little need for going to school for most jobs.	28	178	206	61	140	201	16,63	+++
58. Schoolwork makes me feel worried and confused.	56	150	206	43	158	201	1,85	
59. I feel relaxed and happy when doing schoolwork.	138	68	206	148	53	201	2,18	
60. School is very interesting to me.	165	41	206	153	48	201	0,92	
61. I think that school is very dull.	39	167	206	27	174	201	2,26	
62. You need to go to school in order to get a good job.	197	9	206	188	13	201	0,84	

PART B	BOYS			GIRLS			χ^2	SIGNIFICANCE
	AGREE	DISAGREE	TOTAL	AGREE	DISAGREE	TOTAL		
1. I like mathematics because my friends do.	15	191	206	6	195	201	3,84	+
2. Most of my friends don't do very well in mathematics.	89	117	206	75	126	201	1,47	
3. My friends think mathematics is important.	148	58	206	158	43	201	2,49	
4. Mathematics is not a favourite subject of most of my friends.	130	76	206	109	92	201	3,31	
5. I do not like mathematics because my friends do not like it.	11	195	206	13	188	201	0,23	
6. We do a lot of small-group work in mathematics class.	56	150	206	46	155	201	1,00	
7. I would like more class discussion in mathematics than we have now.	120	86	206	116	85	201	0,01	
8. I think we have too much homework in mathematics.	77	129	206	65	136	201	1,14	
9. The homework we have is usually interesting.	124	82	206	135	66	201	2,14	
10. I like to use objects and other real materials when studying mathematics.	158	48	206	127	74	201	8,85	+++
11. We use many materials other than the textbook in our mathematics class.	68	138	206	65	136	201	0,02	
12. I don't like the textbook we use in mathematics.	61	145	206	56	145	201	0,15	
13. I think our mathematics books are too difficult.	34	172	206	45	156	201	2,25	
14. I think our mathematics books are too easy.	75	131	206	68	133	201	0,30	
15. My father likes mathematics.	164	42	206	152	49	201	0,93	
16. My mother likes mathematics.	151	55	206	130	71	201	3,84	
17. My mother expects me to pass in mathematics.	199	7	206	190	11	201	1,04	
18. My father expects me to pass in mathematics.	199	7	206	195	6	201	0,06	
19. My mother expects me to do well in mathematics.	198	8	206	193	8	201	0,003	
20. My father expects me to do well in mathematics.	196	10	206	197	4	201	2,51	
21. My mother helps me with my mathematics homework.	110	96	206	125	76	201	3,22	
22. My father helps me with my mathematics homework.	105	101	206	89	112	201	1,83	

APPENDIX 3.2

TOTAL RESPONSES OF SAMPLE SHOWING SEX DIFFERENCES, χ^2 AND DEGREES OF SIGNIFICANCE IN STANDARD FOUR

PART A

SENTENCE	BOYS			GIRLS			χ^2	SIGNIFICANCE
	AGREE	DISAGREE	TOTAL	AGREE	DISAGREE	TOTAL		
1. I like mathematics.	202	27	229	161	35	196	3,12	
2. I'd rather work a short easy problem than a long interesting one.	95	134	229	120	76	196	16,46	+++
3. It scares me to have to take mathematics.	32	197	229	27	169	196	0,003	
4. Mathematics is very useful to everyone.	220	9	229	184	12	196	1,08	
5. Sometimes I work extra mathematics problems.	132	97	229	116	80	196	0,10	
6. I usually understand what we are talking about in mathematics class.	202	27	229	161	35	196	3,12	
7. Mathematics is easy for me.	169	60	229	123	73	196	5,99	+
8. It's fun to work with mathematics.	186	43	229	155	41	196	0,31	
9. I would like a job that doesn't use any mathematics.	65	164	229	47	149	196	1,06	
10. It makes me nervous to even think about doing mathematics.	23	206	229	38	158	196	7,50	++
11. I like to solve new problems in mathematics.	190	39	229	133	63	196	13,22	+++
12. I don't like to study mathematics.	57	172	229	63	133	196	2,74	
13. I have trouble with some of the terms and symbols used in mathematics.	129	100	229	132	64	196	5,41	+
14. No matter how hard I try, I cannot understand mathematics.	27	202	229	28	168	196	0,58	
15. Mathematics is important in everyday life.	206	23	229	183	13	196	1,58	
16. I am more interested in mathematics than in most other school subjects.	103	126	229	63	133	196	7,31	++
17. I am not willing to study mathematics any more than I have to do.	62	167	229	67	129	196	2,53	
18. I feel relaxed and happy when working with numbers.	168	61	229	118	78	196	8,31	++
19. There is very little need for mathematics in most jobs.	37	192	229	17	179	196	5,33	+
20. My marks in mathematics have usually been lower than my marks in other school subjects.	87	142	229	108	88	196	12,45	+++
21. I think that mathematics is a very dull subject.	34	195	229	53	143	196	9,65	+++
22. I have always enjoyed mathematics.	180	49	229	118	78	196	11,06	+++
23. Mathematics is not very important for most people.	41	188	229	27	169	196	1,34	
24. Mathematics makes me feel worried and confused.	44	185	229	49	147	196	2,07	
25. I have a good feeling about mathematics.	180	49	229	125	71	196	11,46	+++
26. You need mathematics in order to get a good job.	211	18	229	177	19	196	0,45	
27. I don't like mathematics very much.	56	173	229	82	114	196	14,55	+++
28. Mathematics is very interesting to me.	180	49	229	122	74	196	13,74	+++
29. I have a bad feeling about mathematics.	36	193	229	39	157	196	1,27	
30. I often think "I can't do it" when a mathematics problem seems hard.	134	95	229	140	56	196	7,69	++
31. Most of what we learn in mathematics class is not useful.	27	202	229	35	161	196	3,12	
32. I feel calm and confident when doing mathematics.	169	60	229	102	94	196	21,64	+++
33. I have never enjoyed studying mathematics	45	184	229	62	134	196	8,05	++

	BOYS			GIRLS				
	AGREE	DISAGREE	TOTAL	AGREE	DISAGREE	TOTAL	χ^2	SIGNIFICANCE
34. Word problems in mathematics have always been difficult for me.	86	143	229	91	105	196	3,42	
35. Mathematics makes me feel nervous and uncomfortable.	43	186	229	46	150	196	1,40	
36. My mathematics marks have usually been higher than my marks in other subjects.	118	111	229	74	122	196	8,09	++
37. Mathematics helps in other subjects.	151	78	229	144	52	196	2,82	
38. I am good at working mathematics.	170	59	229	118	78	196	9,52	+++
39. To most people mathematics is less important than other subjects.	125	104	229	122	74	196	2,55	
40. I feel at ease in mathematics classes.	166	63	229	123	73	196	4,60	+
41. I find mathematics very boring.	45	184	229	38	158	196	0,004	
42. I would like to belong to a mathematics club.	114	115	229	77	119	196	4,70	+
43. I am able to work mathematics without trying very hard.	117	112	229	63	133	196	15,53	+++
44. Mathematics is not very important to me.	44	185	229	54	142	196	4,14	+
45. I just don't like mathematics.	40	189	229	62	134	196	11,62	+++
46. I am not frightened or afraid of mathematics.	187	42	229	142	54	196	5,12	+
47. I feel I could do better in mathematics if I tried harder.	202	27	229	163	33	196	2,22	
48. I feel anxious when someone talks about mathematics.	93	136	229	65	131	196	2,51	
49. Mathematics is one of my favourite subjects.	159	70	229	91	105	196	23,07	+++
50. Mathematics is a very worthwhile and necessary subject.	208	21	229	176	20	196	0,13	
51. I remember most of the things I learn in mathematics.	187	42	229	147	49	196	2,78	
52. I feel sure of myself when working mathematics.	167	62	229	116	80	196	8,94	+++
53. I like school very much.	163	66	229	146	50	196	0,58	
54. I don't like to study school subjects.	69	160	229	57	139	196	0,06	
55. I have never enjoyed studying.	72	157	229	49	147	196	2,15	
56. I have always enjoyed going to school.	138	91	229	148	48	196	11,14	+++
57. There is very little need for going to school for most jobs.	28	201	229	13	183	196	3,79	+
58. Schoolwork makes me feel worried and confused.	48	181	229	29	167	196	2,71	
59. I feel relaxed and happy when doing schoolwork.	166	63	229	142	54	196	0,00008	
60. School is very interesting to me.	185	44	229	168	28	196	1,82	
61. I think that school is very dull.	32	197	229	23	173	196	0,47	
62. You need to go to school in order to get a good job.	222	7	229	178	18	196	7,16	++

PART B	BOYS			GIRLS			χ^2	SIGNIFICANCE
	AGREE	DISAGREE	TOTAL	AGREE	DISAGREE	TOTAL		
1. I like mathematics because my friends do.	8	221	229	3	193	196	1,61	
2. Most of my friends don't do very well in mathematics.	77	152	229	78	118	196	1,74	
3. My friends think mathematics is important.	173	56	229	119	77	196	10,80	+++
4. Mathematics is not a favourite subject of most of my friends.	134	95	229	117	79	196	0,06	
5. I do not like mathematics because my friends do not like it.	8	221	229	3	193	196	1,61	
6. We do a lot of small-group work in mathematics class.	44	185	229	21	175	196	5,89	+
7. I would like more class discussion in mathematics than we have now.	146	83	229	129	67	196	0,20	
8. I think we have too much homework in mathematics.	68	161	229	80	116	196	5,76	+
9. The homework we have is usually interesting.	144	85	229	94	102	196	9,54	+++
10. I like to use objects and other real materials when studying mathematics.	158	71	229	147	49	196	1,88	
11. We use many materials other than the textbook in our mathematics class.	94	135	229	61	135	196	4,49	+
12. I don't like the textbook we use in mathematics.	77	152	229	88	108	196	5,45	+
13. I think our mathematics books are too difficult.	49	180	229	42	154	196	0,00046	
14. I think our mathematics books are too easy.	66	163	229	52	144	196	0,28	
15. My father likes mathematics.	180	49	229	166	30	196	2,59	
16. My mother likes mathematics.	149	80	229	130	66	196	0,07	
17. My mother expects me to pass in mathematics.	222	7	229	177	19	196	8,10	++
18. My father expects me to pass in mathematics.	223	6	229	179	17	196	7,56	++
19. My mother expects me to do well in mathematics.	224	5	229	184	12	196	4,27	+
20. My father expects me to do well in mathematics.	223	6	229	186	10	196	1,80	
21. My mother helps me with my mathematics homework.	107	122	229	96	100	196	0,22	
22. My father helps me with my mathematics homework.	103	126	229	100	96	196	1,55	

APPENDIX 3.3

TOTAL RESPONSES OF SAMPLE SHOWING SEX DIFFERENCES, χ^2 AND DEGREES OF SIGNIFICANCE IN STANDARD FIVE

PART A

SENTENCE	BOYS			GIRLS			χ^2	SIGNIFICANCE
	AGREE	DISAGREE	TOTAL	AGREE	DISAGREE	TOTAL		
1. I like mathematics.	175	31	206	149	32	181	0,49	
2. I'd rather work a short easy problem than a long interesting one.	97	109	206	115	66	181	10,52	+++
3. It scares me to have to take mathematics.	19	187	206	32	149	181	6,02	+
4. Mathematics is very useful to everyone.	176	30	206	174	7	181	12,75	+++
5. Sometimes I work extra mathematics problems.	99	107	206	84	97	181	0,11	
6. I usually understand what we are talking about in mathematics class.	163	43	206	160	21	181	6,00	+
7. Mathematics is easy for me.	107	99	206	104	77	181	1,18	
8. It's fun to work with mathematics.	169	37	206	140	41	181	1,32	
9. I would like a job that doesn't use any mathematics.	43	163	206	64	117	181	10,11	+++
10. It makes me nervous to even think about doing mathematics.	13	193	206	34	147	181	14,05	+++
11. I like to solve new problems in mathematics.	168	38	206	135	46	181	2,75	
12. I don't like to study mathematics.	86	120	206	52	129	181	7,12	++
13. I have trouble with some of the terms and symbols used in mathematics.	127	79	206	123	58	181	1,67	
14. No matter how hard I try, I cannot understand mathematics.	30	176	206	37	144	181	2,33	
15. Mathematics is important in everyday life.	200	6	206	170	11	181	2,30	
16. I am more interested in mathematics than in most other school subjects.	79	127	206	48	133	181	6,12	+
17. I am not willing to study mathematics any more than I have to do.	69	137	206	60	121	181	0,005	
18. I feel relaxed and happy when working with numbers.	125	81	206	107	74	181	0,09	
19. There is very little need for mathematics in most jobs.	27	179	206	22	159	181	0,08	
20. My marks in mathematics have usually been lower than my marks in other school subjects.	91	115	206	98	83	181	3,83	+
21. I think that mathematics is a very dull subject.	27	179	206	35	146	181	2,78	
22. I have always enjoyed mathematics.	136	70	206	114	67	181	0,39	
23. Mathematics is not very important for most people.	39	167	206	43	138	181	1,34	
24. Mathematics makes me feel worried and confused.	38	168	206	54	127	181	6,89	+
25. I have a good feeling about mathematics.	154	52	206	120	61	181	3,33	
26. You need mathematics in order to get a good job.	193	13	206	170	11	181	0,009	
27. I don't like mathematics very much.	53	153	206	74	107	181	10,04	+++
28. Mathematics is very interesting to me.	140	66	206	122	59	181	0,01	
29. I have a bad feeling about mathematics.	42	164	206	40	141	181	0,17	
30. I often think "I can't do it" when a mathematics problem seems hard.	119	87	206	137	44	181	13,82	+++
31. Most of what we learn in mathematics class is not useful.	12	194	206	17	164	181	1,77	
32. I feel calm and confident when doing mathematics.	123	83	206	101	80	181	0,60	
33. I have never enjoyed studying mathematics	55	151	206	60	121	181	1,92	

	BOYS			GIRLS			χ^2	SIGNIFICANCE
	AGREE	DISAGREE	TOTAL	AGREE	DISAGREE	TOTAL		
34. Word problems in mathematics have always been difficult for me.	100	106	206	91	90	181	0,12	
35. Mathematics makes me feel nervous and uncomfortable.	37	169	206	47	134	181	3,63	
36. My mathematics marks have usually been higher than my marks in other subjects.	90	116	206	57	124	181	6,09	+
37. Mathematics helps in other subjects.	151	55	206	148	33	181	3,93	+
38. I am good at working mathematics.	119	87	206	91	90	181	2,18	
39. To most people mathematics is less important than other subjects.	161	90	206	108	73	181	0,45	
40. I feel at ease in mathematics classes.	135	71	206	118	63	181	0,005	
41. I find mathematics very boring.	36	170	206	44	137	181	2,74	
42. I would like to belong to a mathematics club.	71	135	206	71	110	181	0,94	
43. I am able to work mathematics without trying very hard.	73	133	206	62	119	181	0,06	
44. Mathematics is not very important to me.	33	173	206	32	149	181	0,19	
45. I just don't like mathematics.	52	154	206	54	127	181	1,02	
46. I am not frightened or afraid of mathematics.	157	49	206	128	53	181	1,50	
47. I feel I could do better in mathematics if I tried harder.	191	15	206	163	18	181	0,88	
48. I feel anxious when someone talks about mathematics.	77	129	206	53	128	181	2,83	
49. Mathematics is one of my favourite subjects.	114	92	206	83	98	181	3,47	
50. Mathematics is a very worthwhile and necessary subject.	189	17	206	169	12	181	0,37	
51. I remember most of the things I learn in mathematics.	157	49	206	147	34	181	1,43	
52. I feel sure of myself when working mathematics.	134	72	206	86	95	181	12,08	+++
53. I like school very much.	112	94	206	147	34	181	31,37	+++
54. I don't like to study school subjects.	79	127	206	58	123	181	1,67	
55. I have never enjoyed studying.	91	115	206	60	121	181	4,92	+
56. I have always enjoyed going to school.	107	99	206	130	51	181	16,04	+++
57. There is very little need for going to school for most jobs.	10	196	206	7	174	181	0,22	
58. Schoolwork makes me feel worried and confused.	46	160	206	35	146	181	0,52	
59. I feel relaxed and happy when doing schoolwork.	99	107	206	131	50	181	23,63	+++
60. School is very interesting to me.	156	50	206	151	30	181	3,48	
61. I think that school is very dull.	44	162	206	16	165	181	11,53	+++
62. You need to go to school in order to get a good job.	202	4	206	172	9	181	2,73	

PART B	BOYS			GIRLS			χ^2	SIGNIFICANCE
	AGREE	DISAGREE	TOTAL	AGREE	DISAGREE	TOTAL		
1. I like mathematics because my friends do.	6	200	206	5	176	181	0,008	
2. Most of my friends don't do very well in mathematics.	95	111	206	66	115	181	3,69	
3. My friends think mathematics is important.	160	46	206	142	39	181	0,03	
4. Mathematics is not a favourite subject of most of my friends.	129	77	206	134	47	181	5,76	+
5. I do not like mathematics because my friends do not like it.	6	200	206	7	174	181	0,27	
6. We do a lot of small-group work in mathematics class.	35	171	206	16	165	181	5,59	+
7. I would like more class discussion in mathematics than we have now.	135	71	206	109	72	181	1,17	
8. I think we have too much homework in mathematics.	76	130	206	52	129	181	2,90	
9. The homework we have is usually interesting.	122	84	206	118	63	181	1,46	
10. I like to use objects and other real materials when studying mathematics.	149	57	206	124	57	181	0,68	
11. We use many materials other than the textbook in our mathematics class.	57	149	206	53	128	181	0,12	
12. I don't like the textbook we use in mathematics.	52	154	206	60	121	181	2,93	
13. I think our mathematics books are too difficult.	34	172	206	41	140	181	2,33	
14. I think our mathematics books are too easy.	36	170	206	40	141	181	1,31	
15. My father likes mathematics.	176	30	206	147	34	181	1,24	
16. My mother likes mathematics.	125	81	206	101	80	181	0,94	
17. My mother expects me to pass in mathematics.	203	3	206	148	33	181	32,14	+++
18. My father expects me to pass in mathematics.	198	8	206	151	30	181	17,52	+++
19. My mother expects me to do well in mathematics.	194	12	206	148	33	181	14,43	+++
20. My father expects me to do well in mathematics.	197	9	206	151	30	181	15,84	+++
21. My mother helps me with my mathematics homework.	66	140	206	65	116	181	0,65	
22. My father helps me with my mathematics homework.	107	99	206	85	96	181	0,96	

TOTAL RESPONSES OF SAMPLE SHOWING SEX DIFFERENCES, χ^2 AND DEGREES OF SIGNIFICANCE FOR THE SYLLABI IN STANDARDS THREE, FOUR AND FIVE RESPECTIVELY.

STD 3
PART C

	BOYS			GIRLS				
	LIKE	DISLIKE	TOTAL	LIKE	DISLIKE	TOTAL	χ^2	SIGNIFICANCE
1 Tables	37	169	206	35	166	201	0,02	
2 Addition	23	183	206	19	182	201	0,32	
3 Subtraction	46	160	206	43	158	201	0,05	
4 Multiplication	38	168	206	24	177	201	3,34	
5 Division	65	141	206	71	130	201	0,65	
6 Money	33	173	206	48	153	201	3,94	+
7 Length	62	144	206	84	117	201	6,05	+
8 Mass	63	143	206	74	127	201	1,77	
9 Capacity	70	136	206	69	132	201	0,005	
10 Time	54	152	206	59	142	201	0,50	
11 Counting numbers	51	155	206	41	160	201	1,11	
12 Notation and Place Value	49	157	206	39	162	201	1,15	
13 Decimal fractions	57	149	206	47	154	201	0,98	
14 Common fraction	62	144	206	42	159	201	4,53	+
15 Geometric shapes	68	138	206	47	154	201	4,65	+
16 Sets	52	154	206	45	156	201	0,46	
17 Graphs	60	146	206	47	154	201	1,73	
18 Terminology	71	135	206	63	138	201	0,45	
19 Mathematical Signs	50	156	206	52	149	201	0,14	

STD 4
PART C

	BOYS			GIRLS				
	LIKE	DISLIKE	TOTAL	LIKE	DISLIKE	TOTAL	χ^2	SIGNIFICANCE
1 Counting numbers	36	193	229	29	167	196	0,07	
2 Notation and Place Value	54	175	229	57	139	196	1,66	
3 Addition	12	217	229	13	183	196	0,37	
4 Subtraction	17	212	229	32	164	196	8,21	++
5 Multiplication	14	215	229	24	172	196	4,88	+
6 Division	50	179	229	60	136	196	4,24	+
7 Decimals	57	172	229	70	126	196	5,90	+
8 Money	37	192	229	39	157	196	1,01	
Length	55	174	229	67	129	196	5,33	+
Mass	56	173	229	61	135	196	2,35	
Capacity	70	159	229	70	126	196	1,27	
Time	60	169	229	58	138	196	0,61	
9 Common fractions	43	186	229	59	137	196	7,43	
10 Geometric concepts	83	146	229	64	132	196	0,60	
11 Perimeter	77	152	229	86	110	196	4,70	+
12 Area	73	156	229	70	126	196	0,70	
13 Sets	43	186	229	47	149	196	1,71	
14 Graphs	42	187	229	63	133	196	10,82	+++
15 Terminology	94	135	229	86	110	196	0,35	
16 Mathematical Signs	42	187	229	49	147	196	2,78	

STD 5
PART C

	BOYS			GIRLS				
	LIKE	DISLIKE	TOTAL	LIKE	DISLIKE	TOTAL	χ^2	SIGNIFICANCE
1 Terminology	92	114	206	93	88	181	1,74	
2 Addition	10	196	206	2	179	181	4,51	+
3 Subtraction	10	196	206	15	166	181	1,88	
4 Multiplication	18	188	206	15	166	181	0,025	
5 Division	64	142	206	43	138	181	2,57	
6 Sets	54	152	206	41	140	181	0,66	
7 Graphs	57	149	206	55	126	181	0,35	
8 Notation and Place Value	68	138	206	82	99	181	6,14	+
9 Decimal System	62	144	206	68	113	181	2,41	
10 Factors	77	129	206	85	96	181	3,64	
11 Multiples	62	144	206	37	144	181	4,72	+
12 Vulgar fractions	76	130	206	75	106	181	0,84	
13 Decimal fractions	56	150	206	58	123	181	1,09	
14 Percentages	18	188	206	26	155	181	3,03	
15 Ratio and proportion	39	167	206	50	131	181	4,11	+
16 Concrete quantities (Money, Weights, Measures, Square measurement etc.)	80	126	206	83	98	181	1,97	
17 Perimeter	86	120	206	94	87	181	4,02	+
18 Area	84	122	206	106	75	181	12,20	+++
19 Points and lines	50	156	206	72	109	181	10,73	+++
20 Angles	41	165	206	74	107	181	20,31	+++
21 Circle	46	160	206	58	123	181	4,63	+
22 Scaling	70	136	206	92	89	181	11,24	+++
23 Averages	35	171	206	37	144	181	0,76	

\+ Significant at the ,05 level
++ Significant at the ,01 level
+++ Significant at the ,001 level

APPENDIX 4

COMPUTER PROGRAMME FOR χ^2

(Used on BBC Microcomputer)

```
10    REM CALCULATION OF χ²
20    PRINT  "ENTER N"
30    INPUT  N
40    PRINT  "ENTER A  B  C  D"
50    INPUT  A,  B,  C,  D
60    χ²= (N* (A*D - B*C) ↑ 2)/(A+B)*(C+D)*(A+C)*(B+D))
70    PRINT  ¦ χ ¦  = b", χ
80    GOTO  40
90    END
```

APPENDIX 5

ASSOCIATED PERSONALITY FACTORS

SENTENCE	FACTOR	DESCRIPTION
1. I like mathematics.	C	EGO-STRENGTH
2. I'd rather work a short easy problem than a long interesting one.	G	CONSCIENTIOUSNESS
3. It scares me to have to take mathematics	C	EGO-STRENGTH
4. Mathematics is very useful to everyone.	J	INDIVIDUALISM
5. Sometimes I work extra mathematics problems.	G	CONSCIENTIOUSNESS
6. I usually understand what we are talking about in mathematics class.	B	INTELLIGENCE
7. Mathematics is easy for me.	C	EGO-STRENGTH
8. It's fun to work with mathematics.	C	EGO-STRENGTH
9. I would like a job that doesn't use any mathematics.	E	ASSERTION
10. It makes me nervous to even think about doing mathematics.	C	EGO-STRENGTH
11. I like to solve new problems in mathematics.	H	AVENTUROUSNESS
12. I don't like to study mathematics.	C	EGO-STRENGTH
13. I have trouble with some of the terms and symbols used in mathematics.	B	INTELLIGENCE
14. No matter how hard I try, I cannot understand mathematics.	B	INTELLIGENCE
15. Mathematics is important in everyday life.	J	INDIVIDUALISM
16. I am more interested in mathematics than in most other school subjects.	F	ENTHUSIASM
17. I am not willing to study mathematics any more than I have to do.	G	CONSCIENTIOUSNESS
18. I feel relaxed and happy when working with numbers.	C	EGO-STRENGTH
19. There is very little need for mathematics in most jobs.	J	INDIVIDUALISM
20. My marks in mathematics have usually been lower than my marks in other school subjects.	B	INTELLIGENCE
21. I think that mathematics is a very dull subject.	J	INDIVIDUALISM
22. I have always enjoyed mathematics.	C	EGO-STRENGTH
23. Mathematics is not very important for most people.	J	INDIVIDUALISM
24. Mathematics makes me feel worried and confused.	C	EGO-STRENGTH
25. I have a good feeling about mathematics.	C	EGO-STRENGTH
26. You need mathematics in order to get a good job.	J	INDIVIDUALISM
27. I don't like mathematics very much.	C	EGO-STRENGTH
28. Mathematics is very interesting to me.	F	ENTHUSIASM
29. I have a bad feeling about mathematics.	C	EGO-STRENGTH
30. I often think "I can't do it" when a mathematics problem seems hard.	G	CONSCIENTIOUSNESS
31. Most of what we learn in mathematics class is not useful.	J	INDIVIDUALISM
32. I feel calm and confident when doing mathematics.	C	EGO-STRENGTH
33. I have never enjoyed studying mathematics	F	ENTHUSIASM

	FACTOR	DESCRIPTION
34. Word problems in mathematics have always been difficult for me.	B	INTELLIGENCE
35. Mathematics makes me feel nervous and uncomfortable.	C	EGO-STRENGTH
36. My mathematics marks have usually been higher than my marks in other subjects.	B	INTELLIGENCE
37. Mathematics helps in other subjects.	J	INDIVIDUALISM
38. I am good at working mathematics.	E	ASSERTION
39. To most people mathematics is less important than other subjects.	J	INDIVIDUALISM
40. I feel at ease in mathematics classes.	C	EGO-STRENGTH
41. I find mathematics very boring.	F	ENTHUSIASM
42. I would like to belong to a mathematics club.	F	ENTHUSIASM
43. I am able to work mathematics without trying very hard.	B	INTELLIGENCE
44. Mathematics is not very important to me.	J	INDIVIDUALISM
45. I just don't like mathematics.	C	EGO-STRENGTH
46. I am not frightened or afraid of mathematics.	C	EGO-STRENGTH
47. I feel I could do better in mathematics if I tried harder.	G	CONSCIENTIOUSNESS
48. I feel anxious when someone talks about mathematics.	C	EGO-STRENGTH
49. Mathematics is one of my favourite subjects.	F	ENTHUSIASM
50. Mathematics is a very worthwhile and necessary subject.	J	INDIVIDUALISM
51. I remember most of the things I learn in mathematics.	B	INTELLIGENCE
52. I feel sure of myself when working mathematics.	C	EGO-STRENGTH
53. I like school very much.	C	EGO-STRENGTH
54. I don't like to study school subjects.	C	EGO-STRENGTH
55. I have never enjoyed studying.	C	EGO-STRENGTH
56. I have always enjoyed going to school.	C	EGO-STRENGTH
57. There is very little need for going to school for most jobs.	J	INDIVIDUALISM
58. Schoolwork makes me feel worried and confused.	C	EGO-STRENGTH
59. I feel relaxed and happy when doing schoolwork.	C	EGO-STRENGTH
60. School is very interesting to me.	F	ENTHUSIASM
61. I think that school is very dull.	F	ENTHUSIASM
62. You need to go to school in order to get a good job.	J	INDIVIDUALISM

	FACTOR	DESCRIPTION
1. I like mathematics because my friends do.	E	ASSERTION
2. Most of my friends don't do very well in mathematics.	G	CONSCIENTIOUSNESS
3. My friends think mathematics is important.	E	ASSERTION
4. Mathematics is not a favourite subject of most of my friends.	F	ENTHUSIASM
5. I do not like mathematics because my friends do not like it.	J	INDIVIDUALISM
6. We do a lot of small-group work in mathematics class.	J	INDIVIDUALISM
7. I would like more class discussion in mathematics than we have now.	J	INDIVIDUALSMM
8. I think we have too much homework in mathematics.	J	INDIVIDUALISM
9. The homework we have is usually interesting.	J	INDIVIDUALISM
10. I like to use objects and other real materials when studying mathematics.	J	INDIVIDUALISM
11. We use many materials other than the textbook in our mathematics class.	J	INDIVIDUALISM
12. I don't like the textbook we use in mathematics.	J	INDIVIDUALISM
13. I think our mathematics books are too difficult.	J	INDIVIDUALISM
14. I think our mathematics books are too easy.	J	INDIVIDUALISM
15. My father likes mathematics.	N	SHREWD
16. My mother likes mathematics.	N	SHREWD
17. My mother expects me to pass in mathematics.	N	SHREWD
18. My father expects me to pass in mathematics.	N	SHREWD
19. My mother expects me to do well in mathematics.	N	SHREWD
20. My father expects me to do well in mathematics.	N	SHREWD
21. My mother helps me with my mathematics homework.	N	SHREWD
22. My father helps me with my mathematics homework.	N	SHREWD

HOW TO DEVELOP POSITIVE ATTITUDES TOWARDS MATHEMATICS

POSITIVE ATTITUDE ⇌ SUCCESS IN MATHEMATICS

SHORT-TERM GOALS

Try paradoxes and fallacies to jolt fixed attitudes.

LONG-TERM GOALS

1. Motivate Maths as often as possible
2. Exude an enthusiasm and love for Mathematics yourself.
3. Be as knowledgeable as you can about all the "blocks" mentioned in the orientation lecture.
4. Use praise rather than damaging remarks.
5. Learn as much as you can about 'mixed-ability' teaching.
6. Make sure you include women Mathematicians when you talk about the History of Mathematics.
7. Liaise closely with the teacher psychologist in deciding who is to continue with Mathematics at the end of Std 7 - make sure he/she is not presenting a male stereotyped view of career opportunities.
8. Don't offer soft options as alternatives to Mathematics.
9. Make sure both sexes visit the same factories - develop a unisex view of Mathematics.
10. Use good, non-sexist text books.
11. Good use of calculators and micro-computers can inspire confidence with slow learners.
12. Keep Maths classes at a reasonable size (particularly for slow learners).
13. Make resource materials available e.g. school library.
14. Gain support of parents and pupils.
15. More teaching time, less examining time.
16. Give as many academic awards as sporting awards.
17. Put your best Maths teachers in Std 7.
18. Run a Mathematics Club, open and meaningful to all pupils.
19. Wait as long for girls to answer a question as you wait for boys.

From: Noble, A. Education Department
Rhodes University
GRAHAMSTOWN (1984)

APPENDIX 6.2

HOW TO TEACH CHILDREN TO HATE MATHEMATICS

Children generally do not hate mathematics when they start school. This is a trait which they acquire as a part of their elementary school training.

The feat of loathing mathematics can generally be accomplished if the teacher will use one or more of the following procedures.

1. Assign the same work to everyone in the class.
   This technique is effective with about two thirds of the class. The bottom third of the class will become frustrated from trying to do the impossible while the top third will hate the boredom.
   WARNING: This MAY NOT be effective with about the middle third of the students.

2. Go through the book, problem by problem, page by page.
   In time, the drudgery and monotony is bound to get them.

3. Assign written work everyday.
   Before long, just the word "mathematics" will remove every smile in the room.

4. Be sure that each student has plenty of homework.
   This is especially important over weekends and vacation periods.

5. Never correlate mathematics with life situations.
   A student might find it useful and get to enjoy maths.

6. Insist there is ONLY one correct way to solve each problem. This is very important as some creative student might look for different ways to solve a problem. He could even grow to like maths.

7. Assign mathematics as a punishment for misbehaviour. The association works wonders. Soon maths and punishment will take on the same meaning.

8. Be sure that ALL students complete ALL the review work in front of the textbook.
   This ought to last until Thanksgiving or Christmas, and is certain to kill off the interest of most students.

9. Use long drill type assignments with many examples of the SAME type problem. (For example: 30 long column addition problems).
   This type of assignment requires little teacher time and keeps the student occupied for a long time. The majority of the pupils are sure to dislike it.

10. Always insist that papers are prepared in a certain way. Name, date, page number, etc. must each be placed in a specific spot. If a student fails to follow this procedure, tear up his paper and let him start over again. Instant humiliation and despair are almost guaranteed.

11. Lastly, insist that EVERY problem worked incorrectly be reworked until it is correct. This procedure is most effective in promoting distaste for maths and if followed very carefully the student may even learn to detest his teacher as well!

Lynn Oberlin.
University of Florida.

BIBLIOGRAPHY

1. BOOKS CONSULTED.

Allport, G.W. Pattern and growth in Personality. Holt, Rinehart and Winston: New York, 1961.

Banks, J.H. Learning and teaching arithmetic. (2nd Edition) Allyn and Bacon: Boston, 1964.

Cohen, D. Piaget. Critique and Reassessment. Croom Helm: London, 1983.

Cohen, L. and Manion, L. Research Methods in Education. Croom Helm: London, 1980.

Farrell, M.A. and Farmer, W.A. Systematic Instruction in Mathematics for the middle and high school years. Addison-Wesley: Massachusetts, 1980.

Hart, K.M. (Ed.) Children's Understanding of Mathematics: 11 - 16. John Murray: London, 1981.

Ilsley, J.R. Relationships between certain Personality factors and mathematics attainment in some selected schools in the range standards two to six. M.Ed. Thesis, Rhodes University, Grahamstown, 1977.

Krasner, L. and Ullman, L.P. Behaviour influence and Personality - The Social matrix of human action. Holt, Rinehart and Winston: New York, 1973.

Krech, D., Crutchfield, R.S. and Livson, N. Elements of Psychology. (3rd Edition.) Alfred A Knopf: New York, 1974.

Kulm, G. Research in Mathematics Education. National Council of Teachers of Mathematics, 1980.

Lavin, D.E. The Prediction of Academic Performance. Wiley Science Editions: New York, 1965.

Mager, R.E. Developing attitude toward learning. Fearon-Pitman Publishers: California, 1968.

Mitzel, H.E. (Ed.) Encyclopedia of Educational Research. (5th Edition) Vol. 3 Free Press: 1982.

Oppenheim, A.N. Questionnaire Design and Attitude Measurement. Heinemann Books: 1972.

Pidgeon, D.A. (Ed.) Achievement in Mathematics. National Foundation for Educational Research in England and Wales, 1967.

Riedesel, C.A. and Burns, P.C. Handbook for exploratory and systematic teaching of elementary School Mathematics. Harper and Row: New York, 1977.

Rosenthal, R. and Jacobson, L. Pygmalion in the classroom. New York, 1968.

Shaw, M.E. and Wright, J.M. Scales for the Measurement of Attitude. McGraw Hill: New York, 1967.

Sund, R.B. and Picard, A.J. Behavioural Objectives and Evaluation Measures - Science and Mathematics. Charles E. Merrill Publishing Co.: Ohio, 1972.

Thurstone, L.L. and Chave, E.J. The Measurement of attitude. University of Chicago Press: Chicago, 1929. (Extr. Krech, Crutchfield and Ballachey - 1962)

2. JOURNALS CONSULTED.

Aiken, L.R. "Personality correlates of attitude toward mathematics." Journal of Educational Research, 56 (1963), 476 - 480.

Aiken, L.R. "Attitudes toward Mathematics." Review of Educational Research, 40 (1970), 551 - 596.

Aiken, L.R. "Research on attitudes toward mathematics." The Arithmetic Teacher, 19 (March 1972), 229 - 234.

Aiken, L.R. "Two Scales of attitude toward mathematics." Journal for Research in Mathematics Education, 5 (March 1974), 67 - 71.

Aiken, L.R. and Dreyer, R.M. "The effect of attitudes on performance in mathematics." Journal of Educational Psychology, 52 (1961), 19 - 24.

Anthony, W.S. "The Development of Extraversion and Ability: An analysis of Rushton's Longitudinal-data." British Journal of Educational Psychology, 47 (1977),193 - 196.

Banreti-Fuchs, K.M. "Attitudinal Correlates of academic achievement in Elementary School Children." British Journal of Educational Psychology, 48 (1978),176 - 185.

Behr, A.L. "Diagnosing Learning Deficiencies in the New Mathematics with reference to the Primary School Child." S.A. Journal for Education and Learning Disabilities, 1 (No 1) 1979, 161 - 186.

Behrens, L.T. and Vernon, P.E. "Personality correlates of over-achievement and under-achievement." British Journal of Educational Psychology, 48 (1978), 290 - 297.

Bernstein, A.L. "Motivations in Mathematics." School Science and Mathematics, 64 (1964), 749 - 754.

Brown, E.E. and Abel, T.L. "Research in the teaching of elementary school mathematics." Arithmetic Teacher, 12 (1965), 547 - 549.

Castaneda, A., Mc Candless, B.R. and Palermo, D.S. "The Children's form of the manifest anxiety scale." Child Development, 27 (1956) 317 - 326.

Dreger, R.M. and Aiken, L.R. "The identification of number anxiety in a College Population." Journal of Educational Psychology, 48 (1957), 344 - 351.

Dutton, W.H. "Another look at attitudes of Junior High School Pupils toward arithmetic." Arithmetic Teacher, 9 (1962), 418 - 424.

Dutton, W.H. "The measurement of attitudes toward arithmetic with a Likert-type test." Elementary School Journal, 69 (1968) 259 - 264.

Entwistle, N.J. "Personality and Academic attainment." British Journal of Educational Psychology, 42 (1972), 137 - 151.

Entwistle, N.J. and Brennan, T. "The Academic Performance of Students." British Journal of Educational Psychology, 41 (1971), 248 - 276.

Entwistle, N.J. and Entwistle, D. "The Relationship between personality, study methods and academic performance." British Journal of Educational Psychology, 40 (1970), 132 - 141.

Fedon, J.P. "The Role of attitude in learning arithmetic." Arithmetic Teacher, 5 (December 1958) 304 - 310.

Fennema, E. "Mathematics learning and the Sexes: A review." Journal for Research in Mathematics Education, 5 (1974), 126 - 139.

Furneaux, W.D. "The Psychologist and the University." University Quarterly, 17 (1962), 33 - 47.

Kiryluk, S. "What the pupils think." Mathematics Teacher, 91 (June 1980), 42 - 44.

Lorenz, J.H. "On some Psychological Aspects of Mathematics Achievement Assessment and Classroom Interaction." Educational Studies in Mathematics, 13 (1982), 1 - 19.

Lyda, W.J. and Morse, E.C. "Attitudes, teaching methods, and arithmetic achievement." Arithmetic Teacher, 10 (1963) 136 - 138.

McCallon, E.L. and Brown, J.D. "A semantic differential instrument for measuring attitude toward Mathematics." The Journal of experimental education, 39 (No. 4 Summer 1971), 69 - 72.

Noble, A. "The Attitudes and Abilities of Boys and Girls in School Mathematics." Humanitas, R.S.A., 2 No 3 (1974(a)), 267 - 275.

Noble, A. "Towards Individualised Teaching in School Mathematics." Bulletin: Department of Education, Rhodes University 3 No. 1 (1974), 32 - 58.

Orpen, C. "Personality and Academic Attainment: A cross-cultural study." British Journal of Educational Psychology, 46 (1976), 220 - 222.

Reese, H.W. "Manifest anxiety and achievement performance." Journal of Educational Psychology, 52 (1961), 132 - 135.

Reys, R.E. and Delon, F.G. "Attitudes of Prospective elementary school teachers toward arithmetic." Arithemtic Teacher, (April 1968) 363 - 366.

Riedesel, C.A. "Research on attitudes towards Mathematics." The Arithmetic Teacher. 19 (1972), 229 - 234.

Seddon, G.M. "The effects of chronological age on the relationship of academic achievement with extraversion and neuroticism: A Follow-Up study." British Journal of Educational Psychology, 47 (1977), 187 - 192.

Wade, B.E. "Highly Anxious Pupils in Formal and Informal Primary Classrooms; The Relationship between inferred Coping Strategies and Cognitive attainment." British Journal of Educational Psychology, 51 (1981), 39 - 49.

Wilson, G.M. "Why do pupils avoid math in high school?" Arithmetic Teacher, 8 (1961), 168 - 171.