

**Relationships between family variables and
children's mathematical achievement.**

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Abstract

This study aims to assess the relationship between family variables and specific mathematical achievement in secondary school children. It employs both quantitative and qualitative methods.

In the early stages, re-analysis of data from the National Child Development Study (NCDS), (e.g. Fogelman, K. 1983), suggested that previous findings may have confounded mathematical ability/achievement with general educational achievement and/or measures of cognitive ability. In addition these studies tended to use only family variables which could be measured quantitatively and in ways which facilitated statistical analysis. However, the re-analysis of NCDS data showed a significant association between teachers' subjective assessment of parental interest in their children's education when they were aged 7 years, and the children's mathematical achievement at age 11 years. This significant relationship led to the focus in the second, qualitative phase on the involvement of parents in their children's education (Steinberg and Silverberg, 1986; Lareau, A. 1987, 1989), on intra-family interactions (Wentzel, K.R. 1994), and the possible relations between them and the children's mathematical achievement. In the later stages, therefore, following a methodological model developed by Goetz and Lecompte (1995), qualitative techniques were utilised to elicit from parents details of intra-family interactions, with particular emphasis on their involvement with their children's educational activities.

The results of the qualitative phase of this study suggested that high mathematics achievers were more likely to be found in families where mothers and fathers had both obtained O Levels, where a similar history of educational achievement in the wider families was reported, and where there was a high level of parent/child/sibling interaction. In contrast, low mathematics achievers were more likely to be found in families where only one or neither parent had obtained O Levels, where there was little evidence offered of educational achievements in the wider families, and where there was little intra-family interaction.

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Declaration

I declare that the attached thesis is all my own work.

Signature ...

... ..

Disclaimer

The views expressed in this thesis are those of the author and not of the Cheltenham & Gloucester College of Higher Education.

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CHAPTER 1

INTRODUCTION

A wide range of studies have suggested that family variables are related to children's literacy and general academic performance in school (Astone & McLanahan, 1991; Entwisle & Alexander, 1992; Steinberg et al., 1992; Marjoribanks, 1993; Campbell et al., 1994).

Furthermore, a number of studies have shown this relationship to hold for mathematical skills as well as for other cognitive skills (e.g. Davie et al., 1972; Fogelman et al., 1978; Entwisle & Alexander, 1992; Ferri E. ed., 1993; Marjoribanks, 1993; Campbell et al., 1994). Since the majority of these studies have been quantitative in design, variables were chosen which tended to lend themselves readily to this design, i.e., dichotic variables such as *mother left school early* or *stayed on at school*, or ordinal variables such as *father's social class* and *number of children in household*. Furthermore, whole cohorts or study groups tended to be used with little refinement of the samples.

Therefore, this study takes as its starting point a re-analysis of the data from the National Child Development Study (Davie et al., 1972; Fogelman et al., 1978, Fogelman, 1985). The National Child Development Study (NCDS) is a longitudinal study of family, medical, social and educational variables, which began with

approximately 17,000 children born in one week in March, 1958. The study returned to the cohort at age 7 years, 11 years, 16 years and has continued to monitor them at regular intervals since. The most recent survey was conducted in 1992 when the cohort was aged 33 years (Ferri, 1993). At age 11 years, the cohort completed a number of cognitive, literacy and numeracy tests, of which the arithmetic test was used in this study as a dependent variable, and this re-analysis focused on family variables in relation to mathematical/arithmetical achievement. The information gained from this statistical re-analysis was used as a pointer to focus on particular variables relating to family circumstances and dynamics, e.g. *parents' interest in their children's education*. By refining the samples of children, in terms of their mathematical achievement, in a more structured way, using techniques justified by recent researchers (Fletcher et al., 1994; Lewis et al., 1994), it was planned to investigate whether elements of mathematical and/or arithmetical achievement could be separated from general cognitive and educational skills, and also to determine whether there was a relation between this area of achievement and particular family variables.

This quantitative investigation constitute the early part of the thesis. From the NCDS data, multiple regression techniques were used to identify small but specific samples of boys and girls with high and low achievement in mathematical and reading skills. Within these

groups, a number of family variables were found to be associated with mathematical performance, but the majority of these were also associated with reading performance. For example, mothers who stayed on at school beyond the statutory leaving age and parents who showed a high level of interest in their children's education were associated with high performance in both mathematics and reading. However, after controlling for possible interactions with cognitive skills and reading ability, very few family variables were found to be associated specifically or solely with mathematics achievement. It appeared that, where previous researchers had found relationships between children's mathematical performance and family variables such as parents' social class, these may have been confounded by interactions with other cognitive skills being present.

The re-analysis of data suggested that the most relevant NCDS variable which attempted measure family involvement in the development of mathematical skills appeared to be *interest shown by parents in their children's education*. Although this variable was based upon teachers' subjective assessment of the level of interest shown by mothers and fathers when the children were aged 7 years, a significant association with all the study groups four years later at age 11 years, suggested that it would be useful to focus on more detailed measures of parental interest. However, it was thought that such measures may not lend themselves to quantitative scaling, and it was this which suggested the

thesis should move toward a more qualitative style of investigation, involving direct access to parents and homes, and focusing on less quantifiable family variables such as parenting style and intra-family interactions (Feldman & Wentzel, 1990; Steinberg et al., 1992; Wentzel, 1994; Campbell et al., 1994).

Therefore, the study developed in two parts. An initial statistical investigation, which then provided the groundwork for a detailed qualitative investigation. This latter phase used a small sample of children and semi-structured interviews with their parents aimed at eliciting new constructs for family variables. These constructs were then related to the children's specific performance in mathematics.

Quantitative work usually involves the use of large samples, and variables that can be readily quantified. Specific effects can be postulated, and mathematical techniques employed to decide whether sample findings are representative of a general population (Campbell & Stanley, 1963; Cook & Campbell, 1979; Tacq, 1997). Qualitative work, in contrast, may involve a large amount of interwoven verbal or textual data, obtained from a small number of sources (Strauss, 1987; Patton, 1990; Dey, 1994). In addition, it is often difficult or impossible to assess whether data from a small sample is generalisable to a larger population. Qualitative analyses are inevitably descriptive, and, unless particular care is taken in project design, may lack rigour.

In choosing a methodological paradigm within which to conduct the major qualitative phase of the study, a number of options were available. However, that outlined by Goetz and Lecompte (1995), appeared particularly appropriate, for the following reasons. Firstly, in relation to this particular study, data about the sample of children were to be gathered at a particular point in their educational progress, i.e. as soon as practicable after their Standard Assessment Tests at age 13/14 years. This was, therefore, to be a 'single moment' type of study, which precluded the use of ethnographic techniques, as described in Spradley (1979, 1980) and Pollard (1985). Secondly, the data were to be compared between different groups, i.e. families of high, moderate and low achievers in mathematics, so analysis based, for example, on grounded theory (Glaser & Strauss, 1967; Strauss & Corbin, DATE), which may be appropriate for a homogeneous group would not be appropriate in this instance. Goetz and Lecompte (1995) founded their methodology on experimental designs described by Campbell and Stanley (1963), in that they pay particular attention to the concepts of validity and reliability which are considered to be essential elements of quantitative research. This emphasis on reliability and validity of data seemed to be particularly relevant in the context of a study which had originated in a statistical investigation.

A great deal of qualitative analysis now takes advantage of sophisticated computer software packages to assist with data management and synthesis (Saunders et al., 1997). Two textual analysis software packages were found to be particularly useful in this study. The hierarchical structure of NUD.IST (Non-numeric, Unstructured Data, Indexing, Searching and Theorising), developed by Richards and Richards (1991), was used in the pilot study to identify categories in parents' talk, and to refine the structure of the questionnaire used in the main study. ATLAS/*ti* (Muhr, 1991) was found to be especially useful for identifying embedded text and was used to code and retrieve text from the main interviews. This facilitated the development of the sensitising sub-categories that are reported in Chapters 5 to 8.

In summary, the present study has sought to combine the quantitative and qualitative paradigms by using:

- quantitative methodology, i.e. a large sample (cohort), with defined and measured variables, tests of significance, etc.;
- a focused, detailed qualitative study to reveal depth and richness of data;
- the use of computer software as an aid to identifying and defining, within the qualitative data, hitherto unexpressed variables, and to analyse them for both qualitative and quantitative display.

The major, qualitative phase of the study suggested that children with a high achievement specifically in mathematics were more likely to be found in families where:

- both mother and father had continued their education at least to O Level examinations;
- a history of educational achievement (beyond O Level) in the parents' wider families was reported;
- parents appeared to take a broad view of education in general, citing a number of its advantages, e.g., as having intrinsic worth, as a preparation for adult life, as a route to academic credentials;
- from the parents' reports in the interviews, home environments appeared to show high levels of parent/child/sibling interaction;
- the parents reported their children as being well motivated to pursue their studies, and enjoying good relations with both teachers and peers.

In contrast, family influences associated with low mathematical achievement appeared to be as follows:

- usually neither, or only one parent had stayed on at school after the statutory school leaving age to take O Level examinations;
- there appeared to be little history of educational achievement beyond O Level in the parents' wider families;
- most parents expressed views which suggested that education has few advantages;
- parents' reports in the interviews suggested that home environments showed little parent/child/sibling interaction;

- the children's motivation to study was reported to be low, and relations with both teachers and peers were reported to be poor.

It would be prudent, at this stage, to point out that the data obtained may be idiosyncratic to this study. Other researchers, occupying different positions and studying different children from different schools, may elicit different responses from parents. The techniques adopted to maximise the reliability and validity of the data are discussed in Chapter 4.

Summary

The thesis begins with a literature review, and then reports the results of a detailed re-analysis of the NCDS data (Chapters 2 and 3).

Chapter 4 describes the theoretical underpinnings that led to the design of the qualitative phase, and the analysis of the interview tapes is detailed in Chapters 5 to 8. Finally, the results are discussed and synthesised in Chapter 9, and suggestions offered as to the direction of further research.

CHAPTER 2

CHILDREN'S EDUCATION AND THE HOME ENVIRONMENT

Literature Review

"When the home and school have divergent approaches to life and learning, children are likely to suffer in their school learning. Conversely, when home and school have similar emphases on motivation and learning, children are likely to do well."

(Kellaghan, Sloane, Alvarez & Bloom, 1993, p.145)

"The home is central to students' daily experience."

(Wang, Haertel & Walberg, 1993, p.278)

"Schools are now confronting an array of families whose involvement with their children's learning is exceedingly diverse. Some are deeply involved, and have the skills to be effective. Others are involved, but in ways that are ineffective or harmful. And still others take little time to inculcate in their children those personal traits that facilitate the school's goals." (Coleman, 1991, p.6)

In this chapter, the influences arising from the home environment, and the effects they may have on children's learning will be reviewed in five sections.

In the first section, parental influences at home will be considered, under three sub-headings:

- 2.1.1. parental capital, cultural transmission and parenting style;
- 2.1.2. changes of parent;
- 2.1.3. measurement and categorisation.

In the second section, parental involvement in the educational process will be reviewed under three sub-headings:

- 2.2.1. parents' engagement with/ distance from their children's schools;
- 2.2.2. educational interactions between parents and their children;
- 2.2.3. home/school collaborations, and the parent as an educational construct.

In the third section, theories of sibling effects will be reviewed under three sub-headings:

- 2.3.1. the resource dilution hypothesis;
- 2.3.2. the confluence theory;
- 2.3.3. the admixture hypothesis.

In the fourth section, some evidence for gender differences in pupils' responses to mathematics will be considered under three sub-headings:

- 2.4.1. gender and mathematics;
- 2.4.2. attitude to mathematics;
- 2.4.3. teachers.

The fifth section focuses on the health and development of the child under two sub-heading:

- 2.5.1. mother's health in pregnancy;
- 2.5.2. child's health and development.

2.1. Parental Effects

2.1.1. Parental Capital, Cultural Transmission and Parenting style

In a development of the cultural transmission theories of Bordieu (1984), current research views parents as repositories of family capital (Marjoribanks, 1994), part of which is described by Coleman (1988) as

human capital (such à priori elements as parents' social class, their level of education, the number of their children and their engagement with their children's schooling), and part as social capital (the aggregate of the relationships and interactions that obtain within the family, sometimes referred to as parenting style).

Data on variables of the type described above as 'human capital' were collected in the National Child Development Study (NCDS) using questionnaires administered to parents and teachers of over 17,000 children born in one week of March, 1958. Questionnaires were completed in the first four of six phases of the study in 1958, 1962, 1969 and 1974, when the children were born, and aged 7 years, 11 years and 16 years. Fogelman (1975, 1983) and Fogelman, Goldstein, Essen and Ghodsian (1978) interpreted the data to suggest that parents from the higher social classes I, II and III (non-manual) were likely to have smaller families, that parents who had continued in education beyond the statutory school leaving age were more likely to have smaller families, and that smaller family size was associated with greater parental interest in their children's schooling. The same authors also concluded from the data that advanced attainment in both mathematics and reading was found in children from smaller families, whose parents were from higher social classes, were well educated and were interested in their children's education (Fogelman et al., 1978). Later work by Ferri (1993), when she analysed the self-

responses from the cohort members at age 33, showed the same pattern of higher education in the next generation being associated with smaller numbers of children.

In a similar project in the United States, the Collaborative Perinatal Project, 36,000 children were enrolled at birth over a six year period. Data was accumulated on their physical and intellectual development, together with data relating to the parents' SES, education and intellectual development as measured by standardised IQ tests. Using multivariate statistical techniques, Broman (1989) concluded that the highest proportion of variance in children's IQ scores at age 7 was accounted for by socio-economic status, maternal intelligence test score and maternal education.

Coleman (1988) argued that good quality social capital, i.e. good relationships and interactions between children and parents, is a conduit through which children may gain access to the human capital that resides in their parents. In contrast, poor quality social capital may block off that access. For example, it is thought that, where linguistic communication between parents is restricted, children do not have as much access to their parents' knowledge and experience as when the linguistic communication is elaborate. Nor do children who use restricted linguistic codes have as good access to the educational curriculum in school as do children who are accustomed to the use of

more elaborate linguistic codes (Aronowitz & Giroux, 1988; Bernstein, 1990).

During the 1970s and 1980s it was conventional wisdom that, as children reached adolescence, parental influence waned, and was replaced by peer group influence. (Berndt, 1979; Steinberg & Silverberg, 1986). More recent research, however, has indicated that this may not be so polarised, and that parenting practice and style may determine not only the likelihood of children turning from their parents to their peers, but also the type of peer groups entered into (Steinberg, Lamborn, Dornbusch & Darling, 1992; Brown, Mounts, Lamborn & Steinberg, 1993; Fletcher, Darling, Steinberg & Dornbusch, 1995). Peer group affiliation is not a matter of chance, but “.... a function of one’s reputation with peers by virtue of one’s background and behaviour.” (Brown et al., 1993, p.469). In a study of the peer/parent networks of 4,500 adolescents in Wisconsin, the Steinberg team of authors observed that authoritative parenting (combining high levels of parental warmth with firm control) was positively correlated with academic achievement and school orientation, and negatively correlated with deviancy, delinquency, stress and peer susceptibility. (All the correlations were >0.2 , $p<.01$). Fletcher et al. interpreted their findings to suggest that “... authoritative style of parenting is associated with adolescent competence, and competent youngsters are attracted to and influence each other (Fletcher et. al., 1995, p. 308).

Since peer group influence has also been shown to be closely related to academic achievement (Hargreaves, 1984; Ball, 1984; Pollard, 1985), there is the additional spin off that effective parenting style of itself not only inculcates academic values, but is also likely to ensure entry to peer groups with similar values. Indeed, Harris (1995, 1998) has gone further, and developed a 'group socialisation' theory of development, where the effective environment in which a child develops is its peer group, and the direct influence of parenting style is minimal.

Less effective parenting styles are sometimes referred to as authoritarian (parents are overbearing and opinionated), or permissive (parents allow their children freedom of action and assertion).

However, there is some doubt as to the effectiveness or otherwise of the authoritarian approach, since, for example, this style may be favoured by certain ethnic minority groups, whose children appear generally to achieve highly in school (Harris, 1995, 1998).

Nevertheless, there is some evidence that less effective parenting styles may lead to a decline in parents' influence as the children reach adolescence, with loyalties being transferred to peer groups whose members have also become alienated from parental influence (Brown et al., 1986; Feldman & Wentzel, 1990). For example, after

interviewing 25 young offenders in a secure institution, Feldman and Wentzel (1990) suggested that boys in particular, in the absence of positive family relationships, may come to depend more on their peer group for support, and so run the risk of adopting negative behaviour and values. Similar observations had been made a generation earlier by Herzog and Sudia (1971, 1973). As Cullingford and Morrison (1997) suggest, such 'negative attitudes' may be the first step, not just to a rejection of academic values, but social values as well, with deviancy and criminality further down the line.

However, a more cautious assessment comes from Marjoribanks (1996) as a result of an analysis of parenting styles, based on scaled responses to questions such as "How often do you praise your children for good work?" He was unable to show that parenting style has any mediating effect between intellectual ability and school outcomes. Clearly, the identification of and measurement of parenting practices and style needs further research.

The effective authoritative style of parenting is described in terms of three components:

- warmth, i.e. parental acceptance and emotional empathy;
- control, i.e. behavioural supervision, strictness and discipline;
- democracy, i.e. the granting of psychological autonomy (Steinberg et al. 1992; Brown et al., 1993; Fletcher et al., 1995).

There would seem to be some resonance here with the conclusions of Cullingford and Morrison (1997) that confident parents beget confident children who, in turn, will make good relationships with their peers. Parents with the confidence to exercise control and discipline, yet grant appropriate autonomy to their adolescents, are likely to conform to the model of authoritative style.

2.1.2.Changes of Parent

Children who live in one parent or step parent families may well have different experiences of parental influence and example from those children who live in two parent families. In terms of Coleman's model, children experience changes in both human and social capital through the loss of a parent, from whatever circumstances. It seems to be generally accepted that such changes are for the worse, although there is not much agreement as to why this should be so, if indeed it is so (Mulkey, Crain & Harrington, 1992; Harris, 1995, 1998).

Suggestions to justify the view that loss of a parent has a detrimental effect on academic performance have been varied:

- that a decline in academic performance by students after the loss of their fathers is largely due to the decline in economic circumstances of the residual family (Herzog & Sudia, 1971, 1973; Ferri, 1976);
- that a decline in grades arises more from the loss of parental encouragement and involvement in the schooling process (Astone & McLanahan, 1991);
- in an analysis of achievement data from the NCDS, Ferri (1976) found statistical evidence to suggest that, although

the general achievement of children living with widowed mothers was, on the whole, similar to that of children from two parent families, mathematical achievement was significantly poorer. (However, Ferri was careful to argue only that her findings may lend some support to the notion that fathers' influence tends toward the quantitative rather than the verbal in their relations with their children).

However, after a carefully controlled analysis of data from the *High School and Beyond* study (Heyns & Hilton, 1982) relating to children in one parent families, Mulkey, Crane and Harrington (1992) rejected the above explanations. Data collected from 3,600 single parent families and a matched number of two parent control families were selected for analysis, and three levels of multiple regression analyses were carried out. First, simple regression coefficients were obtained for an association between parental absence (of both sexes) and levels of academic achievement. In a second stage, demographic variables were added into the analysis (sex, ethnicity, geography) and the resulting coefficients were reduced by as much as half. In the third stage, a number of economic and behavioural variables were added into the analysis (e.g., family income, home tenure, patterns of the children's homework, dating and television watching activities), and the coefficients relating to one/two parents virtually disappeared. One factor which emerged, was that low income was more weakly related to achievement in father-absent homes, more important in two parent homes, and most important in mother-absent homes. Mulkey

et al. (1992) concluded that the relation between student achievement and family's economic conditions is a spurious one, and that parents' income and education stand as proxies for their intellectual capacity. That is, the closer the association between parental academic resources and family income, the closer the association between family income and student's achievement.

Mulkey et al. (1992), therefore, felt able to reject the earlier suggestions of Herzog and Sudia (1973), Ferri (1976), and Astone and McLanahan (1991), and proposed that the real association underlying poorer academic grades in single parent families lies in the students' misbehaviour rather than the economic or relational conditions at home. They suggested that, in high school classrooms, no discrimination occurs for reasons of family income or social class, but there is a strong reaction against student misbehaviour, most likely leading to students' alienation from the educational process.

Furthermore, in a more recent elaboration of group socialisation theory, Harris (1995) returns to the concept of a decline in economic capital subsequent on divorce, and suggests that the lowering of family financial status, often associated with a down market change of residence, disrupts the children's peer group relations:

They lose their peer group and their place in the status hierarchy; they must win acceptance by a new group, and establish their status all over again. (p 480)

Harris' suggestion is that this peer group disruption has a stronger effect than the disruption in the home.

2.1.3. Measurement and Categorisation

The theoretical framework of these studies suggests that children's educational achievement may be related to a limited number of parental variables such as social class, cultural transmission and involvement in the schooling process. Empirical research underpinning these theories has usually adopted a 'social arithmetic' approach (Davies & Kandel, 1981; Fogelman, 1983; Mulkey et al., 1992). Quantified social variables are amenable to statistical analysis which can, to some degree, control for the complex network of interactions between them. For example, when Coleman (1991) determined measures for his structure of 'social capital', he used the quantified variables of parental presence, number of siblings, and parents' aspiration for college entrance for their children.

Much of the research in the field of education has also been quantitative, and quantitative research involves categorisation.

Naming categories is part of a professional terminology, and the use of categories may be perceived as the mark of professionalism, even of distancing, to indicate scientific objectivity. However, in categorising groups of people, difficulties may arise. An interesting example of the way in which the naming of "parents" as a category can obscure

rather than illuminate an issue, is a study by West and Varleem (1991), who interviewed parents about their choice of secondary schools for their children. Of their interviews, 67% were with mothers, and 25% with two parents jointly, but no reference in their report is made to any differences between maternal and other responses. Responses from sole interviews are cited as 'mother' or 'father', but responses from joint interviewees are cited as 'parents'. Furthermore, joint citations, in many cases, use the plural pronouns "we" and "our". This difficulty is acknowledged by West in later work, where responses from mothers and fathers were reported and analysed separately (West, Noden, Edge & David, 1998).

In another example of the difficulties associated with categorisation, Hunter (1994) also interviewed parents about their choice of secondary schools. From the 289 interviews conducted, much of the reporting is in the form of descriptive statistics, e.g.

" ... 147 parents (51%) were parents of boys and 142 (49%) were parents of girls." (p 33)

" ... sixty five parents (22%) had at least" (p 35)

Throughout, the frequencies and percentages are cited as "parents", when what is being counted is the number of interviews.

Clearly, the methodological techniques of quantitative analysis are sometimes misapplied in sociological research. A critique of the poor

quality of statistical analysis to be found among workers in the sociology field is offered by Blalock (1989), who points out that mathematical modelling as a basis for theorising has had little useful effect in sociology. Likewise, Astone and McLanahan (1991) urged that much better variables are needed if we are to understand the relationship between home influences and school achievement. In their investigation using data from the *High School and Beyond* study (National Centre for Educational Statistics, 1980), they found three variables were all strongly associated with school achievement:

- parents' aspirations for their children's future;
- the day-to-day level of monitoring and supervision of the children's homework;
- the amount of time the parents spend talking with their children.

They recognise the measurement error inherent in such single item indicators, but recommend that other researchers improve the collection of data relating to parent/child interactions.

In what he described as "an attempt to overcome some of the measurement limitations of prior research", Marjoribanks (1986) examined the associations between the home and school environments and the educational and employment aspirations of 900 sixteen year old students in Australia. Despite claimed improvements in measurement, and a greater focus on the interdependence of the variables, this study remains an example of 'social arithmetic' and, by Marjoribanks' own

admission, indicates the need for more sensitive family and school learning environment measures (Marjoribanks, 1994 p.453).

Nevertheless, however refined the measurements, it is hard to avoid the difficulty inherent in social arithmetic studies, that the measurements stand only as proxies for the underlying variables.

Thus the theories of 'cultural transmission' (Bourdieu, 1984), 'linguistic code' (Aronowitz & Giroux, 1988) and 'social capital' (Coleman, 1988) may be only imperfectly measured using such variables as social class. In the context of school environment studies, Lee and Bryk (1989) recognise that the development of good measures of the school environment is a difficult task under any circumstances, and they view the variables used in this study as proxy measures:

As a group the variables point towards important features of school life, but we are reticent (sic) to give too much interpretive import to any one of them, given their modest conceptual and empirical base. (p. 189)

2.2. Parents' Involvement in the Education Process

2.2.1. Engagement with and distancing from schools

Of particular importance to children's educational progress is the level of support and encouragement offered by their parents. In a study of the involvement of parents from different schools in their children's education, Lareau (1987, 1989) observed that parents from the school with a predominantly working class intake interacted much less with

their children's schooling than did parents from the school with a predominantly middle class intake. The latter read to their children, initiated contact with the teachers and attended school events more often than the working class parents. For example, where 100% of middle class parents attended parent-teacher conferences, and 96% attended open house events, only 60% and 35% respectively of working class parents attended. While nearly half of middle class parents had been volunteer classroom assistants, only one parent from the working class group did so. Lareau interpreted her findings to suggest that working class parents depended on schools for the education of their children, in the same manner as they depended upon doctors for their health. In contrast, middle class parents saw education as a partnership between themselves and the schools, characterised by involvement and scrutiny. Despite the limited extent of this survey (n = 62), Lareau concluded that the concomitants of social class (education, occupation, income and the characteristics of work) provide parents with unequal resources and dispositions, and these differences critically affect their involvement in the educational experiences of their children. She classifies these as 'separation' in the case of working class parents, and 'interconnectedness' in the case of middle class parents (Lareau, 1987).

A further illustration of this separation from the schooling process was the more substantial study of different educational outcomes

experienced by children from different home backgrounds, undertaken by Entwisle and Alexander (1992). In a longitudinal study across the seasons of the year, involving 800 first grade African-American children in Baltimore City, they found that the mathematical achievement of poorer children fell away during the summer holidays, as compared with their “better off” peers, yet was sustained during seasons when the schools were in session. The interpretation that they put on their results is that home influences are paramount during the summer break from school, whereas during the school terms the home influences are entangled with the school influences. Thus, the fall away of achievement of poorer children during the summer must be due to (unspecified) disadvantageous home variables. The move from correlation to causation, however, is assumed rather than justified, as Entwisle and Alexander conclude that, “Both the power of home resources to stimulate growth in summer and the power of schools to make up for the dearth of poorer children’s home resources in winter is clear.” (p. 80)

Steinberg et al. (1992) also observed that parent/school involvement was significantly correlated with authoritative style, and Wentzel (1994) argued for greater parental involvement in children’s education:

Parents can play a more direct role in fostering their children’s cognitive development and academic achievement by becoming involved in the children’s academic activities. Indeed, parents who directly participate in their young children’s education by helping them with homework, reading to them, and playing educational games, tend to have children who excel at academically relevant tasks. (p.271)

This appears at first sight to contradict the findings of Campbell et al. (1994), that parental help with schoolwork can have a counterproductive effect. Such a contradiction should be viewed with caution, however, since Wentzel is proposing a more holistic approach to parental involvement than simply helping with homework.

The picture that emerges from such studies is that certain positive parental influences are likely to be related to good academic achievement by the children. Such a linkage appeared to be confirmed in an analysis of data from the Second International Mathematics Study (SIMS), performed by Tocci and Engelhard (1991). Comparisons of responses from over 7,000 students aged 13 years in Thailand and the United States revealed that parental behaviours appeared to be related to students' attitudes toward mathematics, as well as their achievement.

For students in both countries, the relationships between parental support and each of the attitude scales had the same direction as those for achievement - the higher the perceived parental support, the higher the mathematics attitude for MYSELF, SOCIETY & MALE DOMAIN, and the lower the attitude for ANXIETY. (p. 285)

(The attitude scales used were from Fennema & Sherman, 1977, 1978)

Parental behaviours appears to be related to student attitudes toward mathematics. Frequently, researchers of adolescent behaviour underestimate the power of the home environment. Some of the more permanent and important effects of attitude may occur because of factors in the home environment that are central to their developing value system. Adolescents' perceptions of their parents' reactions to mathematics and ability to do mathematics, along with the amount of encouragement to study the subject and do well at it, may affect the students' attitudes toward mathematics. (Tocci & Engelhard, 1991, p.285).

The lack of such positive influences may lead to some degree of student alienation from parents, school and study. While the positive influences described point to a parenting style which is committed, consistent and integrated with the educational process, a third type of parent school relationship appears to emerge, to add to the 'separation' and 'interconnectedness' identified by Lareau (1987). This approach is 'pro-active', where the parents assume that they have the leading role to perform in the upbringing and education of their children, and the schools are there to provide the necessary academic and curricular support. Implicit in this model is that children with such upbringing attend school with the desire to learn already in place.

2.2.2. Educational Interactions between Parents and Children

Social capital, as proposed by Coleman (1988), has been defined as "...the general quality of the interactions that occur among the members of the environment." (Marjoribanks, 1994, p. 454). In terms of the relations between parents and children as collaborators in the educational enterprise, these interactions are developed as pressure to succeed, supervision and monitoring, help with schoolwork, and support through intellectual resources such as books and computers.

In parallel studies in five countries, excessive pressure by parents was found to have a dysfunctional (sic) effect on their children's achievement, and high levels of support were found to have a significant positive effect (Campbell & Uto, 1994; Flouris, Hourdakis, Spiridakis & Campbell, 1994; Campbell & Wu, 1994; Pitiyanuwat & Campbell, 1994). Although these linked studies focused mainly on mathematics achievement, they also observed that reading comprehension skills were strongly associated with mathematics achievement. (Campbell & Wu, op. cit.; Flouris et al., op. cit.). As well as parental pressure, parental help with schoolwork was also found to have a significant negative effect, although after controlling for prior ability, a small positive effect was noted. That is, children with low prior ability tended to receive more help from their parents, but this had only a marginal effect on their achievement. The same dysfunctional effect was noted by Etherington (1992). Parents' education was also observed to have a positive effect but, it was suggested, via intervening variables of socio-economic status, pressure and support. As already mentioned, a similar suggestion had been made by Mulkey et al. (1992).

The results that emerged from the international group of studies (Campbell & Uto, 1994; Flouris, Hourdakis, Spiridakis & Campbell, 1994; Campbell & Wu, 1994; Pitiyanuwat & Campbell, 1994) appeared to suggest the existence of a network of parent/child interactions.

1. Low ability children may be under more pressure and receive more help from their parents than do high ability children. It does not appear to have a positive effect, however, since the pressure may bear negatively on their self concept, and the proffered help is only a suppressor variable between low prior ability and low achievement;
2. High ability children are often under less pressure, since they are already achieving, and their parents' satisfaction appears to be good for the children's self concept;
3. Parental help, if unsolicited, seems to be counterproductive, i.e. the more help offered the lower the achievement;
4. Daughters of high achieving mothers may feel overshadowed, and low self concept may lead to low achievement, despite prior ability;
5. Sons of high achieving mothers may also be high achievers. Boys may not feel overshadowed or threatened by their mothers, and may derive the benefits of their intellectual resource, without suffering any of the disadvantages;
6. High achieving fathers are positive models for high ability daughters, who enjoy the benefits of the intellectual resource. Low ability girls, however, may be more likely to reject academic achievement *because* it is associated with their fathers;
7. Highly educated fathers extend less help to girls than to boys;
8. Highly educated fathers are likely to have married highly educated mothers, thus compounding the effects in (4) and (6) above for low ability girls.

Flouris et al. (op. cit.) further elaborated the interconnections between students' self concept and parental control. In common with Cullingford and Morrison (1997), they suggested that parents are largely responsible for the development of self concept in their children, and that excessive control, imposed by authoritarian (as opposed to authoritative) parents, may exercise a negative influence on the success of the children, confirming a relationship suggested earlier by Marjoribanks (1981). Flouris et al. (op. cit) proposed that a high level of school success can be achieved if parents do the following:

- exert low levels of pressure on their children;
- give the children help only when it is needed;
- strike a balance between controlling and supervising their children's schoolwork;
- give children the psychological support they need;
- help the children develop positive self concepts;
- avoid differentiation and discrimination between the sexes.

(Flouris et al., 1994, p.711)

This profile of parenting practices bears a close resemblance to the authoritative parenting style mentioned earlier (Steinberg et al., 1992; Fletcher et al., 1995).

2.2.3.Home/School Collaborations,

and the Parent as an Educational Construct

In an attempt to improve children's reading, Tizard, Schofield and Hewison (1982) developed a collaboration between primary school teachers and parents, and controlled comparisons were made between whole classes from a cohort of 6/7 year old pupils from six primary schools in Haringey. Two classes of infants were selected at random for a collaborative reading programme, where parents regularly heard their children read from books sent home by the teachers. Over a two year period, their reading progress was compared with that of control classes, who were given extra reading tuition at school. At all ability levels, the children in the home-reading classes showed significant gains over the control groups. Although they admitted to not understanding the underlying variables that contributed to this observed effect, Tizard and her colleagues believed that it was strong enough for them to interpret it as a causal relationship between parents hearing their children read and reading attainment. The Haringey paradigm was adopted formally by Hackney LEA under the name of PACT - parents, children and teachers - (Griffiths & Hamilton, 1984). PACT has been widely used and researched (Wolfendale, 1983; Topping & Wolfendale, 1985; Wolfendale & Topping, 1996), and its success led to a companion project in mathematics being developed

called IMPACT - inventing mathematics for parents, children and teachers - (Merttens & Vass, 1990, 1993).

However, collaboration between teachers and parents has been problematic. Home/school collaboration is usually initiated by the teachers, and undertaken within the discourse of professional education. In this, the teacher is the leader and expert, and the parent the assistant in the collaborative project. In particular, teacher discourse about parents is implicitly categorical (Coleman, 1991; Brown, 1993). In the home/school movement attempts have been made to counter the power imbalance through “listening to parents” (Atkin, Bastiani & Goode, 1988), and involving parents more in the classroom situation (Macbeth, 1989). But, so long as the preparation of materials for collaborative instruction lies in the hands of the teachers, their discussions of what parents can or cannot, will or will not do, are conducted in terms of the categories they have developed within the particular school (Brown, 1993).

The problematic use of the term “parent” for the purpose of categorisation has already been discussed above in the section on measurement. In addition, the use of the term as a shorthand category for that group of adults accidentally associated with the schools through their relationship to the children under instruction, has ensured that, in teacher discourse, the individuality of the parent

is often overlooked. For instance, in the report by Tizard et al. (1982) of their collaborative Haringey project, they consistently use the word “parents” rather than “mothers” or “fathers” in describing the adults at home who were recruited to listen daily to the children reading. There is no indication of the identity of these listening adults, nor whether they took turns to listen, nor whether the quality of the experience for the children was in any way dependent upon the identity of the listening adult. In describing the recruitment methods, the authors use the phrase “all parents” indiscriminately, e.g.:

“ ... all were seen before half-term, either at school or at home.”
“ ... all parents agreed to allow the researchers to visit them in their homes.”
“ ... advice was given to all parents on good practice.” (p. 3)

and there is no indication whether this means that every parent of the children in the design group was seen, advised and agreed, or that at least one parent was seen for every child in the group.

In describing home visits, the researchers reported that:

“ ... it was the practice of researchers to observe the children reading to their parents.” (p.3).

It might be reasonable to ask in how many cases did a researcher observe a child reading to his or her parents in the plural; were both parents always present, or was it predominantly the mother or father; is it possible that in every case it was the mother being observed; and to what extent were other adults or siblings involved in the activity?

Yet, earlier in the same text, parents *are* referred to as if they are homogeneous, e.g.

“An attempt has been made to demonstrate how parents perform their role in the dynamics of family life.” (p.100) [not *their roles*]

“The *teacher* complements the *parents’* unique specialist knowledge of the child.” (p.100) [not *the parent’s unique knowledge.*]

“It is the teacher’s role to enable the parents.” (p.100)

These writers are able to discuss the concept of parental individuality, yet, in their professional discourse, while nearly always speaking of ‘the child’, they rarely speak of ‘the mother’ or ‘the father’. In many professional discourses, a specific term may be used as a form of shorthand to indicate a category that has implicit meaning for all fellow professionals in the same discipline. For instance “patients” in the medical profession, “clients” in the financial services industry. Although such words are used in a straightforward administrative context, within each profession, the terms are value laden, carrying with them a whole range of implicit meanings that are understood, if rarely enunciated, by fellow disciples. In administrative terms, within the teaching profession, “parents” are those who maintain or have custody of the children who come before the teachers in the classroom (Macbeth, 1989). However, difficulties arise when types and personalities are ascribed to a group of people whose category “parents” is a purely administrative one. For instance, it could be argued that the most significant differentiation of the category “parents” is not by class or race, but by gender. For example, Tizard

and Hughes (1984) found evidence to suggest that, in a sample of girls only, language acquisition was strongly associated with child/*mother* relationship in the home. Despite the emphasis placed on this relationship in their study, later writers have still continued to refer to “parents”.

Teaching is not the only profession in which parents are categorised in this way. For example, Strauss (1987) uses as a tutorial for his students an interview with parents of a child born with a congenital heart condition. In his analysis, he consistently refers to the parents as a single unit, and accepts, without question, their use of the pronoun “we”. Oppenheim (1992) in discussing checks for validity of interview schedules, suggests that it may sometimes be appropriate to use two informants to report on the same set of facts or events:

“ ... for instance, husband and wife [with regard to marital relations or joint financial transactions], or parent and teacher [with regard to a child’s behaviour] ...” (p.146)

The implication being that husband and wife are distinguishable in the frames of finance or relationships, but indistinguishable in the frame of their child’s education.

Goetz and Lecompte (1984), rightly from a methodological viewpoint, lay great stress on the fact that:

“.. key informants are individuals ... they are often atypical individuals.” (p.119)

The above brief review clearly indicates that, when reading and writing of studies involving 'parents', care must be taken to distinguish between the use of the word as an administrative category, and its use as an identifier of informants.

2.3.Sibling Effects

A number of research studies have investigated the relationship between educational achievement and family size (Douglas, 1964; Davie et al., 1972; Fogelman et al., 1978). From data available in the NCDS study, evidence suggests that children from smaller families tended to achieve better than children from larger families, and that small families were associated with higher levels of parental education and social class. Comparison of the reading and mathematics age equivalent scores of over 9,000 children aged 11 in 1969 indicated that children from smaller families were up to six months more advanced than their peers from larger families (Fogelman et al., 1978).

However, a six months age range in achievement between children with and those without siblings is very small when compared with the 7 year age range that Cockroft suggested obtained in the mathematics achievement of 11 year olds in the UK (Cockroft 1982).

2.3.1. The resource dilution hypothesis

Two possible explanations were proposed by Folgeman (1983) for the range of achievement associated with family size. One is that, in larger families, resources are spread more thinly between the members of the sibship group, and the other that family size is related to parental attitudes, and it is these that are affecting progress.

However, after controlling for parental education and social class, the sibship size effect was still observable, so these researchers concluded that resource dilution was the more likely explanation.

The resource dilution hypothesis has been further elaborated by Blake (1989), and Steelman and Powell (1991). Drawing on the human capital theories of Becker (1964) and Coleman (1988), it proposes that the greater number of children in a family, the more thinly spread its human and economic resources, and that the children's educational achievement is correspondingly jeopardised. There may appear to be an intuitive 'rightness' about this hypothesis, which has led to it being stated as fact perhaps more often than it has been tested. However, a study by Steelman and Powell (1991) into the willingness of parents to pay for higher education for their children, brought this view into question. These authors asked the parents of over 7,000 high school children from the *High School and Beyond* study (Heynes & Hilton, 1982) whether they were able or willing to pay for post-secondary

education for a particular child. In multiple regression equations derived from a series of variables comprising a family profile, the child's ordinal position in the sibship group emerged with the highest coefficients (0.8 +, $p < 0.001$), over twice the size of the coefficients for family income (0.3 +, $p < 0.001$). In effect, the later the child came in the sibship group, the more likely were the parents able to pay. From these results Steelman and Powell (1991) concluded that the decline in the proportion of resources available to each child as the family expands over time may be more than offset by an increase in the absolute amount available as parents' income and status increase, and grandparents retire and become more involved with their families.

Parents are more likely to see themselves as capable of paying when they have more income have fewer children younger than the child in question ... and [themselves] possess more education. (p. 1517)

Parents respond that they are better able to finance the later born child's education ... and have actually saved more for that child's education. (p. 1525).

Nevertheless, these authors appear to be unaccountably drawn to the resource dilution theory. They point out that sibship size (number of children in the family) is a significant influence on all the attitudinal measures they used, although in substantive terms, the regression coefficients for sibship size were the smallest (-0.14 to -0.16, $p < 0.001$).

2.3.2. The confluence theory

Zajonc and colleagues, while attempting to explain the relationship between sibling variables and the cognitive development of 386,000 members of the Dutch armed forces (Zajonc, 1976; Zajonc & Markus, 1975; Zajonc & Bargh, 1980; McCall, 1985), found the resource dilution hypothesis too limited to explain their data. They suggested that the observed patterns in their analysis were due to the confluence of two factors:

- the average IQ of all members of a family declines with each succeeding birth;
- the teaching of younger siblings stimulates the intellectual development of older members.

It may appear that the first factor is unavoidable, if the supposed 'IQ' of the new born infant is included in the averaging calculation, and conforms to the resource dilution theory.

However, the second factor was suggested by Zajonc to explain how the observed mean IQs of singleton children was lower than that of first and second born children from families with sibling groups of three or more. His team sought to explain their results by suggesting that singleton and last born children miss out on the opportunity to teach their younger siblings, and are thus intellectually disadvantaged (Zajonc & Markus, 1975). Although this hypothesis too may possess

an intuitive appeal, attempts to replicate the work have failed, and in a compelling critique of the work of Zajonc and his colleagues, Retherford and Sewell (1991, 1992) claim that the statistical analyses were flawed, it was impossible to observe any fit between the confluence model and their own observations, and that the theory is an inadequate attempt to explain a non-existent phenomenon.

2.3.3. The admixture hypothesis

Since neither the resource dilution theory nor the confluence theory have been entirely successful in linking sibling variables to educational achievement, some researchers have put forward the hypothesis that such associations may be an artefact of the sub-groups within data, for example social class or ethnic sub-groups. In testing this 'admixture' hypothesis, Marjoribanks (1988) found that sibling variables had no significant association with adolescents' educational aspirations after controlling for other family variables. He did however, find ethnic sub-group variations in his analysis, and subsequent work by Shavit and Pierce (1991) noted significant differences across cultural communities in the way family variables were associated with educational achievement. In comparing Israeli communities based on the model of the nuclear family widely adopted in western society, and Arab communities based on the model of the

widely extended family (the *hamula*), Shavit and Pierce (op. cit.) concluded that,

The *hamula* provides a pool of adults who can supervise children, help them with their school work, provide psychological support, and offer financial assistance when needed. Therefore, additional children do not dilute the resource base in the same linear fashion as in nuclear family based societies. (p.328)

2.4. Gender Effects

As already noted, Flouris et al. (1994) proposed that parents should avoid differentiation and discrimination between their sons and daughters. However, the studies conducted by their own team, as well as other studies mentioned above, all suggest the opposite, and they appear to confuse 'equality' of opportunity with 'equalisation' of opportunity. Since boys and girls may respond differently to family variables, it could be argued that positive effects should be differentially reinforced and the negative effects differentially mitigated in order to ensure *maximum* rather than equal opportunities for both sexes. Indeed, since studies of GCSE results have shown that there are differences in performance by boys and girls, particularly in core subjects such as English, science and mathematics, examination boards are now having to address the same sort of issue, in terms which polarise into *equality of opportunity* or *equality of outcome* (Stobart et al., 1992).

2.4.1. Gender and mathematics

One question regarding mathematics achievement that has come under scrutiny is whether there is an achievement differential between boys and girls.

Commonly, tests of achievement are standardised on combined populations, and are supposedly gender blind (Goldstein, 1986; Stobart et al., 1992). In a number of studies, when test results have been analysed for boys and girls separately, no significant differences in mean scores have been found (e.g., Martin & Hoover, 1987; Skaalvik & Rankin, 1994). This has not always been the case, however; results of a longitudinal study of 3,000 New Zealand students by Becker and Forsyth (1994), appear to contradict these assumptions.

Becker and Forsyth (1994) analysed scores on standardised mathematics tests longitudinally from grade 3 (age 8 years) through to grade 12 (age 17 years). In grades 3 - 8, the Iowa Test of Basic Skills (Mathematics Problem Solving) ITBS(M2) was used, and mean scores for boys and girls were found to be almost identical (a difference of less than 1 mark) throughout the six years. In grades 9 - 12, however, the Iowa Test of Educational Development (Ability to do Quantitative Thinking) ITED(Q) was used, and mean scores were consistently higher for boys than for girls (from 1.6 marks to 2.3 marks). One of

the authors appears to have relied on a factor analysis tool from the 1950s to conclude that the two test batteries studied were comparable across gender sub-groups, a conclusion which appears to be in conflict with his evidence. Either the boys suddenly began to outperform girls at grade 9 (see the Table on page 45) or, more likely there is an internal bias in the ITBS(Q) test which generates a differential gender mean score. Some support for this suggestion arises when the mean scores are analysed by centiles. Martin and Hoover (1987) observed that, for grades 3 - 8, in the lower centiles (10%, 25%) girls tended to outperform boys, whereas in the upper centiles the reverse occurred.

In Becker and Forsyth's study (1994), however, this effect for grades 3 - 8 was successfully replicated, but was unaccountably absent in grades 9 - 12 (see left hand Chart on page 45). The effect reappears, however, if their results are adjusted to take account of the gender difference in the mean scores of the ITED(Q) test (see right hand Chart on page 45).

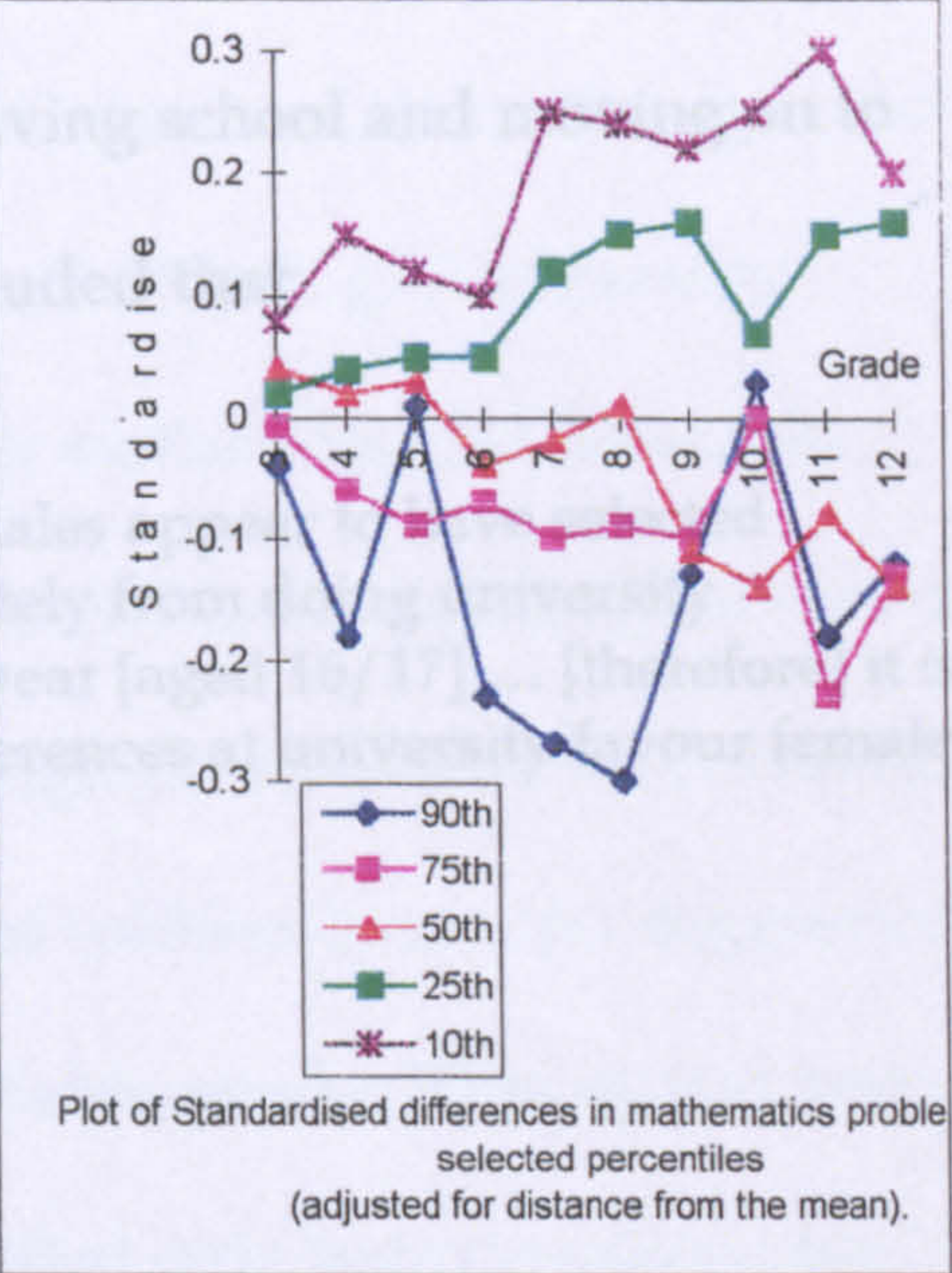
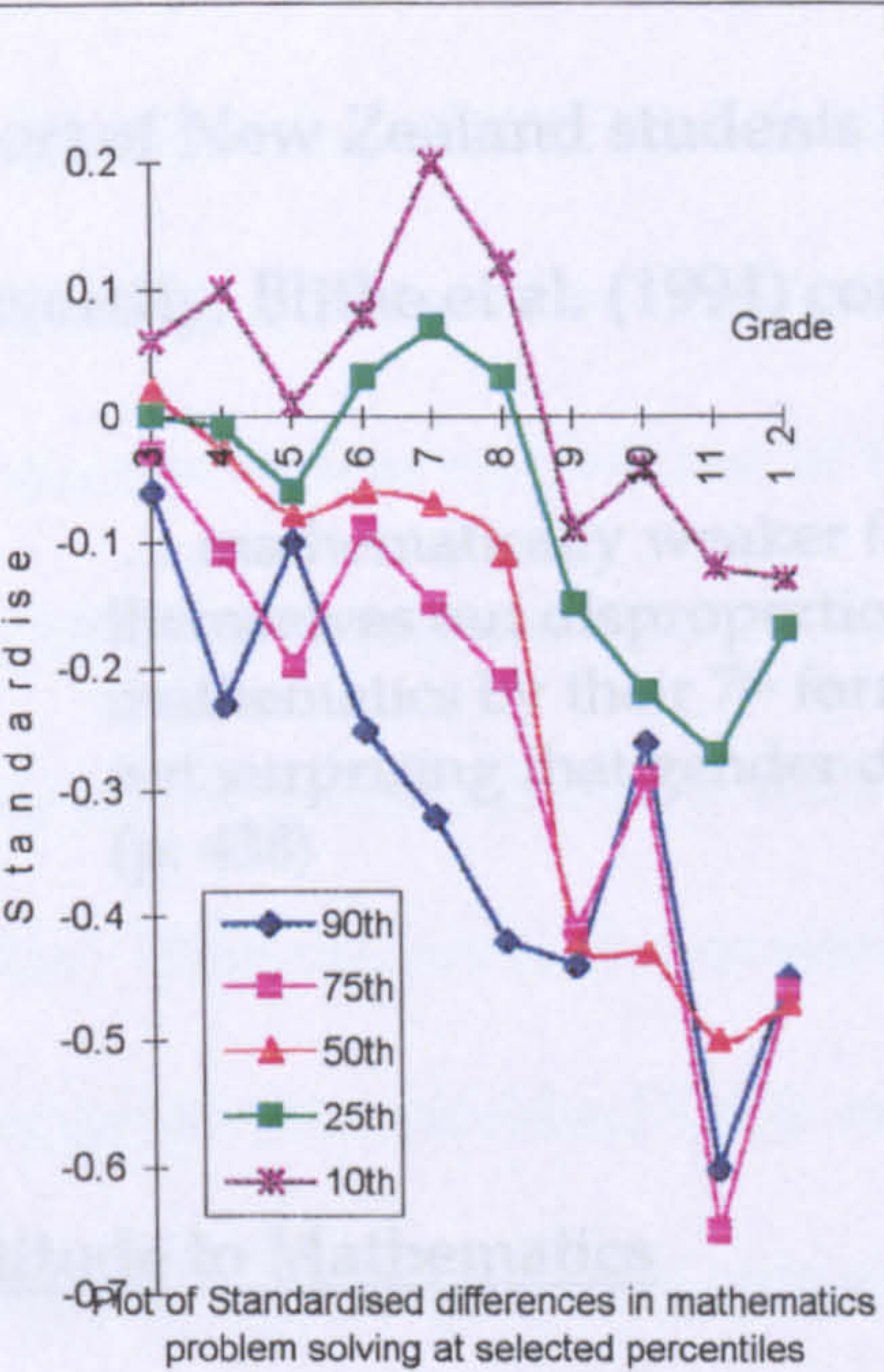
This differential performance by sex at different centiles has been observed elsewhere (Blithe, Forbes, Clark, Robinson & Whitwell, 1994) and is also present in the NCDS analysis which constitutes Chapter 3.

Alternatively expressed, boys show a wider range of mathematical ability than do girls, but not always a higher level of ability.

ITBS/ITED Matched Longitudinal Sample Summary Data for Mathematics Problem Solving

Test Battery		ITBS (M2)						ITED (Q)			
Grade		3	4	5	6	7	8	9	10	11	12
Females											
Mean		43.23	54.17	65.54	77.06	88.45	99.87	14.59	16.78	18.13	19.63
S.D.		9.83	10.8	11.54	12.3	13.29	14.13	4.94	5.21	6.07	6.4
Males											
Mean		43.48	54.78	66.81	77.27	89.23	101.53	16.22	18.36	20.96	21.97
S.D.		10.41	12.04	12.17	13.32	15.45	16.87	5.6	5.75	7.05	7.44
Standardised Differences											
Grade		3	4	5	6	7	8	9	10	11	12
Mean		-0.02	-0.05	-0.11	-0.02	-0.05	-0.12	-0.31	-0.29	-0.42	-0.33
%		3	4	5	6	7	8	9	10	11	12
90th		-0.06	-0.23	-0.1	-0.25	-0.32	-0.42	-0.44	-0.26	-0.6	-0.45
75th		-0.03	-0.11	-0.2	-0.09	-0.15	-0.21	-0.41	-0.29	-0.65	-0.46
50th		0.02	-0.03	-0.08	-0.06	-0.07	-0.11	-0.42	-0.43	-0.5	-0.47
25th		0	-0.01	-0.06	0.03	0.07	0.03	-0.15	-0.22	-0.27	-0.17
10th		0.06	0.1	0.01	0.08	0.2	0.12	-0.09	-0.04	-0.12	-0.13

Females: N = 1642; Males: N = 1360
Standardised Differences = (Female Mean Score - Male Mean Score)/Total Sample Standard Deviation



The table and the lower left chart are reproduced from Becker & Forsyth (1994) Gender Differences in Mathematics Problem Solving and Science: A Longitudinal Analysis. in International Journal of Educational Research Vol.21 No. 4 Page 412

The lower right chart is an extrapolation of the lower left chart, taking account of a likely gender bias in the ITED test.

There is some doubt, therefore, as to whether the findings from this longitudinal study genuinely indicate that boys forge ahead of girls year by year from middle school years onwards, as suggested by Martin and Hoover (1987) and Becker and Forsyth (1994), since other studies have suggested that this effect may be explained by lack of motivation in girls to succeed at mathematics (Blithe et al., 1994; Skaalvik & Rankin, 1994). In consequence, there is a greater likelihood that girls will opt for alternative courses, and so have less practice at mathematics than the boys.

For example, after a study of mathematics achievement of a year cohort of New Zealand students leaving school and moving on to University, Blithe et al. (1994) concluded that:

... mathematically weaker females appear to have selected themselves out disproportionately from doing university mathematics by their 7th form year [aged 16/17] ... [therefore] it is not surprising that gender differences at university favour females. (p. 438)

2.4.2. Attitude to Mathematics

More fruitful studies have observed associations between differential achievement of boys and girls, and their different attitudes towards mathematics. In general it appears that boys have a more positive attitude toward mathematics. Boys appear to have a higher self

concept, and greater confidence in their ability to handle mathematics (Bohlin, 1994; Skaalvik & Rankin, 1994). In addition, it has been suggested that boys are 'holistic' in their learning style, able to grasp wider concepts, whereas girls are 'serialist' in their learning style, preferring to learn and consolidate in small, successive steps (Scott-Hodgetts, 1986; Bohlin, 1994). This may explain why girls appear to succeed in the more structured class test/workbook situation, which requires knowledge and application of routine algorithms, but perform less well in Standardised Tests which often require some form of cognitive restructuring. After analysing responses from 400 students aged 15/16, using Mathematics Learner Profile attitude tests designed by Fry (1988), Bohlin (1994) observed that, although their mean class grades were higher than the boys', girls expressed considerably less confidence in their mathematical abilities. In addition, they expressed a greater need for a structured mathematics learning environment, and scored significantly lower on Standardised Tests. This research also appears to confirm the earlier suggestion that many Standardised Tests are not as gender blind as had been supposed. Bohlin (1994) suggests that girls begin to experience difficulty in more advanced mathematics when required to handle ambiguities or problems that require identifying and choosing a solution from several competing possibilities. If this is the case, then it could be a contributory explanation for why statistical measures of girls' achievement tend to cluster in the middle range, i.e. they

perform better than boys on low to middle level mathematics of a structured algorithmic type, but less successfully than the boys on middle to high level mathematics which requires more relational, cognitive or holistic thinking (see Charts on page 45).

More important than simply identifying different attitudes towards mathematics, is to identify the reasons underlying the different attitudes. How does it come about, for instance, that girls are less likely than boys to view mathematics as a male domain (Fennema & Sherman, 1976), yet are also less likely to succeed in it? (Tocci & Engelhard, 1991; Hanna, 1994). At least three sorts of influence are likely to shape values and attitudes in young people: the society they live in, their schools and teachers, and their homes and parents. As already mentioned, theories of cultural transmission have been confirmed in work on class differences in mathematical achievement (Lareau, 1987), and on resource dilution (Shavit & Pierce, 1991). However, cultural differences in attitude to mathematics are more likely to be mediated through parental influences rather than national ones (Tocci & Engelhard 1991). For example, Hanna (1994) found no evidence to suggest that the differences in boys' and girls' actual achievement were in any way explained by the accident of their nationality.

Sex stereotyping, however, may have some effect on performance in mathematics. Girls in co-educational schools have reported having greater difficulty in maths and enjoying it less than boys in the same schools. They have also reported enjoying maths less than girls in single sex schools (Lawrie & Brown, 1992). In a Norwegian study by Skaalvik and Rankin (1994), boys claimed higher self-perceived mathematics skills than the girls, even though their mean scores on mathematics tests were no higher. In contrast, there was no difference in the self-perceived verbal ability of boys and girls, despite the significantly higher mean scores on verbal tests by girls. Boys also demonstrated higher motivation for mathematics and the girls demonstrated higher motivation for verbal skills. Scales used for mathematical confidence, self perceived skills and motivation were designed for this study, and were reported to have high reliability (Cronbach alpha from 0.72 to 0.94). The researchers concluded that the differences in self-perception could not be explained by differences in achievement, and so were probably due to sex stereotyping of the sort 'mathematics is a male domain' and 'boys outperform girls at everything' (Skaalvik & Rankin, 1994). These interpretations need to be treated with caution, however, since they are speculative. Moreover, the comparison of gender specific mean scores on mathematics tests has been shown to be problematic (see pages 44-45)

2.4.3. Teachers

Differences in educational style, both pedagogic and institutional, have also been considered for their influence on the mathematical development of the pupils. Hanna (1994) found no evidence across 15 countries that differences in boys and girls achievement could be accounted for by a preponderance of single sex over co-educational schools. These findings are confirmed by Blithe et al. (1994), who found that the differences in the mathematics achievement of boys and girls could not be accounted for in terms of the difference in school admission policies (i.e. co-educational or single sex schools). This is not to say that students' perceptions of their mathematical competence is not related to school type, since girls in single sex schools appear to display higher levels of self concept in terms of mathematics than their peers in co-educational schools (Lawrie & Brown, 1992).

The quality of teaching has been considered from two perspectives. Firstly, if the teacher is a role model for the pupils, would it improve girls' attitudes towards mathematics, and thus their achievement, if more mathematics teachers were women? Hanna (1994) rejects this proposition on the basis of her international findings. For example, in British Columbia, where no significant gender differences in mathematics achievement were observed, only 3% of the teachers were women. Conversely, in Hungary, one of the countries in which the greatest gender differences in mathematics achievement were

observed, 60% of the teachers were women. From another perspective, Bohlin (1994) argues strongly that teaching methods need to change. She suggests that girls suffer from traditional methods of instruction and assessment, which encourage algorithmic accuracy and repetition. Girls, therefore, do well in the short term, but, without increasing their conceptual understanding and reasoning skills, they lose confidence and fail at higher levels. Bohlin (1994) proposes that changes in a regulated curriculum, to lay more emphasis on holistic, conceptual learning, would give girls more confidence and improve their achievement. Such a proposal needs to be treated with caution, for if, as Scott-Hodgetts (1986) has indicated, girls are better at serial learning, and if, as Martin and Hoover (1987) and Becker and Forsyth (1994) have shown, girls do not do so well at the upper levels of mathematical achievement, then moving the curriculum agenda away from algorithms and towards more holistic conceptual learning may actually widen the difference in achievement by penalising girls, removing from them the opportunity to do what they do best.

2.5.Health and Development

2.5.1.Mothers' Health in Pregnancy

In the same year that the children of the NCDS were born, Kawi and Pasamanick (1958) suggested that reading disorder might be added to

a 'continuum of reproductive casualty' (Lilienfield & Pasamanick, 1955, 1956). That continuum ranged from the lethal (stillbirth, neonatal death) through cerebral palsy and epilepsy, to behavioural disorder. Kawi and Pasamanick (1958) compared the hospital birth records of 205 reading disordered males aged between 10 and 14 years with the records of a group of non reading disordered males matched by race, mothers age and place of birth. Their findings suggested that complications in pregnancy and delivery, including prematurity, were significantly associated with subsequent reading disorder. They went further to suggest that reading disorder is but one of a number of neurological disorders that might arise from insult to the brain during pregnancy or delivery. However, their study was retrospective and their sample consisted only of white males in order, they argued, to avoid the confounding variables of sex and race. Unaccountably, a proportion of the sample with no complications was excluded from the study, whilst all those with complications were included. Nevertheless, despite methodological weaknesses, their study and conclusions generated sufficient interest that, in the year following its publication, the Collaborative Perinatal Project was established in the United States, with the aim of investigating prospectively the biological and environmental influences on physical and cognitive growth (Broman, 1984). Although this was not a cohort study, since enrolment took place over a six year period, the size of the sample

(36,000) makes it comparable to the NCDS, as well as contemporaneous with it.

At the conclusion of the Collaborative Perinatal project, and after performing a multivariate analysis of 36,000 children at age 7, Broman Nichols, Shaughnessy and Kennedy (1987) confirmed the hypothesis of Kawi and Pasamanick (1958), that potential predictors of mild retardation, as indicated by measured IQ scores in the range 69 down to 50, included complications in pregnancy and delivery. Other potential predictors of mild retardation were suggested to be the length of the pregnancy free interval and whether mother had been a smoker. However, complications in pregnancy and prematurity (as measured by low birthweight) accounted for only 3% and 6% respectively of the variance in IQ scores (Broman et al., 1987).

2.5.2.Children's Health and Development.

Pupils suffering from severe health problems that ensure long periods of absence from school, and those suffering from physical and sensory disabilities, are often found to be in need of special educational resources (Fogelman, 1983). It has been suggested, however, that less severe conditions, of the sort often described as 'auto-immune disorders', such as eczema, migraine, asthma and hay-fever may be associated with learning disabilities, particularly dyslexia. A number

of research studies have offered evidence in support of this suggestion (Geschwind & Behan, 1982; Geschwind & Galaburda, 1985; Pennington et al., 1987; Smith et al., 1983, 1986). However, the Pennington and Smith studies were only confined to groups of familial dyslexics. The Geschwind and Behan study (1982), although widely cited, suffers from flaws in sampling. These authors compared health profiles of left handed subjects in London with those of right handed subjects in Glasgow, and concluded that handedness was linked to dyslexia and auto-immune conditions. Reference to the NCDS data by region, however, indicates that certain auto-immune disorders (e.g. asthma) are more common in London and the South east than in Scotland and the north of England. This variation was not controlled for in the Geschwind and Behan study (1982). A full analysis by Wilkin and Terrell (1996) of the doubts cast on this study by the flaw in sampling may be found in Appendix 1.

At age 11, the NCDS children with asthma, though absent from school more often than their peers, were found to have similar mean scores on the achievement tests as those children who did not suffer (Peckham & Butler, 1978), although asthma was twice as prevalent in boys as in girls.

In the Collaborative Perinatal Project, in terms of the children's general development, Broman et al. (1987) found that low scores on early

developmental tests were significant predictors of later retardation.

Low motor scores at ages eight months and four years, and abnormal speech production at age three years were all significantly associated with mild retardation at age 7.

In another area of research, Blythe and McGlown (1979) have suggested specific learning difficulties may be linked to problems of motor or neurological development in infancy, and have developed a remedial technique of 'reflex inhibition' to improve the performance of children with poor manual/visual co-ordination. However, there appears to have been little follow-up work done in this area.

The comparative impact of the foregoing issues on mathematics achievement will first be assessed in Chapter 3, using quantitative techniques on a whole year cohort from the National Child Development Study (NCDS).

CHAPTER 3

A QUANTITATIVE STUDY

This chapter is a report on an investigation into data from the National Child Development Study (NCDS). It focuses on the gender difference in the way a small number of selected family variables are associated with children's achievement in school, with particular attention paid to their mathematics achievement. The results raise questions as to why certain associations are present in terms of reading achievement, but not in terms of mathematical achievement, and in terms of gender differentiation of parent/child relationships. Attempts to answer such questions will be considered in subsequent chapters.

3.1.Introduction to the National Child Development Study

The NCDS originated in the Perinatal Mortality Survey of 1958, in which parental and medical records of all infants born in England and Wales in the first week of March 1958 were gathered together, forming an initial database of over 17,700 cases. Subsequent follow up studies using the same database were conducted as shown in Table 1.

	1958 PMS birth	1965 Phase I age 7	1969 Phase II age 11	1974 Phase III age 16	1981 Phase IV age 23	1991 Phase V age 33	1995 Phase VI age 37
Perinatal Data	✓						
Parents' reports	✓	✓	✓	✓			
Medical reports		✓	✓	✓			
Education reports		✓	✓	✓			
Case self reports				✓	✓	✓	✓
Reported in:	Butler (1961, 1962, 1963, 1965)	Davie (1973)	Ferri (1976)	Fogelman ed.(1983)	Hamilton and Stasinop- oulos (1987)	Ferri ed. (1993)	Bynner and Parsons (1997)

Table 1 The National Child Development Study -
Categories of data collected in each phase

Earlier NCDS research had suggested that a group of family variables were related to children’s achievement in mathematics and reading (Fogelman et al., 1978; Fogelman, 1983; Ferri, 1993). However, these studies were based on the entire cohort, and reported mean levels of achievement only, variable by variable. For example, the mean age equivalent level of mathematics achievement of children with no younger siblings appeared to be six months in advance of those with 3 or more younger siblings. Similarly, the mean age equivalent level of mathematics achievement of children with no older siblings appeared to be eight months in advance of those with 3 or more older siblings. These results were then, dubiously, conflated to suggest that the difference in age equivalent levels between sole children and children approximately in the middle of families of seven or more was 14 months (Fogelman, 1983). Nevertheless, the six or eight month

differences in mean mathematics achievement across the sibling variables were small, compared with the seven year range of mathematics performance of 11 year olds reported by Cockroft (1982).

In the present study, specific groups of mathematics and reading achievers have been targeted from the database, to assess whether their responses to a group of family variables are different from each other, and different from the overall responses of the cohort.

3.2. Aims and Design

3.2.1. Aims

The study seeks to answer two questions:

- *Of the family variables which are associated with achievement in mathematics and reading, can any be specifically associated with achievement in mathematics?*
- *Are the observed associations differentiated by gender?*

3.2.2. The Sample

Phase II of the NCDS, when the children were aged 11, included tests of cognitive abilities and achievement in mathematics and reading.

By 1969, in Phase II, over 16,800 children remained on the database, of which 12,500 sat all the cognitive ability and achievement tests.

However, a number of these were excluded from the present study for the following reasons:

- a large proportion of adults aged 23 who reported deficiencies in literacy skills, had earlier been identified as needing or receiving special help at school (Hamilton & Stasinopoulos, 1987) . Since the analysis in this study will be using 'normal' achievers as a control group, it was felt prudent to exclude at this stage all children who were reported in Phases I and II to be "in need of special help in school" or "in a special school". (See Fogelman, 1983, pp312-319).
- from the same study (Hamilton & Stasinopoulos, 1987), it was found that an equally large proportion of registered disabled adults aged 23 reported basic skills deficiencies. For the same reason as above, therefore, all children reported in Phase II as having handicaps or disabilities, whether physical, mental, aural or visual, were excluded. (See Fogelman, 1983)

After these exclusions, 10,545 cases remained in the analysis: 5,274 boys and 5,271 girls.

3.2.3. Targeting the experimental (high and low achievers) groups

As already mentioned, in Phase II of the NCDS 11 year old pupils sat a number of tests of cognitive abilities and educational achievement, which included general cognitive tests, both verbal and non-verbal, and achievement tests in mathematics and reading comprehension.

The score on the mathematics test was used as the measure of mathematical achievement, and the score on the reading comprehension test was considered appropriate, not simply as a test of reading ability, but also as a measure of general achievement, since comprehension includes not only the ability to read a text accurately and make use of vocabulary, but also to process information in an active, constructive way (Aaron & Malatesha-Joshi, 1992).

Two models for identifying high and low achievers were considered. The regression discrepancy model is frequently used, where the process of multiple linear regression is used to predict values of a dependent variable, say a mathematics test, from values of a number of other, independent variables. Where there is a substantial difference between the actual and predicted values of certain cases, they may be said to be 'regression discrepant' in terms of the dependent variable. (e.g. Yule, Lansdown & Urbanowicz, 1982; Share, Moffitt & Silva, 1988). Such a test is parametric, requiring that the dependent and independent variables are interval in nature, and that the score distributions are near normal. In the test administered to the

NCDS cohort at age 11, the scores on both reading comprehension and mathematics ranged from 0-40, and the distribution of the reading comprehension test was normal. Although the distribution of the mathematics test was skewed towards the lower end, it was considered sufficiently near normal not to invalidate a regression analysis (see Fig 1).

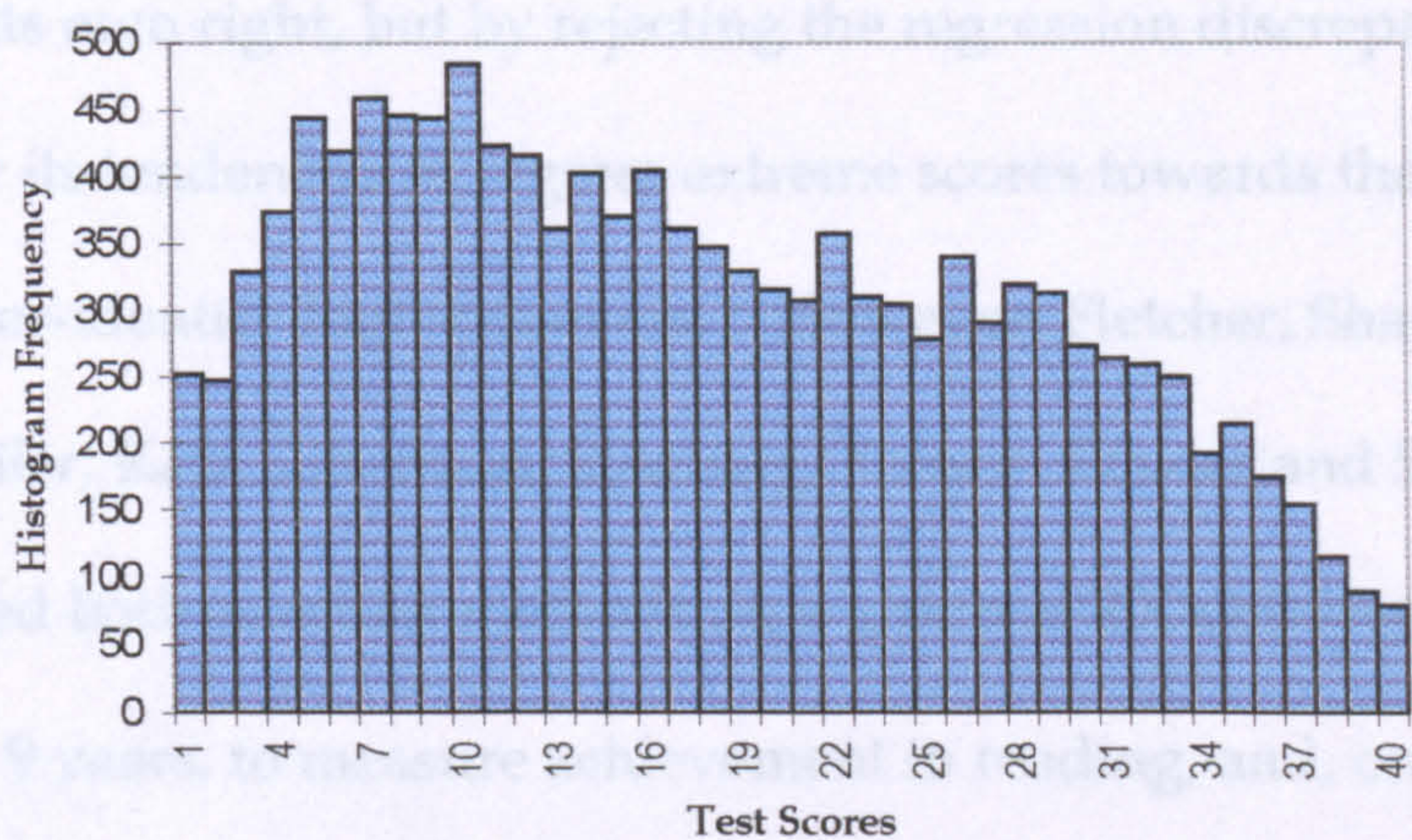


Fig 1 NCDS Phase II (11 years old) Distribution of Scores on the Mathematics Test

However, an alternative model was considered, based on work by Lewis, Hitch and Walker (1994), who used cut-off values of their variables to identify ‘low attainers’ in mathematics and reading from a sample of 1,000 children aged 9-10 years. They identified low achievers in mathematics as those who achieved above a cut-off level of 90 on a standardised non-verbal test, but below a cut-off of 85 on a standardised mathematics test (one standard deviation below the mean). In the same way, low achievers in reading were identified

using the same cut-offs on the non-verbal and reading tests.

However, this method assumes equivalence of standardised mathematics and reading scores in the “normal” child, and thus appears to be a less sophisticated way of identifying the low achievers than the regression discrepancy model, which takes account of interactions between the variables. Lewis and his colleagues justify it, not in its own right, but by rejecting the regression discrepancy model for its tendencies to regress extreme scores towards the mean and to over-identify high achievers. However, Fletcher, Shaywitz, Shankweiler, Katz, Liberman, Stuebing, Francis, Fowler and Shaywitz (1994) used both selection methods on a group of 200 children aged from 7 to 9 years, to measure achievement in reading, and, on testing their selected groups subsequently, were unable to find any difference between them in their cognitive abilities.

As already mentioned, in the present study the interactions between the mathematics and reading scores are considered to be important, since one aim is to establish whether any family variables can be shown to be associated with mathematics achievement alone, free of any interactions with reading achievement. Furthermore, when the achievement groups were identified, the criticism levelled by Lewis et al. (1994), that regression analysis would over identify high achievers, appeared not to apply in terms of mathematics achievement (see Table 2). For these

reasons, the regression analysis model was chosen for this investigation, and the multiple linear regression equations are listed in Appendix 2.

3.2.4.The Study Groups

In identifying cases for membership of achievement groups, cases were selected if their residuals (the difference between the actual and predicted scores on the dependent variable) on the mathematics and reading tests were greater than two standard deviations from the mean. This process of selection identified approximately 5% of the cohort whose scores were at the extremes of the distribution (approximately 2.5% low achievers and 2.5% high achievers). See Table 2.

	Study Groups				Control Groups
	Low Achievers		High Achievers		
	Reading	Mathematics	Reading	Mathematics	
Boys	75	125	137	133	4834
Girls	94	124	154	127	4812

Table 2 Initial selection of cases for study and control groups

As expected, there was a certain level of interaction between the mathematics and reading variables, to the extent that 71 cases appeared in both subject achievement groups. For the first time, this

interaction has been expressed in terms of individual cases, and the ‘noise’ it generates can be excluded from the analysis. After these 71 cases were dropped, the final selection was as shown in Table 3.

	Study Groups				Control Groups
	Low Achievers		High Achievers		
	Reading	Mathematics	Reading	Mathematics	
Boys	60	109	121	118	4834
Girls	78	100	130	111	4812

Table 3 Final selection of cases for study and control groups

3.2.5. Choice and Description of Variables

The literature reviewed in Chapter 2 indicated that the following groups of variables would repay investigation:

- parents’ education and background;
- parents’ concern for their children’s education;
- sibship size/groupings;
- mothers’ health during pregnancy;
- the children’s own health.

In addition, gender differences should be sought among the variables studied.

Thirty variables were selected from the NCDS database, which fell broadly into these categories. Each variable was tested for homogeneity of distribution across pairs of achievement groups (high and low achievers in mathematics/reading from both boys' and girls' files) using the Mann Whitney test. Five variables failed to reach significance ($p \leq 0.05$) on this test, and were investigated no further. The remaining 25 variables were tested for differences across groups, using contingency tables and Chi² tests. Of these, 22 displayed group differences at levels of statistical significance. The full list of variables and the contingency tables are to be found in Appendix 3, but a summary is displayed in Tables 4 and 5.

3.3.Results

3.3.1.Parental and Sibling variables

In original work on Phases I and II of the NCDS, Fogelman (1975) suggested that parents from the higher social classes, who had continued in education beyond the statutory school leaving age were more likely to have smaller families, and that smaller family size was likely to be associated with greater parental interest in their children's schooling. [Later work by Ferri (1993) on Phase V of the NCDS, when the cohort members were aged 33, showed the same pattern of higher

education being associated with smaller numbers of children.]

Subsequently, Fogelman and his colleagues indicated that a small excess in attainment in both reading and mathematics was found in children from smaller families, whose parents were from the higher social classes, were well educated and were interested in their children's education (Fogelman ed. 1983).

Similarly, in the Collaborative Perinatal Project in the United States, Broman (1989) found the highest proportion of variance in IQ scores at age 7 to be accounted for by socio-economic status, maternal intelligence test score and maternal education.

However, the present study has been able to demonstrate that these generalised findings across the whole cohort have missed some of the detailed differences to be found between genders and between targeted achievement groups. For example, of the 17 variables significantly associated with high achievement in mathematics or reading, 7 were specific to boys and 3 to girls. Similarly, of the 18 variables significantly associated with low achievement in mathematics or reading, 5 were specific to boys and 9 to girls (Table 4). In addition, of all 22 variables significantly associated with achievement, 4 were specific to high achievement and 5 to low achievement.



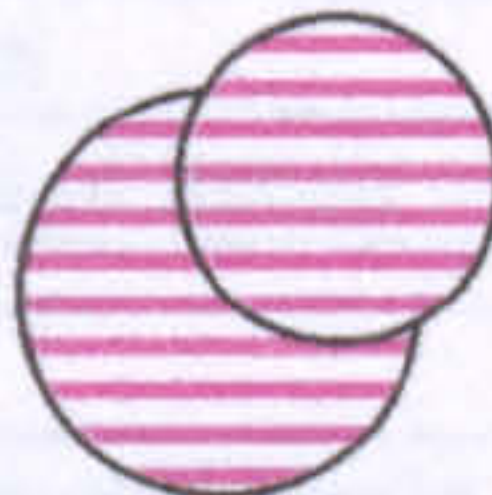
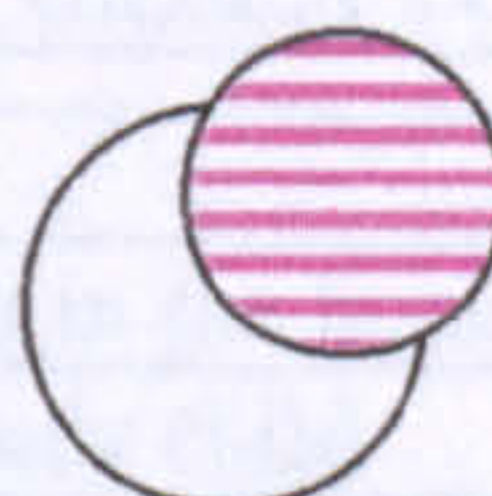
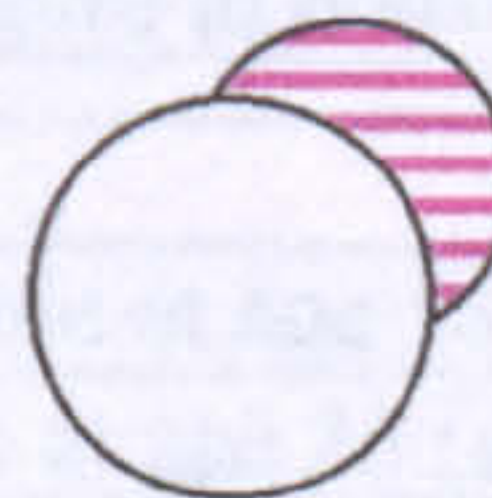
			High Achievement			Low Achievement		
Reading	Maths		Boys only	Boys & Girls	Girls only	Boys only	Boys & Girls	Girls only
								
All variables with significant assocns.			7	7	3	5	4	9
Variables sig. associated with mathematics performance			2	2	2	4	2	0
Variables sig. associated only with maths performance			0	0	0	0	0	1

Table 4 Number of home variables significantly associated with high and low performance in reading and mathematics. ($p \leq 0.05$)

Table 5 summarises the results detailed in the contingency tables (see Appendix 3), under the five headings of parents’ background, parents’ interest, sibling effects, aspirations, health and development.

Parents’ variables

In terms of mathematics achievement, high achieving boys were significantly more likely to have mothers who had stayed on at school, while low achieving boys were more likely to have mothers who had left school.

Table (Variable number) see Appx 3	All Variables (associated with achievement in mathematics or reading or both)	High Achievers		Low Achievers	
		Boys	Girls	Boys	Girls
186	Mother reads books or journals	✓*	✓***		✓***
187	Father reads books or journals				✓*
537	Mother stayed on at school	✓***	✓	✓***	
194	Father stayed on at school		✓*		✓*
1175	Father's social class	✓	✓***		✓
2375	Status of male head of house	✓**		✓**	
Parents' Interest					
43	Mother's interest in children's edn. (age 7)	✓**	✓***	✓**	✓***
44	Father's interest in children's edn. (age 7)	✓***	✓**	✓***	✓**
Sibling Effects					
1117	Number of children in the home	✓***	✓***		✓***
1118	Sibling status of study child	✓*			
1120	Number of younger siblings	✓*	✓***		✓***
2363	Elder brother type figure in household?	✓***		✓***	
2365	Elder sister type figure in household?	✓*			✓
Aspirations					
932	Aspirations for future at age 16 (at age 11)	✓**	✓***	✓**	✓***
958	Expectations of job at age 25 (at age 11)	✓***		✓	
Health & Development					
496	Mother's weight at birth of child			✓*	✓
502	Mother smoked during pregnancy?	✓	✓		
527	Length of first stage of labour	✓*		✓*	✓*
532	Pregnancy break		✓***		✓***
553	Mother's age at birth of child	✓***	✓***		✓***
414	Skin problems (at age 7)				✓*
1305	Ever had asthma/bronchitis?			✓*	
1342	Hay fever in past 12 months?				✓*
1533	Skin problems (at age 11)			✓	
Number of significant variables		14	10	9	13
Joint Variables (where those associated with achievement in mathematics are also associated with achievement in reading)					
43	Mother's interest in children's edn. (age 7)	✓**	✓***	✓**	✓***
44	Father's interest in children's edn. (age 7)	✓***	✓**	✓***	✓**
537	Mother stayed on at school	✓***	✓	✓***	
194	Father stayed on at school		✓*		✓*
1175	Father's social class	✓	✓***		✓
2375	Status of male head of house	✓**		✓**	
496	Mother's weight at birth of child			✓*	✓
414	Skin problems (at age 7)				✓*
1305	Ever had asthma/bronchitis?			✓*	
932	Aspirations for future at age 16 (at age 11)	✓**	✓***	✓**	✓***
958	Expectations of job at age 25 (at age 11)	✓***		✓	
Number of significant variables		4	4	6	2
Variables associated with achievement in mathematics only					
502	Mother smoked during pregnancy?	✓	✓		
1342	Hay fever in past 12 months?				✓*
Number of significant variables		0	0	0	1

Table 5 Variables associated with high and low scores on the mathematics and reading tests

However, this association was not found to apply either to the high or low achieving girls, whose achievements were more likely to be related to whether or not their fathers had stayed on at school. In addition, high achieving girls were more likely to have fathers in the higher social classes. The distinction between mother/son and father/daughter relationships has not been reported in earlier, whole cohort, analyses. In contrast, father/son and mother/daughter relationships were noted from other parental variables. Girls with low reading achievement were significantly more likely to have mothers who reported that they themselves were infrequent readers. Boys with high reading achievement were significantly more likely to live with their natural or adoptive fathers, rather than with stepfathers or males of a less formal status.

In terms of parental interest, the variables assessed were subjective reports by teachers of their perceptions of the level of interest exhibited by each parent when the children were aged 7 years. Mothers' interest was significantly associated with levels of achievement in mathematics in both boys and girls at age 11 years, but fathers' interest was only significantly associated with their sons' mathematics achievement.

A tentative explanation for these cross gender parent/child relationships might be as follows. High achieving girls may see their

fathers' higher education and status as a goal which they too can attain, but they are able to pursue the goal under their own efforts, without necessarily needing day to day encouragement from their fathers. In contrast, to be high achievers, boys appear to require paternal support in terms of day to day encouragement, as well as the support from better educated mothers. Mothers' day to day encouragement is clearly crucial to the achievement of both boys and girls.

Sibling variables

The number of siblings in the family has already been shown to be a significant variable in association with educational achievement, in terms of both confluence theory (Zajonc & Bargh, 1980) and resource dilution theory (Fogelman, 1983; Marjoribanks, 1994). Critics of confluence theory (teaching younger siblings helps to improve one's own performance) have pointed out that there is no reliable evidence to support it, and none has emerged from the present study. Indeed, the significant association between low reading achievement in girls with a number of younger siblings tends to support the resource dilution theory. However, there were no significant associations between the sibling variables and mathematics achievement.

In addition to the gender differentiation in the results from this study, there appears to be sufficient evidence to suggest that, although there

is a strong relationship between the home environment and reading achievement, a much weaker relationship exists between the home environment and mathematical achievement. This distinction has not been clearly made in previous work. Lareau (1989), for instance, makes no distinction between literacy and numeracy outcomes when reporting on her work. Entwisle and Alexander (1992) report only on the mathematical achievement of their samples, before drawing conclusions about unspecified home variables. Similarly, the findings of Backer and Forsyth (1994), that boys exhibit a wider range of mathematical ability than girls, does not take account of the possibility that boys have a wider range of abilities in areas other than mathematics.

3.3.2. Mothers' Health in Pregnancy

In their work on the Collaborative Perinatal Project, Broman et al. (1989) confirmed the retrospective findings of Pasamanick and others (Lilienfield & Pasamanick, 1955; Kawi & Pasamanick, 1958), that potential predictors of mild retardation included complications in pregnancy and delivery, as well as the prior pregnancy-free interval. However, complications in pregnancy and prematurity (as measured by low birthweight) accounted for only 3% and 6% respectively of the variance in IQ scores (Broman et al., 1989).

In the present study, eight variables relating to pregnancy were selected for analysis, and subjected to Mann Whitney tests for homogeneity of distribution between groups. Variables relating to complications in pregnancy, prematurity and low birthweight showed no significant difference in distribution on the Mann Whitney tests ($p < 0.05$), so these variables were not investigated further. Chi² tests were conducted on the remaining five variables (see Table 5). Only those relating to mother's weight at birth and mother's smoking during pregnancy showed differences in distribution across the mathematics achieving groups, but neither achieved significance on the Chi² tests.

3.3.3. Children's Health and Development

The medical data from the NCDS indicated that children with educational problems (i.e. those receiving or in need of special educational help) suffered more physical or sensory disabilities (Fogelman, 1983). However, it will be recalled that these children were excluded from the present study at the sampling stage, so none of the experimental or control groups exhibited high levels of major medical problems. It has been suggested, however, that less severe conditions, of the sort often described as 'auto-immune disorders', such as eczema, migraine, asthma and hay-fever are associated with learning disabilities (Geschwind & Behan, 1982; Geschwind &

Galaburda, 1985; Pennington et al., 1987; Smith et al., 1983, 1986).

There is little confirmation of these suggestions from NCDS studies, in which children with asthma, though absent from school more often than their peers, were found to have similar mean scores on the reading test as those children who did not suffer (Peckham & Butler, 1978), although boys were nearly twice as likely to suffer from asthma as girls.

In the present study, asthma, skin disorders and hay-fever showed significant divergence on the Mann Whitney tests for homogeneity of distribution between high and low achievers, and the Chi² tests showed these variables to be gender and subject specific. As expected from the findings of Peckham and Butler (1978), the boys' achievement in reading was not associated with the asthma variable, but the boys' mathematics achievement was found to be significantly associated with the asthma variable. In contrast, hay-fever was more prevalent in girls, and significantly associated with low mathematics achievement, a finding that has not previously been reported.

In terms of the children's general development, Broman and her colleagues found motor scores at ages eight months and four years, and abnormal speech production at age three years were all significantly associated with mild retardation at age 7 (Broman et al. 1987). Blythe and McGlown (1979) and Field (1990) suggested that

problems with written work in school may be connected to anomalous motor or neurological development in infancy. In the present study, however, variables relating to speech development and manual dexterity, were not found to be of significance in the Mann Whitney tests, and so were not investigated further.

3.4. Discussion

The interest shown by mothers and fathers in their children's educational progress was strongly associated with the children's performance. Parental interest in, and involvement with their children's schoolwork has been suggested as an important element in what Wentzel (1994) describes as parenting style, Tocci and Engelhard (1991) describe as parental support, and Lareau (1989) as interconnectedness. The variables investigated in the present study were based upon teachers' subjective assessment of the level of interest shown by mothers and fathers when the children were aged 7 years. However, the significant association between these variables and all the study groups four years on at age 11 years, indicates that it would be useful to obtain some more specific measures of parental interest. Such measures might, for example, be in terms of the frequency of parental interactions with the schools, levels of supervision and monitoring in the home, and evidence of the provision of resource and support for homework.

The relationships between achievement and parents' backgrounds appeared to be differentiated by gender. Previous studies have indicated that parental class and education are associated with educational achievement (Lareau, 1987, 1989; Bronan et al., 1987; Fogelman, 1983). However, whilst confirming these relationships, the present study suggests that they are neither as strong nor as universal as supposed. Only the boys' achievement appeared to be significantly associated with mothers' education. In contrast, the girls' achievement appeared to be significantly associated with fathers' education and social class. It seems that consideration should be given to the different relationships that exist between fathers and their daughters and between mothers and their sons, during future research into parenting styles.

High readers of both sexes were more likely to live in small families with few or no siblings. In larger families, the presence of siblings appears to be related to low reading, but in girls only. The present findings appear to confirm, in general terms, that high achievers tend to belong in small families, and that the larger the family, the lower the level of achievement (Fogelman, 1983, Ferri, 1993). However, the findings need to be treated with caution since, where there are larger sibling groups, evidence is available for the performance levels of only one member of the group.

Further work needs to be undertaken in assessing the relative performance levels of all the members of a sibling group, and the extent to which parental variables have been consistent or otherwise from child to child.

Although a number of variables were associated with mathematical performance, the majority of these were simultaneously associated with reading performance. For example, parents who showed a high level of interest in their children's education, and mothers who stayed on at school were associated with high performance in both reading and mathematics. Very few variables, however, were found to be associated specifically or solely with mathematics achievement. Boys suffering from asthma and girls suffering from hay fever tended to be low achievers mathematically.

3.5. Conclusion

At the beginning of this chapter, two questions were posed:

- a) of the home variables which are associated with achievement in mathematics and reading, can any be identified that are associated only with mathematics?
- b) are the observed associations differentiated by gender?

The response to question (b) is clearly 'yes', but there appears to be little evidence to support an affirmative response to question (a).

The results of this quantitative investigation suggest that previous studies linking home variables with mathematical achievement (Fogelman et al., 1978; Fogelman, 1983) have not clearly distinguished between mathematical achievement specifically, and educational achievement generally, nor between the different ways in which boys' and girls' achievements are related to their home variables. In particular, two groups of variables have indicated that more in-depth investigation would be fruitful:

- certain associations appeared to be specific to the mother/son relationship, while others were specific to the father/daughter relationship;
- teachers' subjective assessments of both mothers' and fathers' interest in their children's education when the children were aged 7, were strongly associated with children's achievement at age 11.

Clearly, both these areas seem to merit further investigation in more detail. Indicators of levels of parental interest of the 'social arithmetic' type described by Davies et al. (1981) and Marjoribanks (1994) have been attempted, and an extensive Family Environment Schedule has been developed by Marjoribanks (1994). The difficulties inherent in

such schedules are common to many multi-question, scaled response surveys, i.e. the clustering of responses in the middle of the scales, the perception of the respondents that there is a 'right' answer that will either please the researcher or place the respondent in a good light, and the implicit assumptions behind the questions. For example, in the Marjoribanks Family Environment Schedule (see above), questions B24 and B25 ask "If children do well in their homework, how much do you think parents should praise them?" and "How much time do you think a 10 or 11 year old should spend doing homework?" Both questions appear loaded in the form of a positive response, and respondents were then asked to give a quantitative response on a rising scale.

It was decided, therefore, that the next phase of the study would be undertaken, not through survey type questionnaires, but through a series of less formal, in-depth interviews with parents. This would allow them to express their views in their own terminology, rather than through prescribed alternatives.

In the next chapter, the methodology of sampling, interviewing, and analysing of transcripts will be discussed.

CHAPTER 4

METHODOLOGY OF THE QUALITATIVE PHASE

4.1.Rationale

The results of many studies have suggested that the home environment and family processes are associated with children's educational achievement (e.g. Fogelman, 1983; Broman et al., 1987; Haynes & Naidoo, 1991; Steinberg et al., 1992; Campbell et al., 1994; Harris 1995; Marjoribanks 1988, 1994, 1996; West et al., 1998). Other research has suggested that gender and parental attitudes towards education are also associated with children's educational achievement (Tocci & Engelhard, 1991; Becker & Forsyth, 1994). Since the majority of such studies have measured educational achievement through language and literacy skills, it has not always been possible to establish whether over or underachievement in mathematics is but one indicator of general academic achievement, since much mathematics teaching and learning is language based (Haylock, 1991). In Chapter 3, a quantitative investigation attempted to establish to what extent a number of quantifiable family variables were associated with mathematical achievement. The results were inconclusive. However, it has been suggested by Marjoribanks (1994) that the use of solely quantitative measures to investigate such associations is flawed, and

new methodologies are needed if we are to understand educational interactions within the family.

This, the second stage of the study therefore, used qualitative techniques in an attempt to elicit parental constructs relating to the home environment and family interactions, with particular focus on the children's mathematical achievement. The method involved the identification of a small number of children who have different levels of achievement in mathematics, and semi-structured, in depth interviews were conducted with their parents.

4.2.Design

The design of the second, qualitative, phase is described under six headings:

1. theoretical stance;
2. selection of informants;
3. researcher status and social context;
4. interviewing style;
5. interview techniques;
6. analysis of Transcripts.

4.2.1.Theoretical stance

The methodological style adopted in the design of this study has been largely influenced by Goetz and Lecompte (1995). These authors

argued that the issues of rigour documented in experimental studies (Campbell & Stanley, 1963; Cook & Campbell, 1979) must also be addressed in ethnographic and quasi-ethnographic studies if they are to gain an equivalent credibility. In experimental studies, the key issues of reliability and validity are usually addressed through statistical methods of selection and analysis, and strict control over external conditions. These are designed largely to ensure that experimental studies are replicable with similar samples, and generalisable to whole populations (Goetz & Lecompte, 1995). Examples of such studies are those conducted with whole cohorts or populations, such as the NCDS (see Chapter 3), and the large sample studies of 900 Australian children aged 11 years (Marjoribanks, 1988) and 800 first-graders in Baltimore City (Entwisle & Alexander, 1992). The data obtained in such studies are generally of a similar type, i.e. responses to questionnaires, collected at a specific moment in time, and tend to be analysed and reported using statistical techniques.

Ethnographic (or case) studies, in contrast, tend to focus on a small range of situations (a pair/group of schools, a group of children/parents), but are conducted over an extended period, typically one or two years. Data are presented in a descriptive or narrative style, often in such a way as to illustrate contrasts between the groups of respondents. The study by Lareau (1987) is typical of such studies. She observed a first grade class in each of two schools

over a period of a year, then selected a small number of children from each class on achievement criteria, for follow-up interviews with their parents. Her data were presented in such a way as to compare the outcomes of the two schools.

Whilst acknowledging that ethnographic studies often involve non-statistical selection of informants from part populations, Goetz and Lecompte (1995), nevertheless, believe that generalisation and replicability can, without loss of rigour, be reconstructed as comparability across groups, and translatability across disciplines. In order that these issues can withstand the same degree of scrutiny as those advocated in experimental research, it is important that the design of non-experimental studies be just as clearly delineated, and that categories and characteristics of both phenomena and cases be explicitly identified (Goetz & Lecompte, 1995). In this section, therefore, each element of the design of the present study is described, and assessed for threats to reliability and validity.

As already mentioned in Chapter 3, the data from the NCDS cohort, consisting of predetermined responses to operational concepts, lacked the depth and richness needed for the elicitation of more subtle themes. The second part of this study, therefore, relies on the ethnographic paradigm to the extent that a small group of pupils from a small group of schools was selected on achievement criteria. Since

the interviews with their parents, conducted over a short space of time, provided the data, the longitudinal element of the true ethnographic study was missing. Hence, the present study can perhaps best be described as positioned mid-way between the descriptors 'experimental' and 'ethnographic', and may be described as 'quasi-ethnographic'.

Characteristics of a quasi-ethnographic study are that:

- it deviates from the 'classical' ethnographic style, in that it studies small sub-sets of a larger cultural system (the present study investigated only parents of teenage school children in their fourth year of secondary school);
- its data are derived from biographical interviews, rather than extended participant observation (in the present study, encounters with informants were unique and biographical);
- it rejects multi-modality, and opts for a single data collection, without triangulation or corroboration. (Goetz & Lecompte, 1995)

However, it should be noted that all informants in the present study were interviewed in the same situation, and responded to the same set of enquiries. What these interviews lacked in within-case triangulation and corroboration, was compensated for by cross-case triangulation and corroboration. It was this cross-case corroboration

and triangulation that facilitated the derivation of constructs, and enhanced the validity of the data.

To summarise, the objectives of this study required that both quantitative and qualitative paradigms be brought to bear to achieve them. In many areas of the social sciences, disciplinary orientations (quantitative v. qualitative) are assumed, and applied to research questions, often without questioning whether the orientation is appropriate to the questions posed (Goetz & Lecompte, 1995, p. 37). Functionalism, however, demands that method, form and materials are adapted primarily with regard to the purpose in hand. A functionalist, multi-modal study, therefore, will probably consist of an innovative combination of methods and tools from a number of investigative paradigms. This is such a study, because its objectives are different from those generally achieved through uni-modal, single paradigm methods. Whereas the qualitative study may seek to discover a network of linkages that conform to a paradigm (ethnography, case study, grounded theory), or an overarching explanation for the perceived links between concepts, this study began with operational concepts, e.g. parental education, parental support, home environment, and attempted to tease out more subtle and sensitive sub-concepts that had not previously been explored. The combination of methods used to achieve these objectives were:

- a quantitative study of operational concepts (see Chapter 3);
- a qualitative study to elicit sensitising sub-concepts;
- use of computer software (NUD.IST) to establish the framework of the interviews;
- use of computer software (ATLAS/*ti*) to code and retrieve data;
- display of qualitative data in both textual and non-textual form.

4.2.2. Selection of informants

The population

Goetz and Lecompte (1995) emphasise the importance of precisely delineating the relevant population from which selection is made for the investigation. For the present study, the population consists of the parents of pupils in secondary schools in a rural county of the UK.

The county has a high proportion of grant-maintained secondary schools, compared with those remaining under the control of the Local Education Authority, and in order to represent this, all three of the schools chosen to participate in the study are grant-maintained. The schools that participated in the study are:

School A	A church-aided comprehensive with sixth form;
School B	A traditional comprehensive with sixth form;
School C	A community school with tertiary college.

All three schools are co-educational.

Pupils in Year 10 (aged 14/15) were chosen for the study, since they had an established academic history in their schools, and their parents had good knowledge of the schools' styles and processes. In addition, the pupils had completed national Standard Assessment Tests at the end of their previous academic year (Year 9 SATs).

Selecting the Sample

Whilst ethnographers view the selection process as ongoing and sequential, many social science studies, which are interested in generalising their results to a wider population, plan a series of strategies to generate their sample, which is then fixed (Goetz & Lecompte, 1995). Such a strategy greatly enhances the replicability of the study, since the selection process can be clearly delineated, step by step, and the criteria for selection are explicit.

Sample size:

In order to obtain rich data from which parental constructs could be elicited, in-depth, semi-structured interviews were the preferred method of data collection. Since this technique generates large quantities of data, the sample size did not need to be large to satisfy the requirements of validity. Previous researchers who have used this technique have worked with samples of between 15 and 30

respondents (e.g. Hammersley, 1980), and a sample size of around 20 is generally recommended (Miles & Huberman, 1994).

Access to schools

The two stages in identifying a sample of schoolchildren were to approach first the schools, for permission to conduct the research, and secondly the parents to request their participation. As already mentioned, three schools were selected, and all agreed to participate.

Selection of cases

Schools were asked to provide full lists of Year 9 pupils' Standard Assessment Test (SAT) scores in English, Science and Mathematics from the previous summer (approximately 200 pupils from each school). Multiple regression analysis of these scores identified pupils whose performances on the Mathematics SAT were unpredictably low or high when compared with their scores on the other two SATs (see Chapter 3 for the rationale behind this selection process). All pupils whose Z-residuals on the Mathematics SAT were greater than 1.5 (or less than -1.5) were asked to take home a letter addressed to their parents (see Appendix 7). In addition, in order to obtain the necessary control cases, the same letter was sent home with a number of children whose Z-residuals were close to zero. The letter introduced the writer, explained the research briefly, and asked for the

parents’ participation. A response slip was enclosed, with a pre-addressed envelope. On receipt of the response slips, telephone contact was made with the parents, and dates and times arranged for the interviews.

As in Chapter 3, the groupings of cases were by mathematical achievement and by gender. Near equal numbers of boys and girls were required for each of the three groups of maths achievers, high, medium and low. Eighteen cases were enrolled, and one extra girl was added to improve the gender balance of the high maths achievers (Table 6).

Math. Level	Sex	No. of Cases
High	M	4
High	F	3
Middle	M	3
Middle	F	3
Low	M	3
Low	F	3

Table 6 The Sample by Mathematics Level and Gender

In summary, the sample was built through appropriate use of purposeful sampling strategies (Patton, 1990; Kuzel, 1992) as detailed in Miles and Huberman (1994), with the aim of fulfilling the desired quota. Since regression analysis and quota sampling are highly replicable strategies they give added confidence to the reliability of the findings. Furthermore, a quota sample of this type lends itself well to

comparisons between groups (Miles and Huberman, 1994), and reflects the strategy used in the analysis of the NCDS data in Chapter 3.

Campbell and his colleagues (Campbell et al., 1994), following Stevens (1986), argue that, in experimental research, outliers and extreme cases should be excluded after initial regression, and secondary regression employed without them. However, if maximum variation is to be achieved through regression analysis, this can only be achieved through the use of cases identified from their extreme Z-residuals. Using such cases also satisfies Goetz and Lecompte's (1995) requirement that "researchers [should] actively seek instances of the extremes of the continua, so that comparisons against the norms may be made." (p.81). (In the present study, the "norms" are those cases whose regression Z-residuals are close to zero).

These selection techniques are reliable, since they can be readily replicated. As Goetz and Lecompte (1995) observe, the researcher who hopes to replicate a study must contact individuals similar to those who served as informants in previous studies. As already pointed out, the informants in the present study were chosen only on the criteria of their children's age and performance in mathematics. Furthermore, the fact that the informants were self selecting volunteers meant that they were enthusiastic for the project, the data were freely given, and no problems arose over access or elicitation. A replicating

study of volunteer parents is likely to generate a similar profile in its informants, so that useful comparison of findings may be made across groups, while the design of the study would translate robustly across disciplines.

4.2.3. Researcher Status and Social Context

The researcher in empirical research attempts to take the position of a neutral, detached observer, whilst, in contrast, the role of the ethnographer is often that of participant observer. Where the experimental researcher makes every effort to avoid subjectivity, the qualitative researcher endeavours to explicate it (Goetz & Lecompte, 1995). The effort expended by the experimentalist in attempting to ensure objectivity and control is replicated by the qualitative researcher in self-reflection, cross-checking of understanding with participants, and triangulation.

In the present study, the role of the researcher was quasi-experimentalist, in the sense that the researcher was external to the study, and acted as investigator, and quasi-ethnographic, in that there was an element of sympathy/identification between investigator and informant at the level of parent. To this extent, the researcher and the participants used the same terminology, in the same way that the

anthropologist is required to be fluent in the language and idioms of the culture being investigated (Goetz & Lecompte, 1995)

The social context of the participant/researcher interaction must be explicated, since the informants may be prepared to talk freely in one set of circumstances, but may avoid or distort the data in another (Goetz & Lecompte, 1995).

In the present study, however, researcher role and social context are entangled. Interviews with parents took place in their homes, were conducted informally, and lasted for between one and two hours each, in the evenings. Clearly, in this context, the researcher enjoyed some of the attributes of invited guest.

The content of the data obtained, and the constructs elicited by the interviews will have been idiosyncratic to some degree. Other researchers occupying different positions (e.g. students, mothers) may elicit different findings (Goetz & Lecompte, 1995). Likewise, a similar study, conducted in different contexts/situations (e.g. on school premises) may produce different findings. However, the researcher status and interview context as described above are sufficiently explicit for replication.

4.2.4. Interviewing Style

The style of the interviews was semi-structured, with parents being asked to range over certain areas, rather than being asked to respond to specific questions (Robson, 1993; Powney & Watts, 1987). Goetz and Lecompte (1995) refer to this style as “guided interview”, where general questions to be addressed, and specific information required by the interviewer are anticipated, but may occur informally, or in whatever order or context in which they happen to arise.

There is a balance to be struck between the neutral disengagement of the empirical researcher and the empathetic interaction of the participant observer. In common with earlier researchers (e.g. Denzin, 1978; Patton, 1980), Goetz and Lecompte (1995) encourage the middle mode of conversational interaction that was used in the present study. It allows informants to feel that their contributions are valued and significant, whilst allowing the interviewer to adopt a neutral profile. Perhaps most importantly, they suggest that it is likely to elicit the trust, confidence and ease among informants that are necessary for the elicitation of valid data. It has been argued that this style results in each interview being idiosyncratic, and thus posing difficulties in terms of reliability and validity (Cicourel, 1964, as quoted in Goetz & Lecompte, 1995, p.131). However, in a study of this small size, idiosyncrasy of data is inevitable, and reliability needs

to be maintained by ensuring that all the items on the interview schedule are covered.

Given the likely idiosyncrasy of the interview data, it is important that they be recorded as accurately as possible. Traditional ethnographic field notes, written up subsequent to encounters with informants, almost inevitably are paraphrased. Distortions can arise where subtleties of phrasing are lost, or the researcher assumes connotations that are unintended by the informant. Given the relatively small number of encounters planned in this study, it was decided that near-verbatim records would be obtained through the use of a tape-recorder and transcription, with interpretive comments to be added later (Goetz & Lecompte, op. cit.).

4.2.5. Interview Techniques

Avoiding Bias

“Overcoming interviewer/informant bias is integral to the way in which the interview is conducted.” (Saunders, Lewis & Thornhill, 1997, p.219).

Bias may occur where an informant provides only a partial picture. This may be due to a variety of reasons, e.g:

- feelings that privacy is being invaded in areas in which the informant is unwilling to be open;
- feelings that self esteem is being threatened, where the informant provides information presenting him or herself in the best light, and suppressing information that may do the opposite;
- the informant may have come to a view as to what the researcher wants to know, and only provides information that coincides with that view;
- there may be a perceived lack of neutrality in the researcher's position that may lead the informant to angle statements in such a way as to satisfy the researcher. (Saunders et al., 1997).

Additionally, there may be a perceived imbalance of power between researcher and informant that may lead to the informant feeling embarrassed, hostile or subservient (Jones, 1991). Finally, lack of control over the direction of the interview, and too great a variation in technique between interviews may produce data that is rambling or poorly focused.

In order to avoid as much as possible these difficulties, care was taken in the planning of the interviews for both content and context.

Planning the content of the interviews

The rationale behind the study was that home environment and family processes are associated with educational achievement (Broman et al., 1987; Haynes & Naidoo, 1991; Campbell et al., 1994; Marjoribanks,

1994). The analysis of the NCDS data in Chapter 3 indicated that variables relating to family size, parental education, the health of the children and their mothers' histories of pregnancy were associated with academic achievement. Other research has suggested that parental attitudes towards education, and gender also have some effect on achievement (Tocci & Engelhard, 1991; Becker & Forsyth, 1994). It has been difficult to establish whether over or under achievement in mathematics is but one indicator of a general academic achievement, since much of mathematics teaching and learning appears to be language based (Haylock, 1991).

For this study, therefore, three groups of pupils aged 14/15 years were identified as over, "normal", and under achievers in mathematics, and their parents were interviewed. The analysis of the interviews aimed to establish whether there were any family attitudes, processes or environments that were characteristic of these different groups.

During the pilot phase of the study, interviews covered five areas:

- details of the household;
- family processes and interactions;
- school interactions;
- parental career;
- parental attitudes.

Each area was introduced with a key question, followed by several subsidiary questions, prompts and probes.

The interviewer, in adopting a non-interventionist role, allowed the parents to develop their responses in their own way, in order to identify the constructs and phraseology that would later be elicited in the main study. Inevitably, there was much repetition, circular talk and inter-parent reinforcement talk.

It became clear from the pilot study that three issues of interview management needed to be addressed:

- mutual protection - if one parent seemed uneasy in responding to a question, the other would often briskly fill the gap, and steer the conversation away, leaving no opportunity for the reflective pause, or gentle prompt;
- a second, and related issue, was that of dominance - one of the parents would attempt to monopolise the interview, often cutting short the other parent and completing statements for him/her;
- a third issue was the use of the pronoun “we”. When discussing management of their children, mothers and fathers would often speak as if every action was taken jointly. Gentle probing would sometimes reveal that the parent using “we” had not been involved in the activity described.

In the main study, the interviewer took a more pro-active role, exercising a degree of control over the direction of the interviews, and

the interview schedules were re-structured to reflect the parents' responses in the pilot study, as well as to address the issues mentioned above. Thus parental biography was brought to the beginning of the schedule, so that informants would feel comfortable talking about the topics with which they were most familiar, and become accustomed to use the pronoun "I" from the beginning. An additional section on the current levels of development and maturation of the study child was added, since the parents tended to introduce many such details without prompting throughout the interviews, and any missing data could be completed at the end. Questions specifically relating to:

- parental education and career;
- mothers' histories of pregnancy and smoking habits;
- numbers of children in the home together with their health and sibling status

all reflect the areas analysed in Chapter 3. Further questions, arising from the literature describing the work of, among others, Campbell et al. (1994), Marjoribanks (1994), included:

- parents' attitudes to education and to mathematics;
- parents' family histories, hobbies and interests;
- parental hopes and aspirations for their children;
- parents' understanding of school processes;
- parents' interaction with their children including the study child;
- allocation of family resources.

Thus, the final content of the interview schedules was determined by the constructs arising from the pilot interviews, and consisted of six sections:

Section 1 Parents' and family background.

Section 2 Study child's early development.

Section 3 Study child's present status.

Section 4 Parents' interactions with the study child's education.

Section 5 Present family environment.

Section 6 Study child's present personal and educational profile.

The full details of the interview schedule may be found in Appendix 4.

Planning the context of the interviews

Recruiting letters were sent to parents, giving a brief explanation of the programme, and inviting those who wished to participate to return an enclosed response slip, containing their names, addresses, telephone numbers and a sentence of authorisation (see Appendix 7 for specimen of letters sent out). After returning the responses, the parents were telephoned by the researcher who introduced himself, reminded the parents of the recruiting letter and their responses, and arranged dates and times for the interviews. If the arranged date were some time forward from the telephoned arrangement, the researcher telephoned again the day before the interview date to confirm that it was still convenient.

Goetz and Lecompte (1995) are unequivocal that data collection through the use of mechanical aids (tape recorders, video recorders, cameras etc.) strengthens the reliability of the results. Furthermore, the validity of the data is enhanced, since the phraseology used by the informants is close to the empirical categories that they are attempting to explicate.

The informants were asked, therefore, if they would permit recording.

The same reasons were given to all the informants, viz:

- that the interviews were to be conversational, rather than question and answer, and the interviewer wished to give all his attention to the informants with a minimum of distraction from note-taking;
- the interviewer did not wish to miss anything said, nor to interrupt with requests for repetition.

At the same time, confidentiality was promised. Informants were assured that

- the researcher had no connection with, nor commitment to, their child's school;
- the tape recordings would remain under the researcher's sole control;
- the transcripts would contain no identifiable names for people or schools;
- if they so wished, the tapes would be returned to them to deal with as they saw fit.

All informants expressed themselves willing to be recorded, and none requested return of the tapes.

Before starting the recording equipment, the interviewer explained the rationale for the research as follows:

- in previous research it had been established that the home environment is a most important element in children's achievement at school;
- this connection had usually been measured through the children's achievements in literacy based subjects, but rarely through achievements in mathematics;
- it is important to fill this gap in our understanding of how children learn.

A small, flat microphone that could be placed unobtrusively on a table or the arm of a chair was the preferred instrument. Saunders et al. (1997) recommend that the recorder should be controlled by the informant, who may switch it off if sensitive topics arise that he or she is unwilling to have taped. They argue that valuable data may be lost from an unwilling or embarrassed informant. In the present study, this argument was considered, but rejected for the following reasons:

- if there were some areas that the informant was unwilling to have recorded, there would probably also be other areas that would not be discussed at all, even without the recorder, so the information coming from the informant would at best be partial anyway (see earlier discussion on bias);

- since the majority of interviews were conducted with both parents together, it was unlikely that any statements would be forthcoming that could not be made before the spouse or partner, and hence on tape;
- the act of passing control to the informant may cause him or her to be even more conscious of the presence of the tape recorder, and so less likely to be open and forthcoming.

In the event, nobody asked for the recorder to be switched off, and informants appeared to forget that it was running, an experience also reported by Jones (1991).

Conduct of the Interview

The opening question was designed to give the informants the opportunity to talk about themselves, what they knew and felt comfortable about, yet was not specific enough to be intrusive at this early stage.

The interviewer gave attention to each informant in turn. The schedule was overtly open on a clipboard, and the interviewer occasionally referred to it. Probes and prompts were addressed to individual informants, and they were encouraged to speak in turn, rather than simultaneously. Care was also taken to ensure that informants were able to take turns at speaking first. Contributions

from the interviewer were as minimal as possible, consistent with retaining control over the direction of the interview, allowing silences to extend where necessary for informants to marshal thoughts and recollections. However, as Jones (1991) found, some informants were laconic in their responses, and interventions and prompts from the interviewer were more frequent in these cases. Control was not exerted without flexibility. If early in an interview, conversation took a turn that was relevant to issues to be discussed later in the schedule, or an informant appeared to be particularly passionate about an issue, the interviewer would follow this up, prompting the informant to continue, or probing for additional clarification, rather than overriding or cutting short the informant in the interest of keeping to the schedule.

Reference to the pre-printed schedule would regularly be made.

Being seen to refer to the schedule, and to be making progress through it by turning pages, are:

- useful reminders to informants of the purpose of the conversation;
- an assurance to the informants that their contributions are fulfilling the expectations of the interviewer;
- a brief opportunity for the interviewer to take stock and review any earlier statements that may require clarification.

After the interview

In conclusion, the tape recorder was overtly switched off, and the informants were asked if they had any questions they wished to ask, or any information they wanted to give that had not been requested. They were thanked once again, reassured of confidentiality, and promised a précis of the report when it is completed. Immediately following the interview, the researcher made notes of preliminary impressions (Robson, 1993; Saunders et al., 1997). A detailed schedule was designed to assist in this, matching the format of the interview schedule (see Appendix 5). Finally, letters of thanks were sent to the informants (Jones, 1991).

4.2.6. Analysis of Transcripts

As already mentioned, the interview tapes were fully transcribed to ensure that there was no loss of richness or depth of data. The transcripts constituted the primary documents for analysis, which was undertaken with the assistance of specialised computer software.

Computer software is now widely used for the coding and analysis of qualitative data. Weitzman and Miles (1995) and Wilkin (1997) have reviewed available programmes, and concluded that the two most powerful are NUD.IST (Richards & Richards, 1991) and ATLAS/*ti* (Muhr, 1991). The section following, on the use of computer software

in qualitative analysis, is an edited version of the contribution that this author made to a recently published text on research methods (Wilkin in Saunders et al., 1997).

Using A Computer For Qualitative Analysis

Computer software for qualitative analysis performs four basic functions. These help the qualitative analyst by acting as an aid to:

- project management;
- coding and retrieval;
- data management;
- hypothesis building and theorising.

The software performs these functions through the five basic operations familiar to qualitative analysts: file, retrieve, cut, paste and display. The speed at which it performs these operations gains time in which the researcher can consider linkages and their meaning. The qualitative analysis programme is a tool which performs tedious and time consuming operations, thus releasing the researcher for creative thinking and the generation of ideas.

Project Management

Data, whether in the form of text, or other non-textual 'documents' (such as video tapes, audio tapes, photographs etc.) need to be organised in such a way that access to them is both quick and accurate.

In so doing, a good qualitative analysis programme will display an index of documents, with facilities to select and retrieve individual documents. Computer readable, text based documents can be displayed in full, and 'chunks' of text can be selected, for operations such as editing, indexing (coding) or note making (memos), without affecting the primary document.

One of the most powerful tools in a qualitative analysis programme is the ability swiftly to search any number of documents for specified units of data or codes.

Furthermore, the ability to use the software to cluster units of text containing selected words or phrases, and to display the cluster in a window together with reference to primary documents, replaces the process of multiple photo-copying, slicing copies into dozens of paper slips and annotating each one before sticking them on to data cards and filing them in piles, or pinning them in appropriate places on a vast 'clipboard'. This process can be undertaken without any damage to the primary data, which are still held in the original documents.

Coding and retrieval

If all the data are word processed, or in some other computer readable form, it is possible for primary documents to be accessed 'on-line', that is the programme can search the text itself and allocate codes to

specified units of text. The more powerful programmes such as ATLAS/*ti* and NUD.IST can display the documents on screen in a range of formats.

The identification of text units is usually by line number, although more powerful software such as ATLAS/*ti* and NUD.IST offer the facility of choosing the most appropriate size of text unit for the data (e.g. sentence, paragraph, utterance) simply by highlighting the appropriate section of text in the document window. In the present study, the transcripts were line numbered, and units of text were identified by highlighting (see quotations in Chapters 5, 6, 7 and 8)

Data are coded by selecting a unit of text, and directing it either to a new or to an existing code 'address'. A text unit may be directed to any number of code addresses. For example, the text unit: "... and I wouldn't dream of changing doctors, because I wouldn't have confidence in the youngster he has just taken on as partner." could be encoded under 'attitudes to change', 'trust', 'health', 'older respondents' etc. In order that categories (or codes) in a hierarchical system can be readily traced by their location in the hierarchy, they may also be allocated a code number.

In addition, NUD.IST and ATLAS/*ti* offer an 'off-line' facility for the coding of data such as video tapes, audio tapes, maps, photographs, or archive texts.

Data Management

Most qualitative projects quickly gather more and more data. This needs to be managed in such a way that it can readily be accessed and reviewed. There are three classes of data: primary data, index codes and memos. The qualitative analysis software retrieves and displays all or any of these individually, in specified groups or clusters, and can indicate cross references or links between them. Some more powerful software, such as ATLAS/*ti*, may incorporate a linked window system whereby the selection of a unit of text from the primary document results in the automatic display of its code, any memos associated with it, and the text of cross references from other primary documents. 'System closure' should also be available, whereby notes and memos are themselves open to the same search and retrieval procedures as the primary documents.

Hypothesis Building and Testing

The foundation of hypothesis building lies in discovering links between elements of the data. Sense then needs to be made of these links, and that is the function of the analyst. The software, however,

can help to discover the links and, with graphic facilities, can display them. Two basic ways of organising and linking data are available:

- hierarchical organisation, where data may be classified in a few broad themes, then each theme classified into a number of sub-categories, and each of these into sub-sub-categories, etc. For example, data may initially be classified under the broad themes of 'Values', 'Concepts' and 'Strategies'. Upon reviewing all the data under 'Strategies', it may be appropriate to divide them into 'Mature' and 'Immature', or 'Long term' and 'Short term'. The 'Values' theme may fall naturally into, say, 'Internal' and 'External', and then into several sub-categories such as 'Duty', 'Trust' and 'Liking'. An alternative approach is to code each section of data on a first reading, and then, later on, discover ways of gathering together like categories that can be grouped together under common headings, which can in turn be grouped together in broad themes, and so on. For example, in the case above the concepts of 'Duty', 'Trust' and 'Liking' may be identified from the reading of the data, and then grouped under a common heading of 'Values'. NUD.IST, ATLAS/*ti* and INSPIRATION, all offer this style of organisation.
- network organisation where the categories may be more flexibly linked to one another, without the rigidity implicit in the hierarchical structure. In particular, the ability to represent a project in graphical form can be a very powerful aid to theory building, and INSPIRATION offers an extremely varied network facility, with publishable quality printing. ATLAS/*ti* offers a library of code and linkage icons, so that the nature of the relationships between categories can be seen at a glance.

Networks can be re-arranged in whatever way suits the developing project, simply by 'click-and-drag' on the elements of the network. INSPIRATION and ATLAS/*ti* offer both networks and hierarchies, with tools for automatically moving between them.

Choice of software

In the pilot study, interviews were conducted using an open structure of broad themes, guided by the literature (Campbell et al, 1994; Marjoribanks, 1994; Broman et al, 1987). The NUD.IST software (Richards & Richards, 1991) was used to code the pilot interviews, and to identify more specific concepts within the broad themes. The interview schedules were subsequently refined to cover 34 operational concepts within 6 broad themes. A copy of the final interview schedule used in the main study can be found in Appendix 4. For the main study, however, the ATLAS/*ti* software (Muhrr, 1991) was used, since it offers both hierarchical and network structures, and the flexibility of being able to alternate between the two. Texts coded under each operational concept from the interview schedule were revisited, and further coded into more sensitive sub-categories emergent from the transcripts. The distinction between operational and sensitising concepts is described by Goetz and Lecompte (1995):

“Concepts termed operational are defined prior to data collection. Sensitising concepts remain purposely vague and abstract until the researcher has gathered sufficient data to clarify and differentiate their dimensions.” (p. 216).

Reliability and Validity of Constructs

The use of a substantial group of pre-defined operational concepts goes a considerable way to ensure reliability of the analysis, since it affords the potential for subsequent researchers to reconstruct the strategies. Concepts derived later in the analysis, however, also need to be clearly defined.

At the same time, the derivation of operational concepts from participant pilot interviews, and their subsequent use in the main study, provide internal validity to the results, since informant responses are necessarily phrased within the empirical categories being measured (Goetz and Lecompte, 1995).

In the following chapters, transcripts of the interviews are analysed. Operational concepts form the starting point of each analysis, from which more sensitive constructs are derived. These are illustrated, as they emerged, by statements from the participants.

CHAPTER 5

PARENTS' EDUCATION AND THEIR FAMILIES' EDUCATIONAL HISTORIES

5.1. Introduction

Earlier chapters have reviewed evidence which suggests that parents' level of education is a predictor for the children's academic achievement. For example, in the NCDS study, parents were asked to report whether they had left school at the statutory leaving age, or had stayed on: high mathematics achievers were found to be significantly more likely to have mothers and fathers who had stayed on at school (Fogelman, 1983). Elsewhere, Lareau (1989) has suggested that better educated parents were more likely to be "engaged" with their children's education.

In this Chapter, therefore, an attempt is made to provide more detailed, qualitative information about parents' education, and to relate it to the children's mathematical achievements. In the interviews, mothers and fathers were asked to describe their experiences and achievements at school, in Further Education and, in some cases, in Higher Education. In addition they were asked to report the educational achievements of their own parents and siblings,

nephews and nieces, in an attempt to develop a picture of the educational traditions and achievements current in each family.

The names of the study children are not their real names, but have been allocated so that names beginning with early letters of the alphabet (A, B, C) represent high mathematics achievers and names beginning with letters from the end of the alphabet (T, V, W) represent low mathematics achievers. Names beginning with letters from the middle of the alphabet (L, M, N) represent middle mathematics achievers. The names were chosen to avoid the necessity of adding a group category marker to a child's name at each mention of it.

Quotations from the interviews with parents are mostly verbatim transcriptions from the taped interviews. In some instances, quotations are condensed where the original speech tended to deviate from the topic, or synthesised from a number of short related comments. Line numbers are given against each quotation in case reference needs to be made to the transcript.

In the display tables that follow, colours are used only to indicate more readily where cells form clusters.

5.2. Summary of the Data

A summary of the results is shown in Tables 7, 8 and 9 below.

High Maths Ach'vers	Was Father happy at sch.	Was Mother happy at sch.	Did Father gain O Levels	Did Mother gain O Levels	Father's Further Educn.	Mother's Further Educn.	Father's Higher Educn.	Mother's Higher Educn.	Father's Family Educn.	Mother's Family Educn.
Anne	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Ben	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Brenda	No	Yes	Yes	Yes	Yes	No	Yes	No	No	No
Alan	Yes	No	Yes	Yes	Yes	(Yes)	No	No	No	Yes
Carl	No	Yes	Yes	Yes	(Yes)	(Yes)	No	No	Yes	No
Christine	No	No	Yes	Yes	No	Yes	No	No	Yes	No
Bruce	No	No	No	No	No	No	No	No	No	No

Table 7 Experiences and achievements in education in the families of High Mathematics Achievers. ('Yes' in parentheses indicates having taken the course, but dropped out or failed the exams.)

Low Maths Ach'vers	Was Father happy at sch.	Was Mother happy at sch.	Did Father gain O Levels	Did Mother gain O Levels	Father's Further Educn.	Mother's Further Educn.	Father's Higher Educn.	Mother's Higher Educn.	Father's Family Educn.	Mother's Family Educn.
Timothy	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Theresa	No	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Wayne	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	No
Wilma	Yes	Yes	No	Yes	No	No	No	No	No	No
Vanessa	n/k	No	n/k	Yes	n/k	No	n/k	No	n/k	No
Vince	No	No	Yes	No	No	No	No	No	No	No

Table 8 Experiences and achievements in education in the families of Low Mathematics Achievers.

	Was	Was	Did	Did						
Mid Maths	Father	Mother	Father	Mother	Father's	Mother's	Father's	Mother's	Father's	Mother's
Ach'vers	happy	happy	gain	gain	Further	Further	Higher	Higher	Family	Family
	at sch.	at sch.	O Levels	O Levels	Educn.	Educn.	Educn.	Educn.	Educn.	Educn.
Lucy	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Michael	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Nikki	No	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Nicholas	Yes	n/k	Yes	n/k	Yes	n/k	No	n/k	Yes	n/k
Luke	Yes	Yes	No	No	Yes	No	No	No	No	No
Melanie	No	Yes	No	Yes	No	No	No	No	No	No

Table 9 Experiences and achievements in education in the families of Mid Mathematics Achievers

Similarities across the Study Groups

Parents' Higher Education

Each group contained three children with at least one graduate parent, and in one case both parents are graduates.

Parents' O Levels

In nearly all the cases from each group, at least one of the parents had obtained O Level credentials.

Differences between Study Groups

Education in the wider families

In the group of high mathematics achievers, five children had members of their wider families who were reported as having achieved credentials of at least O Level or above, in two cases, from both their mothers' and fathers' families. In the group of low mathematics achievers, however, wider family credentials were reported only by two of the mothers. Reports from parents of the mid mathematics achieving group were similar in distribution to those of the high mathematics achieving group.

Credentials achieved by both parents

In the high mathematics achieving group, both parents obtained credentials at O Level or above in all but one case. (The case of Bruce, is an exception, in that both his parents reported having been taken out of school at the statutory leaving age, and before sitting their leaving examinations.) In the groups of low and mid mathematics achievers, however, in only two cases did both parents obtain O Level credentials.

Parent's' experiences of schooling

Ten parents from the group of high mathematics achievers reported having been unhappy at school. All of these, with the exception of Bruce's parents (see above), obtained O Level credentials, and 8 went on to further or higher education. It is possible that their unhappiness at school may have been partly a result of pressure on them to achieve their credentials.

In contrast, only 10 parents spread across the other two groups reported having been unhappy at school. The five mothers who so reported found that difficulties with mathematics contributed to their unhappiness.

5.3. Details of parents' comments in interviews

5.3.1. Fathers' Education

Fathers' Experiences of Schooldays

All but one of the fathers of high mathematics achievers reported having been unhappy with aspects of their schooldays. For example, Brenda's father disliked the academic emphasis, whilst Carl's father

disliked the emphasis on sport. Other fathers also reported that they had not enjoyed their schooldays.

I hated sports at senior school ... I just don't like being told what to do and when. In the county at that time it was rugby - now it's winter time, you must play rugby. (Carl's father 15-21)

I went to a single sex inner city grammar school. The curriculum was very narrow, very academic I didn't enjoy it. At that [A] level, the maths was forced on me I've avoided maths ever since. (Brenda's father 47-50)

I left school without taking any exams ... I left as soon as I was able There were some teachers, particularly in the grammar school, who I didn't get on with. (Bruce' father 45-47, 54-56)

I left school without taking any exams. I was brought up a Jehovah's Witness, and at that time we had a rather blinkered view of education, and Further Education wasn't encouraged. (Bruce's father 62-66)

My earliest recollection of school is of being overshadowed by fear and anxiety (Anne's father 43-44)

I didn't like going to school I failed the 11 plus. (Ben's father 240, 245)

I remember being lazy. I never enjoyed primary school. Went to a grammar school in London, run by Jesuit priests. You either learned or had it beaten into you. I couldn't wait to leave school. I must have been 16 when I left with 4 O Levels: English, Maths, French and Latin. (Christine's father 5-10)

Similarly, three of the fathers of the low mathematics achievers said they had been unhappy at school.

My overriding memory is that, basically, I wasn't very good. I regularly finished at the bottom end of the class tests. I wasn't interested in school at all, and found it very stressful. My parents were not comfortable in [visiting the] school, it was an alien environment of which they were in awe. I was bullied quite a lot - by two boys in particular. (Timothy's father 39-52)

Nobody ever told me why I was doing it, to what it applies, and how it is going to affect my future. I blame the teachers for not telling me the relevance of the material. (Vince's father 55-59)

At secondary school, I went into the 'booster' stream for bright children, so I was a year ahead of my peer group. Being one of the youngest in the class caused a bit of a problem Bright boys had their fees paid for them, and the parents of the rest had to find the fees. This damaged my relationship with my younger brother, and caused tensions between us. (Theresa's father 284-287, 293-296)

The other fathers interviewed from the low mathematics achieving group were generally positive about their schooldays, for example:

I found early school easy. I was quite adept at most subjects. My parents were both teachers, so I got constant help at home, and never had any problems. I was almost top of the class all through my school life. I sailed through my O Levels, and did reasonably well in my A Levels. I was very lucky in many ways. The schools I went to were all good, the grammar school had only 200 pupils. I actually enjoyed my years there. (Wayne's step-father 5-8, 16-17)

I went to the local primary school, a happy place where everybody knew everybody ... Then I went to the senior school at (name), and got on really well there. Found it a bit daunting at first after a small school to be in a school with three stories. Had some good teachers, especially the maths teacher, who was very strict but very fair. If you wanted to learn he'd help you, I found him very good. At one time I did struggle a bit with maths, but he helped me out a lot. I took my CSEs and left when I was sixteen. (Wilma's father 103-111)

Four of these fathers had taken O Levels at school.

(Vanessa's mother had been divorced two years prior to the interview, and had only recently remarried. She spoke only once of her ex husband, to mention his employment and to say that he had, unlike his wife and daughter, understood mathematics.)

Fathers' Experiences of Continuing Education

Five out of 7 fathers from the high mathematics achievers group and 3 out of 5 from the low mathematics achieving group had continued with their studies after O Levels. Carl's father accepted a job offer after only one year in the sixth form, and undertook no further formal education, but the fathers of Ben, Brenda, Timothy, Theresa and Wayne all achieved A Levels, while Anne's father achieved an OND at technical college.

Six fathers (three from each group) also described the different ways in which they had moved into Higher Education. Ben's father reported how he was suddenly motivated to work towards a professional qualification.

*Going on to the Polytechnic, I suddenly woke up, and set to work. I and one other chap from my year group passed all the exams without faltering.
(Ben's father 248-252)*

Brenda's father returned to education after two years in commerce.

After I left school, I worked for the building society for two years, then went to Polytechnic to do a degree in social sciences. (Brenda's father 51-52)

Theresa's father followed the common route via A Levels direct to University, and Wayne's step-father entered the accountancy profession after leaving school with A Levels, and sat his professional

examinations whilst in training. Anne's father reported being urged by his college tutors to aim higher after his OND success had indicated his potential.

I did well on the OND course, got distinctions in every subject, and took a prize. I only ever thought of myself as a technician, but my (FE) tutors thought I should go to University. (Anne's father 56-59)

However, four fathers left school (3 at age 16 and one at age 18) to enter the world of work, reportedly with no intentions of pursuing education further. Wilma's and Vince's fathers spoke of leaving school for work as if it were a matter of course.

I went to the senior school at (name), and got on really well there ... Had some good teachers, especially the maths teacher, who was very strict but very fair. If you wanted to learn he'd help you, I found him very good. At one time I did struggle a bit with maths, but he helped me out a lot. I took my GCSEs (sic) and left when I was sixteen. (Wilma's father 105-112)

I left school at 17, on account of having done an extra year at preparatory school for the sake of the music. In those days you could get a job easily, so I never considered 'A' Levels left after 'O' Levels, joined the bank, and have been there ever since. (Vince's father 33-34, 62-65)

whereas Christine's father declared that he was glad to leave a school he disliked as soon as possible.

You either learned or had it beaten into you I couldn't wait to leave school. I must have been 16 when I left with 4 O Levels: English, Maths, French and Latin. (Christine's father 6-10)

Only Alan's father offered a wider analysis of his reasons for abandoning education.

I didn't like the chap who made the arrangements for university entrance, so I didn't go. Also there was no family history of university entrance, my sister left grammar school and went straight out to work. If my sister had gone, I would probably have been expected to go as well. If I had my time over again, I would get down to it, but there was nothing like that at home. My parents didn't encourage me to go to University, so when I said I was going to leave school and get a job, that was accepted, because that is what they had done, and that was what my sister did..... The generation that I came through, didn't go to University, a lot of them just went out and got work, because you didn't need a degree in those days, so getting a job, and there were plenty of them, was a much easier prospect than it is today. If we had been told that we wouldn't get a job unless we had a degree, a lot of us would have got a degree. I would have done, anyway. But I wanted to earn some money, buy a car, go out with girls. (Alan's father 34-41, 47-52)

The pattern of fathers' experiences of education found in the mid mathematics achieving group showed similarities to both the high and low mathematics achieving groups. Three out of the six fathers went on to Higher Education. Like the fathers of Alan and Brenda, Michael's and Lucy's fathers obtained University degrees, and, like Wayne's step-father, Nicholas' father obtained his professional qualifications whilst in training. However, the fathers of Luke, Nikki and Melanie left school at 16 and obtained apprenticeships, obtaining their vocational qualifications through day release schemes and evening classes.

I left school at 16 ... [I was] fairly average in maths, not much interested in academic things, mainly concerned with having a good time. I didn't like the school environment. I made better progress once I got to college - the environment was more open. There, the onus was on the student - if you don't want to do it, don't bother coming. (Nikki's father 86-92)

I was the dumbo of the family - went to secondary modern school - started in the bottom stream, but was promoted to the top stream. I got 7 CSEs ... Design and woodwork were my best subjects. Worked up from craft apprentice, through technical apprenticeship, City & Guilds exams, machinist, setter, programmer, general problem solver. I've been there now for 29 years. Still need my maths. (Melanie's father 26-36)

I left because I was getting independent - certainly an English teacher was making life a misery, and I thought there was no way I'd get through the next two years to get an English O Level. I was offered a job in a laboratory, so I left school at Easter. I didn't even sit the final - the LEA exams at the time, but I was top boy in the school, so just on my school report I got the job. I don't think it went against me, although it was a mistake to leave at 15..... I did night school for about 9 years, and got an HNC in Applied Physics. I meant to go back and do a management course after I got married, but never got round to it. (Luke's father 13-21, 26-29)

Only Luke's father expressed regret at having left school early.

5.3.2. Mothers' Education

Mothers' Experiences of Schooldays

Four of the 7 mothers of high mathematics achievers reported having been unhappy at school.

My first (secondary) school was K School. I hated English - used to stand outside the door dreading it - wishing the time away. When we came to live here, I went to N School, and that was a big mistake. I should have stayed at K school rather than transferring - I wasn't happy there. (Bruce' mother 7-13)

I can remember not liking maths. I can remember thinking that, somehow or other, everyone knew the trick, and I hadn't quite got it. I hated it [maths], I didn't understand any of it. I swore I'd never do maths again (Ben's mother 24-25, 61-62)

I went to three primary schools, because my mother and father moved around, all within the same area. I have an elder sister, and she used to come home from secondary school, saying how difficult maths was, so I was terrified from day one. (Alan's mother 59-65)

I was always middle to low stream. I was never very confident - a very slow learner - always have been maths to a certain extent, but I couldn't grasp some aspects of it, so I did struggle, and I was happy to leave after I'd done my GCEs. (Christine's mother 5-11)

Of these the mothers of Alan, Ben and Christine attributed some of their unhappiness to difficulties with mathematics.

The other three mothers in this group reported they had enjoyed their schooldays, and Carl's mother was particularly positive.

I went to two primary schools, both in the same town. Then I went to technical high, which was between a secondary and a grammar. I loved school, absolutely adored it, not because I was particularly bright or had loads of friends, I just liked being there.
(Carl's mother 37-40)

I went to a Church of England junior school, and I was very happy there. Although I failed the 11 plus, I passed into the grammar stream of the comprehensive school. (Brenda's mother 11-13)

I preferred practical subjects at school, cooking and sewing, because that was what I was interested in. What I really liked about school was the friendship, the social aspect. (Anne's mother 25-30)

Nevertheless, despite their mixed experiences of school. all but Bruce's mother from the high mathematics achieving group sat O Level examinations, and 5 continued into further education.

From the low mathematics achieving group, 3 of the mothers reported unhappy schooldays.

It was very rigid - I'd come from a much more relaxed school, so I found it very hard. I had a lot of problems there, I couldn't cope with it. The teacher was very very strict, far too strict for me - I didn't need someone like that - he didn't work for me, and I struggled in every subject.
(Vince's mother 3-20)

I was in the top division for languages, but felt rather bogus, as the French exam was easy(Theresa's mother 25-33)

I didn't like maths, I didn't get on with it, couldn't see what it was for. Couldn't see the logic in it, (Vanessa's mother 15-16)

Wayne's mother was also keen to move on from school and start her career in nursing.

*I went on to do what I wanted, which was nursing. ... I left school at 16, did 2 years pre-nursing at college, then went into nursing at 18.
(Wayne's mother 31, 43-44)*

As with the mothers of the high mathematics achieving group, the mothers of the low mathematics achievers reported mixed experiences of schooldays, but only 3 obtained O levels. Only Ben's mother went on to Higher Education, obtaining an Open University degree whilst bringing up her children.

The pattern of responses from the mothers of the mid mathematics achieving group was similar to that of the low mathematics achieving group in respect of their credentials achieved, i.e. 3 mothers obtained O Levels and 3 went on to Further Education.

Only two mothers from the mid mathematics achieving group reported having been unhappy at school.

*I was petrified of maths at Junior school. I can still remember a ferocious red haired teacher who used to spring tables on you, and was furious if you didn't know the answers. I used to get in such a state, I was moved down a stream to a more sympathetic teacher. As regards maths, I could never get to grips with it, left me blank. When it came to problems I hadn't a clue - couldn't see what they were getting at. I failed 11 plus, I think due to the maths, because my English was good, and my reading age was excellent.
(Lucy's mother 38-45)*

I hated all teachers. I didn't believe that they had sisters and brothers, mothers and fathers. I didn't like school. (Nikki's mother 39-44,)

Mothers' Experiences of Continuing Education

There was a similar distribution of experiences in both the high and low mathematics achieving groups. In each group were found mothers who reported no more education after leaving school at 16 years, mothers who had completed Further Education and Ben's and Timothy's mothers who had obtained University degrees.

In the high mathematics achieving group, only Bruce's and Brenda's mothers left school at 15, the other five mothers continued in education. Carl's mother stayed on to do A Levels, but failed the exams, and Alan's mother did a year's secretarial training at Further Education college before dropping out. Christine's mother completed vocational training for secretarial work, Anne's and Ben's mothers trained as teachers, and Ben's mother later went on to obtain an Open University degree while raising her family.

In the low mathematics achieving group, 3 of the 6 mothers continued with their education. Wayne's mother explained that she had a clear ambition in life, to be a nurse, and described how she pursued that ambition successfully,

I trained at the Royal, and did a year as a staff nurse at the local cottage hospital. Then in industry for 18 months, then senior staff nurse at another city hospital, had a child and went back for one night a week for ten years. (Wayne's mother 31-32, 43-46)

In contrast. Timothy's mother, who was the only degree holder in this group, reported achieving through a belief in education for its own sake, rather than to fulfil an ambition,

*I always felt I was an achiever. I took the 11 plus early, and went to grammar school aged just over 10 years, at the same time as my sister who was 15 months older. I took O Levels early, and then catapulted into the sixth form, so I retrieved my earlier sense of achievement and self worth Within the family, [mother, father and the two girls] I think there was the assumption that the Arts were more worthwhile than the sciences. Literature was highly valued, rather than discovery.
(Timothy's mother 27-37, 43-45)*

Theresa's mother, however, did report academic ambitions, but explained she found it difficult to harness them, because of the priority she gave to her social life during her later school years.

I think my social life was probably more important to me than school. I mean, I was a good girl, and was discreet about not doing homework ... I'd tell [my parents] I'd done it, before dashing out. I wasn't rebellious, and I realised that work was important. I was disappointed that I wasn't doing as well as I felt I ought to, but I didn't know how to sort myself out. I did do A Levels and got two, but not particularly good results, and went on to college for a Teacher Training Course. It took me a long time to get myself organised for learning. The years between age 13 and 18 were too busy doing other things. (Theresa's mother 35-45)

The remaining 3 mothers from the low mathematics achieving group left school to go to work, and spoke of their decisions, as had the fathers of Wilma and Vince, as having been a matter of course.

*.... took ten GCEs, eight in the fifth form and two in the sixth form. My maths was ungraded. I then went into nursing in [name of city].... I was 17 ... got married, had children Now I'm a practice nurse.
(Vanessa's mother 16-20)*

We did CSEs, and then you paid, and I paid to do three O Levels, which I passed. English, Maths and Science at CSE, then Domestic Science, English Literature and Typing for O Level. I left at sixteen to do hairdressing. (Wilma's mother 40-42)

Once again, as in the case of fathers' education (see above), the pattern of mothers' education in the mid mathematics achieving group showed similarities with both the high and low mathematics achieving groups. Like the mothers of Ben and Timothy, Lucy's and Nikki's mothers obtained degrees and, like the mothers of Brenda, Bruce, Vanessa, Vince and Wilma, the mothers of Nicholas, Melanie and Luke left school without following any further education. There were no degree holding mothers in this group.

5.3.3. Other Members of Parents' Families

In the high mathematics achieving group, 4 fathers and 3 mothers reported examples of educational or professional credentials in their own families. For example, Christine's uncle is a consultant surgeon. Anne's uncle is an accountant, as were Ben's and Christine's grandfathers. In addition, Anne's great-uncle and an aunt went to University, as did Alan's grandmother.

My brother went to grammar school got his O Levels, then left school and went to work He went to night school, and got his Chartered Accountant exams..... My mother left school at 14 and worked in a shop. Father did the same, and was a rep - a traveller. There were no opportunities for FE. Mother had to go to work so that her [elder] brother could go to college, which he did, and became a headmaster. (Anne's mother 97-108)

My mother went to University, studied Law and Politics. My father would have gone to University, but he got caught up in National Service, which he chose to do rather than take exemption. There he met his future brother-in-law, who played in a jazz band, and when he came out, father just dropped everything in favour of music. Then they married, mother became pregnant, and dropped out of University just six months before graduating. (Alan's mother 93-101)

One of Carl's uncles achieved well at O Level, but left school to work, and another uncle and an aunt left school after achieving O Levels.

I've got a younger brother. He went to the grammar [school], got loads of O Levels, then left and went to work. (Carl's father 185-187)

In contrast, only two mothers and no fathers in the low mathematics achieving group reported educational or professional credentials from their own families. Timothy's and Theresa's aunts and uncles are all graduates, but the remaining 4 mothers and 5 fathers all reported that there were no traditions of education in their families. For example,

My father was a plumber and my mother was a housewife. They both left school at 14. My parents were not comfortable in [visiting my] school, it was an alien environment of which they were in awe. (Timothy's father 28-30)

... mother didn't trust the state system. I went to (a named cathedral school) on a music scholarship, as a chorister. (Vince's father 62-64)

Wayne's maternal grandmother was a secretary, who returned to work after her daughter entered primary school. Her husband had been a naval officer, and their son, Wayne's uncle, is also in the navy.

No educational traditions were reported in the families of Brenda or Wilma, but Wilma's aunt and grandfather were reported to have been good at maths.

In the mid mathematics achieving group, 7 of the 11 parents reported various levels of educational achievement in their own families. All

four of Lucy's uncles are graduates, as is Nikki's uncle. Nikki's aunt is a Deputy Head teacher.

I've got two brothers and two sisters, all brighter than me, all four went to Grammar school after taking the exams, and all got O Level maths. One of them did A Level maths. B and S were language based, A was science based, and became a doctor. F was all over. They've all got degrees, although F didn't get hers until she was 31. (Lucy's mother 74-80)

I was youngest of three, [having] one brother and one sister. I was born 1953, went to grammar school, but nobody bothered with me. My parents bothered only with my brother. They thought it was important that he went to university. Only deemed important for the boy to get the academic qualifications. He took 'O' Levels, 'A' Levels and went to University to study economics and psychology. Now my sister took 'O' Levels, then went to Teacher Training College. She's now Deputy Head at [nearby school]. (Nikki's mother 24-28, 50-53)

Michael's paternal grandfather was the only member of his sibling group to matriculate, and his maternal great-uncle was a dentist

My mother would dearly have loved to have been a doctor, but my grandfather having but one son, and he wanting to do dentistry, he came first and they said they couldn't afford to put two through University, so she was a secretary. (Michael's mother 202-205)

Nicholas' grandfather was reported to have made a substantial contribution to both Nicholas' and his father's educational achievements.

He put it into our minds that education was the key to a happy and successful future It felt like a responsibility that I had to discharge Their grandfather spent a lot of time with them ... awakened various interests in them (Nicholas' father 20-23, 93-94)

5.4. Summary of the Chapter

As predicted in the literature, there was a noticeable contrast in the levels of education obtained by the parents of the high and low mathematics achieving groups.

Among the high mathematics achievers, both parents obtained at least O Levels in 6 out of 7 cases, although the majority reported being unhappy at school. Among the mid and low mathematics achievers, however, in only 4 out of 12 cases did both parents obtain at least O Levels, although the majority of parents in these groups reported having been happy at school.

It is, perhaps, not unreasonable to infer that, when recalling their feelings about their schooldays, those parents who felt under pressure to achieve did not much enjoy the experience, whilst those who felt under less pressure enjoyed their time at school.

There was also a noticeable contrast between the levels of their own families' education, as reported by the parents. From the high and mid mathematics achieving groups, parents reported educational/professional qualifications equivalent to O Level and beyond in 9 out of 13 cases. Parents of the low mathematics achieving group reported such qualifications in only 2 out of 6 cases.

From the three groups studied, therefore, it appears that nearly all the high mathematics achievers have both parents and members of their wider families obtaining O Level qualifications or above, whilst only two of low and two of the mid mathematics achievers have both parents and members of their wider family educated to that level.

In addition to these family “traditions” and their own educational experiences, the parents also reported their personal feelings and attitudes towards education in general and mathematics in particular. These attitudes and experiences are described in the next Chapter.

CHAPTER 6

PARENTAL ATTITUDES TOWARD EDUCATION AND MATHEMATICS

6.1. Introduction

The previous chapter focused on parents' reports of their experiences and achievements in education, as well as the achievements of members of their wider families, i.e. their own parents and siblings.

This chapter links those experiences to the attitudes towards education in general and mathematics in particular as expressed by the parents of the three study groups, high, mid and low mathematics achievers.

6.2. Parents' Attitudes Towards Mathematics

6.2.1. Summary of the Data

Parents' reports of their experiences of mathematics at school and of their present attitude towards mathematics are displayed in Tables 10 and 11.

Study Cases	Parents who had difficulties with mathematics	Parents who were comfortable with mathematics
High Maths Achievers	8 (3 fathers) (5 Mothers)	6 (4 fathers) (2 Mothers)
Low Maths Achievers	8 (4 fathers) (4 Mothers)	4 (2 fathers) (2 Mothers)
Mid Maths Achievers	1 (1 Mother)	10 (6 fathers) (4 Mothers)
Totals	17	20

Table 10 School mathematical experiences of parents of study cases

The distribution is statistically significant ($p<0.025$, $F=8.7$, $d=2$)

Study Children	Fathers Positive	Mothers Positive	Fathers Negative	Mothers Negative
Boys HM	1		3	3
Girls HM		1	3	2
Boys LM	1	1	2	2
Girls LM			2	3
Boys MM	3	2		
Girls MM	3	2		1

Table 11 Pattern of distribution of parental attitudes to mathematics by study groups by gender

Similarities across groups

The majority of parents of both high and low mathematics achievers reported having experienced difficulties with mathematics in school (see Table 10). Parents’ mathematical experiences were described in terms varying from fear to fun and, in most cases, parents’ experiences at school were carried over to their current feelings for mathematics which varied from strongly positive to strongly negative. A small

number of parents suggested that mathematical ability is in some way innate.

Comparing the three groups, it would appear that parents' experiences of mathematics, both past and present, are in no way related to their children's experience of mathematics. This appeared to be true of both girls and boys.

In broad terms, high and low mathematics achievers were found in families where both parents viewed mathematics in a negative way (see Table 11).

Differences between groups

In terms both of parental experiences of mathematics and their current attitude to mathematics, the parents of the mid mathematics achieving group differed consistently from the other two groups. Parents of mid mathematics achievers were almost all positive about their mathematics experiences, both past and present (see Tables 10 and 11).

6.2.2. Details of parents' comments in interviews

Twenty parents spoke positively of their school experiences of mathematics, using terms varying from 'comfortable' to 'fun' (Table 10).

Whilst others were puzzled, I was always very comfortable with maths, as with most subjects (Anne's father 49-50)

In terms of commercial maths, I'm quite good. I surprise myself. (Nikki's father 100-101)

French I enjoyed, History, Science, Maths. I joined the Maths Club. (Luke's mother 6-7)

They ran a course that they used to call 'Maths for Science', which I can remember, actually, being quite fun. (Michael's mother 51-53)

However, six of these (all fathers) reported reaching a 'ceiling' of competence during their post-16 studies,

At that level, the maths was forced on me, and I didn't enjoy it. I've avoided maths ever since. (Brenda's father 49-50)

*My O Level result was reasonable. I actually did the additional maths course, but never understood it, it was just mechanical manipulation.
(Theresa's father 303-305)*

I did quite well (at O Level), but when I went on to do A level, it was an absolute nightmare. (Nicholas' father 35-36)

Seventeen, the largest group of parents, spoke negatively of their school experiences in mathematics, using terms varying from 'struggling' to 'petrified',

Academically, I can remember being quite good at English, but really struggled in maths. (Alan's father 7-9)

French and maths (I liked) to a certain extent, but I couldn't grasp some aspects of it (maths), so I did struggle, and I was happy to leave after I'd done my GCEs. (Christine's mother 9-11)

Maths was beyond me (Timothy's father 46)

I was petrified of maths in Junior School. I remember a ferocious red-haired teacher who used to spring tables on us, and was furious if you didn't know the answers. (Lucy's mother 38-40)

Only mothers used expressions such as 'frightened' and 'terrified'. None of the fathers spoke of his experiences in terms of fear.

Eight of the twelve parents of low mathematics achieving children were found in this category of struggling or fearful parents, together with eight of the fourteen parents of high mathematics achieving children, and only one from the middle mathematics group. This distribution was found to be statistically significant (see Table 10).

Using mathematics at work was reported by 7 parents. One of these, a mother who was afraid of mathematics when herself at school, is an infant teacher, who finds herself just able to cope with mathematics at the level required of her.

I can remember not liking maths. I can remember thinking that, somehow or other, everyone knew the trick, and I hadn't quite got it but I had to learn maths in order to teach it. I understand enough for the [infant] curriculum, but not higher. (Ben's mother 24-25, 54-55)

Four other parents also spoke of having only a limited competence in basic number skills.

I can do what maths I need to get through my job, but statistics don't mean a lot to me. (Wayne's mother 39-40)

I could cope with arithmetic all right, in fact I'm still quite good at mental arithmetic. (Bruce's father 56-57)

A Chi² analysis of the figures in Table 10 indicated that the distribution is statistically significant. What is of interest, rather than significance, however, is the uniformity of distribution between high and low mathematics achievers. Across these two groups, parents' experiences of mathematics are in no way related to their children's experiences of mathematics. In the low achieving group, mothers and fathers were equally represented as being comfortable or in difficulties with mathematics, whereas in the high achieving group, the ratio of fathers to mothers was 2:1 for comfort, and 3:5 for difficulties. (This may represent a greater willingness of mothers to admit to difficulties in mathematics.)

The majority (18 out of 28) of the parents of both high and low mathematics achievers still feel uncomfortable with mathematics. In most cases, the parents' experiences at school were carried over into

their present attitudes towards mathematics, which lay on a continuum from strongly positive to strongly negative.

Absolutely essential, they'll get nothing without it. If I was an employer, and a kid came to me without maths, I wouldn't give them a job. (Nikki's mother 76-78)

I think it's a pretty peculiar person who is going to get excited about maths per se. I'll lay my cards on the table, I can understand why people want to do it - a certain fun - a puzzle element in it, but the whole point of doing it is so you can do other things - pursue interesting questions. (Theresa's father 437-441)

In addition, three parents expressed their opinion that mathematical ability is innate.

I think there is a natural ability in maths. I strongly believe there is a certain talent there you have to have to start with. My own personal belief is that you're born with that sort of ability. (Nikki's father 106-113)

Maths is one of those subjects where you've either got it or you haven't got it. You can get up to a reasonable level with most people, but after that you've got to have a flair for it. Perhaps it's an innate ability in their brains, to structure data and to handle it. An aptitude, more than anything else, and a wanting to understand how things work. (Luke's father 372-381)

If you can do maths, I think it's easy. My present husband, he can do maths, it's no problem for him, he can't see why I don't understand. (Vanessa's mother 52-53)

In broad terms, the high and low mathematics achieving study children were found in families where both parental attitudes towards mathematics were, in varying degrees, negative. (See Table 11)

It depends on what sort of mood I'm in. If I'm in a woolly headed mood[tails off]. I'm quite good at estimating how much the food bill is, I usually get it to within a pound or so, but that's on a good day. (Bruce's mother 152-155)

I find maths pretty dull, I have to say. (Vince's father 41)

I'm interested in Geography and History, I'm not interested in mathematics. So when he asks me questions about (maths), I guess I refer him to his teacher. (Timothy's father 127-129)

The middle mathematics achieving study children were found almost exclusively in families where both parents were positive towards mathematics. The distribution patterns for both boys and girls were similar, and no gender differences were observed. (see Table 11)

6.3. Parents’ Attitudes towards Education in general

Five broad themes emerged from the interviews, and these are categorised under the headings in Table 12:

Education is:	a preparation for adult life	for obtaining credentials	good for its own sake	an exclusive activity	not what it used to be
HM					
Bruce	✓	✓	✓		✓
Brenda	✓	✓			✓
Ben			✓	✓	✓
Christine			✓	✓	✓
Anne	✓			✓	✓
Alan		✓		✓	
Carl			✓	✓	
LM					
Timothy	✓			✓	
Vince				✓	✓
Theresa		✓	✓		
Wilma	✓				✓
Vanessa				✓	
MM					
Luke	✓	✓	✓		✓
Lucy			✓	✓	✓
Michael	✓	✓			✓
Melanie		✓			✓
Nikki		✓		✓	
Nicholas	✓				

Table 12 Educational themes elicited at each interview

6.3.1. Summary of the Data

Similarities across groups

Despite the diversity of these themes, the majority of parents were united in expressing dissatisfaction with the educational system as they now experience it through their children. Only two sets of parents expressed positive ideological commitment to the state/comprehensive sector, and both were parents of mid mathematics achievers.

.... we chose (name) school for our own children. Although the eldest daughter, Christine, was offered a place at the grammar school, we fought to send her to (name)comprehensive, even though it was outside the city limits. (Brenda's mother 60-62)

Then we had a good chance to look at the schools around the area and, being committed to the state sector, we decided that this was the place to be, both for the junior school and the senior schools. (Michael's father 405-408)

In 10 of the interviews, one or other parent expressed a view of education as an 'exclusive' activity, and in 11 interviews one or other parent spoke of a decline in standards that they perceived in comparison with their own years in education.

Differences between groups

The widest range of views on education was found among the parents of the high mathematics achievers. The most frequent references made by this group were the decline in standards and the 'exclusive' nature of education (5 interviews each). Education as good for its own sake, as a preparation for adult life and as a means of obtaining credentials were each referred to in at least 3 of the 7 interviews.

In contrast, the range of views expressed by the parents of the low mathematics achieving group was much narrower. The ‘exclusive activity’ view was expressed in 3 interviews, whilst education for its own sake, for obtaining credentials or as a preparation for adult life were mentioned in only one or two interviews each.

The range of views expressed by parents of the mid mathematics achieving group was intermediate between the ranges of the other two groups, with no one view predominating.

6.3.2. Details of parents’ comments in interviews

Education is good for its own sake

<i>High Mathematics Achievers</i>	<i>Mid Mathematics Achievers</i>	<i>Low Mathematics Achievers</i>
<i>Ben</i>	<i>Lucy</i>	<i>Theresa</i>
<i>Carl</i>	<i>Luke</i>	
<i>Bruce</i>		
<i>Christine</i>		

Seven interviews contained references to education as a goal worth pursuing for its own sake, 4 from the high mathematics achieving group, 2 from the mid mathematics achieving group and 1 from the low mathematics achieving group. Lucy’s mother and Theresa’s father both expressed clear ideals as to the value of education, although Theresa’s father appeared sad that the ideals were not being met,

I wonder, is there more than paper qualifications? But I think education is important, even if it doesn't lead to paper qualifications. Education is never wasted, no matter what it is, if you can grab it some of it sticks. (Lucy’s mother 230-234)

I would like to say education has to do with encouraging her to engage in the extraordinary world she lives in. I think that is partly true, but mostly it is learning to jump through a certain number of hoops, and we would be doing her a disservice if we didn't help and encourage her to jump through those hoops. That's not the real reason for education, that you come out with a certain number of certificates, the real reason is to become an educated person. (Theresa's father 428-434)

Bruce's father took up a similar theme, and pointed out that, much as the purist might deprecate the loss of a classical education, it does not fit comfortably with modern society. Nevertheless, he believed that the choice between a classical and a modern education should still be available to those who wish to make it, and he claimed to have encouraged all his boys in their own choices,

It's striking a balance between academic requirements and vocational requirements. Business now needs people who have not just got communication skills, but all sorts of other things - technical - language. I think education has to supply all those in balance It's no good having a background in literature, and being well versed in Latin and Greek, without having any of the other skills necessary for the normal world.

It's difficult to say there should be equal emphasis, 'cos some are going to be drawn towards the classical end, and others to the technical end. It's being able to give people the opportunity to get the breadth they need. (Bruce's father 500-520)

I think we've encouraged our children to do their best with their exams, because of our own experiences we've felt it's a priority. (Bruce's father 139-141)

Luke's father described mathematics as a counterweight to the more academic disciplines,

I understand that maths is important, but what I like about it is that it balances your studies. (Luke's father 311-312)

Ben's father, however, focused on members of his own family, and the requirement that they should receive a good education. He appeared to view education as a 'private good', and would like, ideally, to see his children receive an individually designed education,

I'm not interested in how Amy (the youngest) compares with the rest of the population, 'cos the rest of the population have got somebody else worrying about them. What I want to know is, is she achieving her potential. (Ben's father 284-287)

Children should be assessed as individuals, not as members of a year group. (Ben's father 304-305)

He, like Theresa's father, regretted the passing away of education for its own sake, in favour of training for jobs, which he sees as demeaning the academic institutions.

Carl's father was not persuaded of the parity of esteem that is supposed to exist between traditional academic courses and modern vocational courses,

I work with business all the time, and one of my main contacts is with the insurance companies. The senior personnel director of a large insurance company said, "If they've done an A Level course, and got good grades, I'll take them, rather than GNVQ students." Also, they target certain universities for graduates, where there is a history of successful outcomes. (Carl's father 557-562)

Noticeably, other than Lucy's mother, it was fathers who spoke of the value of education for its own sake, and were disappointed that the ideal no longer prevails. Only one father questioned the ideal itself, and appeared to dismiss those aspects of education that are not pertinent to a chosen career,

If Christine wanted a particular career, I'd be all for it [a university education]. But I'd rather she went out and earned some money for herself. (Christine's father 329-331)

Clearly, the consensus among fathers who spoke of education for its own sake, was that it is an ideal from the past. However, their reactions to its departure differ quite widely. Ben's father expressed anger that the ideal has been abandoned, while Theresa's father

appeared sad, but accepted that is the way society is. Carl’s father believed the ideal is still alive, he holds to it, and reported that, in his experience, some traditional employers do also, whereas Christine’s father was glad it has finally been buried. Bruce’s father could see ‘both sides of the coin,’ and would prefer choice to remain.

Education as a preparation for real life

<i>High Mathematics Achievers</i>	<i>Mid Mathematics Achievers</i>	<i>Low Mathematics Achievers</i>
<i>Anne</i>	<i>Michael</i>	<i>Wilma</i>
<i>Brenda</i>	<i>Luke</i>	<i>Timothy</i>
<i>Bruce</i>	<i>Nicholas</i>	

Whereas all the above fathers have made ‘hard’ contributions in terms of a philosophy of education, and the educational system, other parents, predominantly mothers, tended to be more pragmatic and ‘soft’ in their contributions, expressing the benefits to their children in terms of personal development. The word ‘rounded’ was used by three parents to describe the sort of development they were looking for, as well as the hope that their children would grow up able to think for themselves,

They are more confident, worldly-wise, rounded than we were (Anne’s mother)

..... self-opinionated (Anne’s father)

.... they've been taught to think for themselves ... (Anne’s mother)

But that's a two-edged sword. Once you teach someone to think and make judgements for themselves, then the teachers have got to start earning their respect, they can't demand it. They question things more - it probably makes them harder to manage, but they are stronger for it. (Anne’s father 303-310)

I think that school is an exciting, interesting place. I’m impressed by the confidence that the children exhibit. I want an education that makes him think - be self motivated. (Timothy’s mother 112-114)

At the grammar school, I suppose we felt that [the eldest son] missed out on some of the social and practical skills. You perhaps get a more rounded education in a comprehensive school they are more balanced now, they try to educate them with a bit more life experience, rather than being misfits either in University or society. (Luke's father 108-119)

All three seem to have become well rounded able to mix well. I'm relatively happy that they've had a good grounding. (Alan's father 313-315)

The mother of Brenda and her two elder sisters added a feminist note, pointing out that education offers girls a route away from what used to be the inevitability of marital dependence. This view was unusual among this group of parents since, as mentioned elsewhere, the majority of the mothers, including Brenda's, had themselves settled for marital dependence whilst bringing up their children.

I've always said, in answer to 'What do you want for your children?', that I want them to be independent of a man, i.e. that they should be self sufficient in their job, whatever it may be I encourage them along the academic road, because that seems to open more doors for them initially to be independent. (Brenda's mother 184-188)

The need for young people leaving school to be prepared for the activities of real life was most clearly expressed by Bruce's father and Luke's parents

The world of work has changed. The idea that just a classical education will set you up for every other eventuality may have been true in a less technologically advanced time, but not now. The skills in electronics, computing, and understanding how things work, are very important now, aren't they? (Bruce's father 511-515)

I don't think he did any metalwork or woodwork while he was there, so he's got none of the skills to run a house. They don't teach them any skills, they just educate them in subjects, and I find that wrong. They [the schools] are more balanced now, they try to educate them with a bit more life experience, rather than being misfits either in University or society. (Luke's father 113-119)

Most schools don't teach anything like time management or communication. If you can find them a job that doesn't need either of those, you're a better man than I am. I think that's a big failing of schools at the moment, particularly when it comes to the sixth form. They suddenly say, "Right, you're adults, now we're going to treat you differently," but they haven't given them any of the skills to actually run a project, or how to share your time between girl friend, sport and education. I think that's a big failing.
(Luke's father 121-129)

There is one thing [on which] John and I agree, they should be taught mental arithmetic..... In a shop the assistant can't give you the right change unless the machine tells her how much change to give. [Mother's voice rises to an incredulous squeak] and if you offer them the right money over a £10 note, that totally confuses the issue. That to me is sad, because they could be diddled all through their lives.
(Luke's mother 85-86)

The way that work patterns inculcated at school may be carried forward into employment was also made explicit by two parents,

I think, if you can keep them like that at school, then when they go to work they realise ... So many of them have time off at school, they think they can do it at work. (Wilma's mother 268-270)

I don't think that modular 'A' levels should detract from their work, either. I think if you've done your modules, you've done your modules. In life, it is rare, in a job, that you study for two years and do an exam at the end. You've got access to things there - you've got to be able to access things, even if you have to have a certain level of knowledge, and I think modular 'A' levels are a very good idea, actually, I think it's a very fair test. (Michael's father 169-175)

In summary, the idea that their schooling should prepare the children for life in the real world was expressed by both mothers and fathers in about half of the cases across all three groups, using the concepts of independence, roundness of personality and skilfulness. The wider view that education leads to success in later life was contributed by two fathers, one strongly believing in it, the other taking the opposite view,

My father was a great influence for learning. He put it into our minds that education was the key to a happy and successful future.
(Nicholas' father 19-21)

I think it depends on what you want out of life. If you're just happy to have a nice home, and a nice holiday, and enough money to do whatever you want with, then I'm quite certain you don't need to go to University to do that. You can use your brains, be a self-made person, and be well off.
(Christine's father 260-264)

Education is for obtaining Paper Qualifications

High Mathematics Achievers	Mid Mathematics Achievers	Low Mathematics Achievers
Brenda	Melanie	Theresa
Alan	Luke	
Bruce	Nikki	
	Michael	

However, the link between schooling and later life, that was most often mentioned by parents, was that of accreditation. As mentioned above, Theresa's father summed it up philosophically, whilst Brenda's mother made the same point more pragmatically,

I would like to say education has to do with encouraging her to engage in the extraordinary world she lives in. I think that is partly true, but mostly it is learning to jump through a certain number of hoops, and we would be doing her a disservice if we didn't help and encourage her to jump through those hoops. That's not the real reason for education, that you come out with a certain number of certificates
(Theresa's father 428-433)

These days, jobs are so few and far between that, if you want a choice, rightly or wrongly, you must have the academic qualifications, down on paper, to get you in the door. (Brenda's mother 153-155)

However, different levels of qualifications appeared as the concerns of different groups of parents. Although all the children in the sample were in their penultimate year before GCSE, Alan's mother and Melanie's father were looking ahead to degrees for their children, whilst the parents of Bruce and Luke seemed preoccupied with GCSE grades,

... a degree gets you a job by virtue of your proven ability to set your mind to something, and produce an outcome. (Alan's mother 109-110)

The only way to get on now is to have a degree.' (Melanie's father 172)

That's why English and some of the basic subjects are extremely important, 'cos you need that, whatever. If you can't communicate, you're not going to succeed in any field. So even if it's a subject they don't enjoy as much as others, I say they've got to concentrate on that, 'cos that's the nucleus. (Bruce's father 527-531)

At his junior school, Luke was marked in 'creative writing' and was not taught how to spell or how to use structure and grammar. I feel that he has been let down, because GCSE marking now takes account of these. [speaks with emphasis and some passion]. (Luke's mother 224-227)

He doesn't see why he should have to put them back now, at age 15, so it's a constant battle. He's capable of getting a B or even an A, but he's got to get his head down, and he's got to read more. But, he thinks if he gets a C that's adequate. I'm pushing him to get a B. I tell him if he doesn't get at least a C in English, they won't let him do A Levels, however much he wants to. Because (to do A Levels) you have to be literate. (Luke's mother 228-235)

In Geography, he's expecting an A, in science an AA, and in maths he's taking the central paper, with B as the top, and I think he'll get that. I'll be happy if he does, 'cos he does have problems, particularly with formulae. (Luke's mother 237-240)*

Two fathers expressed views on the examination system, one approving of modular exams, and the other concerned that the later teenage years are hardly the best time to expect young people, and boys in particular, to pay sufficient attention to a crucial accreditation process.

I don't think that modular 'A' levels should detract from their work, either. I think if you've done your modules, you've done your modules. In life, it is rare, in a job, that you study for two years and do an exam at the end. You've got access to things there - you've got to be able to access things, even if you have to have a certain level of knowledge, and I think modular 'A' levels are a very good idea, actually, I think it's a very fair test. (Michael's father 169-175)

I think it's unfortunate that they're doing exams at 16 or 18 when they're having to cope with big changes overall. There probably isn't a 'good' time, but that is a particularly bad time - in the development of a boy, anyway. Probably girls are not quite so bad, 'cos they develop that little bit earlier - they do seem to be very grown up very young these days. (Luke's father 151-156)

As already mentioned, Christine's father set little store by education for its own sake, and viewed accreditation as necessary only in the professions (medicine, law, etc.) He has pursued a career in car sales to his own satisfaction with no greater accreditation than four O Levels, and he mentioned his brother's medical qualifications with some irony,

[It would] take up three lines of A4 to fit in all the letters after his name. He's a very clever chap, if you like an example to the rest of us. (Christine's father 53-55)

When Christine's mother was later asked how she viewed the value of Further or Higher Education, she appeared to have difficulty responding. In an echo of her husband's views, she first indicated that she felt they were not important, but soon afterwards agreed it might be necessary for access to better employment.

The issue of credentials appeared to be important to the parents of high and middle mathematics achievers. From the low mathematics achievers group, only Theresa's father offered an opinion on credentials.

However, his opinion summarised the issue, pointing out that the pursuit of credentials is not necessarily good for his daughter's education, but since it is a fact of life, he would be doing her a disservice if he did not encourage her in it. He appeared to appreciate that the children's collecting of paper qualifications is, individually, a rational choice which is collectively irrational, in that it narrows and degrades the educational process. (Labaree 1997)

Education as an ‘exclusive’ activity

<i>High Mathematics Achievers</i>	<i>Mid Mathematics Achievers</i>	<i>Low Mathematics Achievers</i>
<i>Ben</i>	<i>Lucy</i>	<i>Vince</i>
<i>Carl</i>	<i>Nikki</i>	<i>Timothy</i>
<i>Anne</i>		<i>Vanessa</i>
<i>Alan</i>		
<i>Christine</i>		

Many parents appeared to view teachers as the experts in the field, and were prepared to leave the education of their children to them,

The teachers seem a good lot doing their best. I don't know much about school discipline. I mean, I'm aware there are disruptive pupils, butPerhaps TTCs [teacher training colleges] should address the issue. (Anne's mother 274-278)

You looked upon the teacher as the expert, and you were taking advice from the expert. I think we have now both learned that, as with all experts, you can question their expertise. (Lucy's father 263-265)

Lucy's parents, in particular, expressed this view in considerable detail. They were asked whether it had occurred to them to supplement their perceived failures of the education system, and they replied that it hadn't. They were also asked the hypothetical question, if they had another child, starting now, would they do anything differently, and they said not.

The only thing I'd be prepared to do is to ask more questions. (Lucy's mother 255)

What we've learned is to ask more questions with Lucy than we did with her sister. (Lucy's father 256)

Pressed further, they both agreed that they would not be so easily reassured, and would be more likely to keep questioning, and to 'push'. But at no time did they suggest that, in face of the perceived failure of the school, they would take action themselves.

*"Would you go as far as to say 'You're wrong, I know better?'"
(Interviewer)*

*I doubt it. You wouldn't say they are wrong, but please reassure me.
(Lucy's mother)*

*But now, having had two children through the system, you know
enough about it to keep questioning it. (Lucy's father)*

*I don't know anything about education theory, and I wouldn't query
how they were being taught, but if I had a problem, and I wasn't
happy about it, I'd keep going back until I was reassured.
(Lucy's mother 263-274)*

Vince's parents and Timothy's father also express their feelings of exclusion by virtue of the teachers' expertise. Vince's mother perceived that the educational system was failing her younger son, and spoke at some length and with bitterness about the lack of support he had received after being diagnosed dyslexic. She was concerned that Vince is not receiving proper teaching, but was unable to put her finger on the problem. On the one hand she was aware that Vince is doing different things this year from what he was doing last year, yet she seemed to think that unusual, and wondered why.

I don't understand the courses Vince is following. (Vince's mother 329)

On the other hand, Vince's father, also aware that his son was failing, reported accepting a primary school head's judgment that there are many children worse off than Vince, so special measures need not be taken.

Timothy's father spoke of a conversation with his brother-in-law, a mathematics teacher, in which terms like vectors and tessellation's were bandied about, and it all seemed *"like magic."* (104-106)

The perception that higher education is for an elite group was further spelled out by Carl's father,

[in a public school] every boy from age 12 is groomed towards university. School days end with university entrance, whereas, in the state schools, the whole ethos is geared towards GCSE. At (named public school) they find out what the universities require, and teach that to the boys. (Carl's father 525-529)

Evidently, the expectations arising from Lareau's work (1987), that middle class parents will not accept the expertise of teachers without question, are only partly fulfilled. Despite their apparent prosperity and articulacy, many of these parents still remain in awe of the teaching profession, even when they perceive that it is failing their children.

Although all the parents spoke of the educational system as it impinged upon their own children, a few parents offered opinions of a wider nature. Michael's and Melanie's parents, as mentioned earlier, were explicitly committed to the state sector, and Luke's parents had worked through their own commitment to co-education. However, only Ben's and Christine's fathers spelled out the narrow view that might have been implicit in much of what the majority of parents said.

Speaking of SATs, Ben's father said,

What I want to know is, is she achieving her potential - is she doing better than her teachers' expectations It's like someone saying to me, "Do you think the service from the Post Office is good, if we get 98% of all first class mail there the next day? My response is, "Not if I'm in the 2% that doesn't get there the next day, 'cos I'm not interested in the other 98%." (Ben's father 284-291)

Whilst Christine's father saw no value in education beyond how it can serve his daughter's aspirations,

If Christine wanted a particular career, I'd be all for it. But just for the pleasure of having a BA, I cannot see the worth in that..... I think it depends on what you want out of life. If you're just happy to have a nice home, and a nice holiday, and enough money to do whatever you want with, then I'm quite certain you don't need to go to University to do that. You can use your brains, be a self-made person, and be well off. (Christine's father 260-264, 329-331)

Both these fathers seemed to be arguing that education is a 'private good', to be compared with a commercial service, bought and paid for, and for which the purchaser is entitled to receive value. Only Carl's parents (see above), however, carried the view to its conclusion, and stated a blunt preference for the independent sector. It provides just that value in exchange that Ben's father decried as lacking in a state system whose policies are geared to the population generally, rather than the individual child. (see Labaree, 1997)

In addition, several parents, predominantly mothers, spoke of their own experiences of 'exclusion' from the education process, either through sex discrimination, or simply the perception that education was for an elite group of people,

[My father] thought it important that his daughters received a good education, but I lacked the self confidence to take it up. I never thought I was bright enough to do A Levels, I thought I'd just be wasting my time. (Vanessa's mother 29-31)

I didn't stay on, but that was a long time ago when, in an all girls grammar school, if you were clever, you were in the top stream and were encouraged to go into teaching. If you were in the middle stream or the lower stream you were encouraged to go either into a bank or into shop work. (Christine's mother 13-16)

My parents only bothered with my brother, they considered it was important that he went to university. It was only deemed important for the boy to get the academic qualifications. It was almost the fashion for girls not to be good at maths - only boys were good at maths. I still think that the older generation even now thinks boys are cleverer at maths than girls. I've got strong views on that, but that's how it was. And any girl that was good at maths was just like a (shrug). Girls were not supposed to be good at maths, and any that were good were put down by their peers. Also, they would hold themselves back. (Nikki's mother 26-38)

Education is not what it used to be

High Mathematics Achievers	Mid Mathematics Achievers	Low Mathematics Achievers
Ben	Lucy	Vince
Brenda	Luke	Wilma
Anne	Melanie	
Bruce	Michael	
Christine		

There was an element of nostalgia in much of what parents said about their perceptions of education, in that the reforms that have taken place between the days when they were at school, and the present day, have not been to the children’s advantage,

I think we’ve taken something that was of value, and we’ve broken it By giving degree status, through the new universities, to craft courses, we have demeaned and devalued the academic institutions. (Ben’s father 307-310)

That is one thing [on which] John and I both agree. They should be taught mental arithmetic. [Mother also upholds phonics for reading]. Education has gone in and out of phases, and has let some of the children down, because they’ve been used as guinea pigs. In a shop, the assistant can’t give you the right change unless the machine tells her how much change to give. (Luke’s mother 85-90)

At his junior school, Luke was marked in ‘creative writing’ and wasn’t taught how to spell or how to use structure and grammar. I feel that he has been let down, because GCSE marking now takes account of these. [said with emphasis and some passion]. He doesn’t see why he should have to put them back now, at age 15. (Luke’s mother 224-229)

I got on very well at school, but it was a small school, not like they are today, about three hundred in the whole senior section, everyone was known by name, and you knew every teacher, and they knew you, at least your face if not your name, which is not the case today in a lot of schools. (Wilma’s mother 11-14)

A number of parents specifically raised the issue of basic skills. There was a perception that current teaching methods leave the children unable to cope with, what the parents believe, are simple, straightforward everyday tasks.

I think that basic skills have gone by the board. Particularly, children today don't spell as well as their parents did at the same age. I'm sure that's because of the modern method of not marking errors but concentrating on the creative element of the work.
(Anne's mother 291-295)

Mother is not happy with modern teaching of maths. There are too many calculators. (Brenda's mother 159-160)

Kids who click with the concepts are OK, but those who don't click straight away, lack the basics to work it out for themselves.
(Brenda's father 163-164)

One of the drawbacks of education now is that children aren't very good at mental arithmetic. They use calculators and don't seem to be able to see the shortcuts that you can use in your mind.
(Bruce's father 147-150)

Perhaps the pendulum has swung too far from 'You will learn this, these are the facts, remember them and you will pass your exam' to 'Go and work it out for yourselves'. Perhaps there isn't enough of a good grounding in basics, before moving on to the enquiring, broadening skills. (Lucy's father 241-244)

However nostalgia and complaints about a decline in standards were not universal. Six parents believed that modern schooling is better than it was in their day.

Children leaving school today are better educated than my generation - more rounded. (Anne's father 289-291)

I think modern maths teaching is more sophisticated than in my day, more conceptually oriented. (Brenda's father 160-161)

I actually get very cross, (speaking of recent publicity over a decline in standards of A Levels), because I think there are a vast number of students and teachers who work very hard, and I think they deserve what they get, to be honest. They've worked hard, and they've got good results. I don't think it's because the 'A' levels getting easier, I think it's because they're working hard. (Michael's mother 151-155)

I agree, I think a lot of people are talking a load of rubbish. I try to help my elder son through his science 'A' levels that he's doing now, and I know that they are much more demanding than when I did them. It's not just that I've forgotten a lot that I knew, and that life has progressed anyway, the degree, the depth to which they're expected to go is much greater than when I did the same 'A' levels.
(Michael's father 159-165)

I didn't stay on, but that was a long time ago when, in an all girls grammar school, if you were clever, you were in the top stream and were encouraged to go into teaching. If you were in the middle stream or the lower stream you were encouraged to go either into a bank or into shop work. There was no such thing as career guidance at my grammar school, which there is now. My eldest daughter had career guidance. (Christine's mother 13-18)

6.4. Summary of the Chapter

The interviews have elicited a range of parental responses in terms of attitudes towards education in general. Among the positive views taken, fathers tended to speak of education as a means of obtaining credentials, or as good for its own sake. This latter view in particular was prevalent among fathers of the high mathematics achieving group of children, although only one mention of it was made by a father of a low mathematics achiever. Mothers from all three groups, however, tended to speak in terms of the value of education in developing, or rounding, the personalities of their children.

Education was described as an 'exclusive' activity by a number of both mothers and fathers. This view was prevalent among parents of the high mathematics achieving group, where some mothers reported having been held back in favour of their (male) siblings.

Had this not been the case, the numbers of mothers advancing to further and/or higher education might have been greater (see Chapter 5, Tables 7, 8 and 9).

The majority of parents of both high and low mathematics achievers reported having experienced difficulties with mathematics in school (see Table 10). In most cases, parents

who had difficulties with mathematics in school still feel uncomfortable with mathematics.

In terms both of parental experiences of mathematics and their current attitude to mathematics, the parents of the mid mathematics achieving group differed consistently from the other two groups. Parents of mid mathematics achievers were almost all positive about their mathematics experiences, both past and present (see Tables 10 and 11).

A crucial issue for this study is that parents' experiences of mathematics, both past and present, appeared in no way to be related to their children's experience of mathematics, since, in broad terms, high and low mathematics achievers were found in families where both parents viewed mathematics in a negative way, whilst mid mathematics achievers were found mainly in families where both parents were positive about mathematics (see Table 11). This appeared to be true of both girls and boys

In addition to their parents views on education and mathematics, the children are also exposed to the practical outcomes of these views in terms of the help, support and supervision that they receive at home. These resources made available to the study children are the subject of the next chapter.

CHAPTER 7

PRACTICES IN THE HOME

7.1.Introduction

In previous chapters, 5 and 6, parents recalled their memories of their own and their families experiences of mathematics and of education in general, and expressed their current views on both these issues.

This chapter focuses on the practical ways in which parents engage with the educational process as it affects their children. The responses from the interviews are presented under five operational headings:

7.2. Educational help and support in the home;

7.3. Supervision of homework;

7.4. Parents engagement with schools;

7.5. Expression of parental aspirations for their children;

7.6. Activity and examples in the home;

7.2. Educational Help and Support

After interview transcripts had been coded, all the data coded with the operational concept 'help and support' were re-examined, and 13 sensitising sub-categories were identified. Some of these fell into groups, as indicated in Table 13.

- A1 Parental Examples of Achievement and Expertise.
- A2 Provision of Additional Resources.
- A3 Support for Extra-curricular Activities.
- B Parents' non-involvement in Schoolwork.
- C Private Tutors Employed.
- D1 General Encouragement by parents.
- D2 General Help with Homework.
- E1 Specific Curriculum Areas (SCAs).
- E2 Separate Parental Responsibilities for SCAs.
- E3 Parental Help with Mathematics.
- F1 Parents Confident with Mathematics.
- F2 Pressure to Achieve.
- G Sibling Examples of Achievement.

CASE	MATHS LEVEL	A1	A2	A3	B	C	D1	D2	E1	E2	E3	F1	F2	G
Ben	High				✓			✓						
Christine	High				✓		✓			✓				
Bruce	High		✓		✓			✓						
Brenda	High						✓	✓						✓
Anne	High						✓	✓	✓	✓		✓	✓	
Carl	High		✓					✓	✓	✓		✓		✓
Alan	High									✓	✓	✓	✓	✓
Nikki	Mid			✓			✓		✓					
Melanie	Mid							✓						
Lucy	Mid											✓	✓	✓
Luke	Mid			✓					✓	✓	✓	✓	✓	
Nicholas	Mid	✓	✓	✓			✓	✓	✓	✓		✓	✓	✓
Michael	Mid					✓	✓	✓						
Vanessa	Low				✓	✓								
Theresa	Low	✓	✓	✓					✓	✓	✓			
Timothy	Low	✓	✓	✓	✓		✓	✓						
Vince	Low		✓			✓	✓	✓						✓
Wilma	Low								✓	✓				✓

Table 13 Occurrence of sub-categories of 'Help and Support' in interviews

7.2.1. Summary of the Data

Similarities across groups

Approximately half the parents of children from each of the three mathematics achieving groups reported offering encouragement and general help to their children and, in two cases from each group, the mothers and fathers offered specific expertise in different areas of the curriculum. Elder siblings were reported as being examples by way of high achievement in at least two cases from each group.

Differences between groups

However, whilst those parents of high and mid mathematics achievers who offered encouragement and general help, also reported extending their assistance into the area of mathematics, this was not so with the parents of low mathematics achievers., None of these reported engaging with their children's mathematics.

The use of private tutors for mathematics was reported in 2 cases each from the low and mid mathematics achieving groups, but not by parents of high mathematics achievers.

The parents of 2 children in the low mathematics achieving group and 3 in the mid mathematics achieving group reported supporting their children in extra-curricular activities such as sport and the performing arts, but none of the parents of high mathematics achievers reported involvement in these areas.

7.2.2. Details of parents' comments in interviews

Active engagement by parents who expressed themselves confident enough to give help with mathematics was reported in 6 interviews. This group contained two of the three parents who expressed themselves as prepared to push for their children's educational success. The group consisted of parents of 3 high and 3 middle mathematics achievers, 4 boys and 2 girls.

*... she'll ask me an occasional question about, say, vectors ...
(Anne's father 262-263)*

*He'll bring his maths to his father, sometimes They [the text book] just give him the formula, without explaining how to work it out.
(Carl's mother and father 476-479)*

*I am now the one who will sit with Alan and help him with his maths homework. I have the ability to do it, although I was badly taught.
(Alan's mother 70-72)*

I give it [help] willingly. I actually enjoy it. The penny has dropped for me about a lot mathematical principles - I just wish they had dropped earlier. (Nicholas' father 70-72)

I took GCSE maths from the tech., and passed with grade A. It boosted my ego, that I wasn't as dumb as I thought. I thought, "Gosh, this was easy" When I was helping the girls with their tables, I came to see that there was a pattern, a logic. (Lucy's mother 59-66)

*They were in a grammar school, but we weren't happy with the grammar school here [after the move]. We wanted a school with a sixth form, and on this side, but actually we felt it was the best one we looked at.
(Alan's mother 260-263)*

*I was determined for the boys, if they were good enough, that they were going to get the education they wanted, not just what could be afforded.
(Luke's mother 16-17)*

None of the parents of low mathematics achievers reported actively helping their children with mathematics. This would be expected from the earlier reports of these parents' negative reactions to mathematics as described in Chapter 5. Nevertheless, in the cases of Theresa and Timothy from the low mathematics achieving group,

references were made by parents to their examples of expertise, to their provision of additional resources and to their support for their children in extra-curricular activities. A similar combination of reports occurred in the interview with Nicholas' father.

They've all needed some guidance in revision planning, but they've seen how well their mother manages her life, coping with the family and the home. They've had lots of examples in their lives of good management. (Nicholas' father 90-93)

We always ask to see her English and Humanities homework, because we're both English teachers. (Theresa's father 402-403)

Q. Where do you think is the source of her academic ability?

A. Some natural ability, parental academic achievement, that academic success is taken for granted. (Theresa's father 459-461)

If Timothy asks for help with projects, we will either direct him towards resources here at home, or we'll borrow them from the college. (Timothy's mother 88-90)

Theresa's musical, and I go to a lot of concerts with her. I'm not very knowledgeable [about music] but I enjoy it. (Theresa's mother 97-99)

We spend a lot of time each week transporting him around [for his swimming and his music]. Timothy plays the euphonium in his local band, and delights in public performances. (Timothy's mother 126-128)

[They will ask for help] particularly in business studies, 'cos they know I can discuss it with them. (Nicholas' father is an accountant 65-66)

In 8 interviews, parents reported a separation of responsibilities by curriculum areas. As mentioned above, the fathers of Anne, Carl, Luke and Nikki reported helping their children with mathematics, while Anne's mother spoke of helping with cookery projects and Carl's mother with languages.

I preferred practical subjects at school, 'cos that's what I was interested in She'll ask me for help with a cookery project. (Anne's mother 23-24, 262-263)

Justin did French, and I could help him with his French (Carl's mother 481-482)

Christine's father spoke of his wife as the most likely source of assistance with non-technical subjects,

If she's stuck, she'll come and ask. I think she would ask me about maths, rather than [my wife]

Q. What about an English project, say? A. Oh, I think she'd ask mum about that. She's not daft. (Christine's father 138-143)

Theresa's parents both spoke of support for their daughter's English, and her mother, as mentioned above, of her support for Theresa's music. Wilma's mother, however, spoke only in non-specific terms of her husband and elder son being more likely to help Wilma with any homework problems.

If she has problems with homework, she's more likely to ask her father or [her brother]. She'll take it from them. (Wilma's mother 368-369, 381-382)

Altogether, non-specific references to encouragement or general help with homework were reported in 12 interviews. For example,

We encourage her to do her homework, but we don't get involved in it. (Anne's father 267-268)

I encourage them along the academic road, because there seem to be more open doors for them to be independent. (Brenda's mother 186-188)

She's got a lot of ability, so whatever she does she'll do it well. We'll encourage her all we can. (Christine's mother 221-222)

Q. You mentioned he occasionally asks for help. Could you say how often? A. About once a fortnight, I should guess.

Q. Which of you would he ask? A. Either of us.

Q. Any particular subjects? A. Not especially. (Bruce's father 355-366)

I felt I should have got more [O Levels], and that's why we encourage both the girls. (Nikki's mother 45-47)

His concentration wasn't good, and you'd have to say "Stop looking out of the window, and get on with your work," or "Hang on, get on with it now, and you'll finish it in 10 minutes, otherwise you'll sit with it for an hour." (Michael's mother 467-473)

We try to encourage him. I hold my hand up, I've got a busy job, we're all working hard, you start off with good intentions, you go several weeks or whatever, it gradually diminishes and gets pushed to the back.
(Vince's father 137-139)

Despite the range of assistance reported by parents and siblings, in 5 interviews parents were explicit in their non-involvement with their children's schoolwork,

Timothy always works in his own room he rarely asks for help with his homework. If Timothy asks for help with projects, we will either direct him towards resources here at home, or we'll borrow them from the college.
(Timothy's mother 83-90)

I'm not particularly active on a daily basis in steering Timothy. This may be to do with being busy at work. Perhaps we try to make a nice atmosphere at home, but we're not very good on detail.
(Timothy's mother 165-167)

I don't help Christine ... she never asks for help. (Christine's mother 89)

We encourage her to do her homework, but we don't get involved in it .
(Anne's father 267-268)

He does an awful lot himself - we've got an encyclopaedia on CD Rom, which he uses quite frequently for homework.
(Bruce's father 374-375)

I don't help, because I can't understand either. The teachers aren't much help. (Vanessa's mother 46-47)

Additional resources (use of library, CD ROM, purchase of books etc.) were reported in 6 interviews. As already mentioned, in 3 of these the parents of Nicholas, Theresa and Timothy also spoke of themselves as examples or role models for their children, and they were also those who supported their children in extra-curricular activities.

Levels of support were variable across the achievement groups, with none of the categories clustering in any one achievement group.

Approximately half of the study children received active help from their parents, but the remainder found their own way through

occasional provision of resource, general encouragement and parental example. However, 8 of the children were reported as rejecting parental involvement in their work (see below). It is possible that the level of help and support provided by the parents of these children was less than it might have been had the parent/child relationships been better.

Rejection

When children approached their parents for help with homework, in many cases their parents perceived this to be in the spirit of seeking comfort, approval and support, rather than in the spirit of academic enquiry. For example,

*With Kate, we've never needed to supervise her work. She sometimes asks for help, but only to discuss what she's done, or get some ideas.
(Brenda's mother 128-130)*

*She'll sit down with me and show me her work. She sometimes ticks me off for immediately criticising her spelling ... she says I ought to take a constructive view, but we usually settle that amicably .
(Melanie's mother 122-126)*

She'll ask us to help with a vocabulary test She'll ask us to check (her homework), but she's got to the age where, if we help, it's going to be our work not hers. (Theresa's mother 250-253)

However, it appeared from reports that a number of parents responded to requests for assistance from their children by trying to explain or interpret the work. In some of these instances, children were reported to have reacted with hostility or impatience. They appeared to resent their parents overstepping the boundary of their parental role into that of the teacher. Theresa's mother summed it up,

Theresa is more receptive to her teacher's explanations, and she regards us as having different functions. Also, in class, she is just one of many who don't understand, whereas, at home, she is on the spot, the only one, who is expected to understand. (Theresa's mother 237-243)

Perceptions of their parents' place in their academic lives varied from child to child. As reported above, Theresa resented her parents adopting their 'teacher' role when she was trying to obtain their help as supporters. Lucy was reported as erecting a barrier against her parents' crossing of the role threshold, even to the point of producing incorrect work, despite her mother's attempts to give guidance,

She doesn't want help, she doesn't want you to see her work, she doesn't want you to look at anything she has done. As far as she is concerned, as soon as you see anything she's done, you're going to criticise it. When you go in (to her room) she'll cover everything up, she's not willing to show you anything She had a project recently that I could have helped her with, 'cos it was in my field of work. I tried to help her in understanding what was wanted, but she wouldn't hear of it. When the project was returned 'Do again', she was devastated. She thought she had done so much, but she had misunderstood the instructions. (Lucy's mother 170-173, 188-191)

Hannah, Rachel and Kate have all represented their school at sport, but have asked their parents not to attend matches. For her part, Anne has adopted sullen refusal as a strategy to keep her parents at arm's length.

For instance, I asked her to read it out loud, to see if she had properly understood it, and she just refused stood silent. I could see there would be a total breakdown in communication if I forced the issue, so I backed off. (Anne's father 249-253)

Vince has extended the barrier to include his elder brother as well, despite his expertise in mathematics, and being much closer in age.

When David [his elder brother, and an advanced level mathematician] said he would look at his homework, Vince just didn't want to know, if they were wrong he didn't want to know. That indicates to me a lack of interest. (Vince's father 152-154)

Christine's strategy, as reported earlier, has been simply to ignore her parents, and just get on with her work in her own room,

Their parents report that Michael, Lucy and Vince have all been assessed as dyslexic, and they have done their best over a number of years to give help and support at home. All three appear, however, to have reacted against the help offered to them at home. These cases appear to offer some support for the observations of Campbell and his colleagues that too much parental involvement may be counter productive (Campbell et al., 1994).

We have always offered help, but he's been reluctant to ask for it, or to involve us in it. He prefers to do it on his own, whether it's well done or not. I'm worried about being on his back all the time.
(Michael's father 485-492)

You never appeared to show that much interest in my work, and she finds that you're nagging her, which is something you never did to me. Admittedly you never had to. She feels that you're getting at her. She comes up and complains to me about it. It doesn't matter what you do, this is the feeling she gets.
(Lucy's sister, an honours undergraduate at Cambridge 177-180)

In contrast, where good relationships have been reported, the transgression of roles has not presented a problem. David perceived his father to be expert in business and maths, and was reported as willing to co-operate with his father-as-teacher. The father of Nikki and Clare said he enjoyed helping his daughters with business studies, and, in contrast to the stance taken by Kate, Rachel and Hannah (see above) over sporting events, Nikki, Clare and Luke were reported to be glad to see their parents turn out to support them at sporting fixtures. Alan, after rejecting his parents help will often turn to his elder brother for assistance at peer level, and Anne will consult her mother over such items as a cookery project.

7.3. Parental Supervision/Monitoring

As in the section on “Help and Support at Home” (7.2. above), all the data coded ‘supervision’ was re-examined, and 9 sensitising sub-categories identified. The occurrence of these categories is presented in Table 14.

- A Parents content to leave supervision to the school;
- B1 Parents ask if homework has been done, and accept ‘yes’;
- B2 Sporadic, unsustained supervision by parents;
- C1 Negative reaction against supervision by children;
- C2 Parents back away from confrontation;
- D1 “Doing Homework” as a generic activity;
- D2 Parents have little or no idea of what homework is being done;
- E1 Parents believe children exercise time management;
- E2 Parents believe there is no need to supervise their children.

Case	MATHS LEVEL	A	B1	B2	C1	C2	D1	D2	E1	E2
Ben	High		✓							
Carl	High		✓				✓			
Brenda	High						✓			✓
Anne	High	✓			✓	✓	✓	✓		
Alan	High	✓	✓				✓	✓		
Bruce	High		✓	✓						✓
Christine	High	✓		✓						
Nikki	Mid						✓		✓	
Luke	Mid			✓		✓		✓	✓	✓
Nicholas	Mid	✓						✓	✓	✓
Melanie	Mid					✓		✓		
Lucy	Mid		✓		✓	✓				
Michael	Mid	✓	✓	✓	✓	✓				
Theresa	Low		✓	✓	✓	✓		✓	✓	✓
Timothy	Low		✓	✓		✓		✓		
Vanessa	Low						✓	✓		
Wilma	Low						✓	✓	✓	
Vince	Low	✓		✓						

Table 14 Occurrence of supervision sub-categories

7.3.1. Summary of Data

Two themes appeared to converge in discussions of supervision. These are inaction and acquiescence. Parents did not appear to exercise supervision or monitoring of homework on a systematic basis, and fathers in particular were prepared to accept assurances from their children that everything was under control. Fathers were inconsistent in their reporting of supervision, commenting sometimes on monitoring they had undertaken individually, sometimes on monitoring that they believe had been undertaken by their spouses and sometimes on monitoring that they believe ought to have been undertaken.

However, when the sub-categories were analysed, they bore no relation to the three groupings of the mathematics achievers. Categories all contained a mixture of high medium and low mathematics achievers.

7.3.2. Details of parents' comments in interviews

The level of parental supervision appeared to lie along a continuum, from little or none, to a moderate level of concern. At the lower end of the continuum, 9 parents reported having little or no idea what homework their children have been given.

*We encourage her to do her homework, but we don't get involved in it.
(Anne's mother 267-268)*

*I've never had to say to him "Have you got homework, shouldn't you be doing it?" He arrives home, goes up to his room and gets on with it.
(Nicholas' father 86-88)*

She'll sometimes say, "I've got so much homework to do Mum." But ten minutes later I'll ask her, "Where's all that homework?" she'll say she's done it and put it away in her bag. I've asked at the school, and they say her homework is always in on time and it's always completed. But where? When? (Wilma's mother 317-323)

When the direct question is asked by parents, "Have you done your homework?", 8 reported accepting an answer in the affirmative without question, although not always without reservations.

You can ask him, but he could tell you anything. I mean, I don't know whether he has finished it in the class, or did it yesterday He may have sat in his room with the book open in front of him, but I don't know whether he's done anything." (Alan's mother 221-226)

I would ask, 'Have you done all this?', and on the basis of an affirmative answer, I would sign it. (Bruce's father 351-353)

If he says, 'I've done it' you can't be checking it all the time. (Michael's father 495)

I don't actually look at Tim's work. I'll ask him if he's done it, but I wouldn't sit down with him and go through it. (Timothy's father 201-203)

This ready acceptance of verbal assurances was justified by 5 parents as non-interference, in terms such as 'using a light touch' or 'getting the balance right,'

You can't be checking it all the time It's a question of getting the balance right. (Michael's father 495-497)

I suppose it's more with a light touch than a heavy hand. (Lucy's mother 159-160)

I'm not forever nagging them - they're left to get on with it. (Melanie's mother 110-112)

Five parents, from all groups, said that they felt supervision was unnecessary, since their children were sufficiently well motivated to get on without it, and exhibited adequate time management skills.

She's never needed supervising. (Brenda's mother 128)

It's left to him to manage his time. He usually manages to meet deadlines, and I can only remember one occasion when work was reported as not handed in. (Luke's father 417-419)

It's her world, she's in control of it, she just gets on and does it. It's not an issue. (Theresa's mother 261-262)

When supervision was reported by 7 parents, it appeared to be characterised by inconsistency. Fathers may sometimes feel obliged to come down heavily, perhaps in response to a negative report from the school, monitoring the work for a short while, then falling away. Vince's father expressed it most clearly,

You start off with good intentions, you go several weeks ... it gradually diminishes, and tends to get pushed to the back. When you get a report of concern over homework, it tends to re-ignite the whole thing. (Vince's father 138-141)

I don't want to be seen to be on his back all the time. (Michael's father 492-493)

Since then [a recent discussion with Timothy's head teacher over setting] I've tended to be in supervisory mode. I shall liaise more closely with the school in future. (Timothy's mother 102-103)

Perhaps because of the perceived inconsistency of this approach, these sporadic efforts were sometimes met with hostility or impatience from the children,

I'll give you an example. The other day I asked her to read something out, just to establish whether she had understood it, and she just refused. I could see a total breakdown of communication if I forced the issue, so I backed off. (Anne's father 250-253)

He is reluctant to ask for help, or have us involved in his work.

(Michael's mother 490-491)

She feels that you're getting at her. She comes and complains to me about it. It doesn't matter what you do, that is the feeling she gets. (Lucy's elder sister in passing 177-180).

It used to cause tensions, I lost patience and she finished up in tears. Mother is much more patient. (Theresa's father 416-418)

In discussing the value that they attach to supervision, parents spoke in three distinct modes, using the pronouns 'I', 'we' and 'you'. When 'I' was used, it appeared to represent action by the speaker, almost always the mother, or an admission of personal failure to take action (almost always the father). For example, Bruce's parents expressed conflicting views of their approach to homework diaries,

Q. What were you signing for? A. I never asked that question [of] myself. I believed it was to monitor what they were doing and whether they'd done it. Q. So you would check what was in the diary against what they had done? A. I wouldn't say we did that every time.
(Bruce's father)

I refused to sign it. I said, 'I'm not signing this until you've done the work.' (Bruce's mother)

I would ask, 'Have you done all this?', and on the basis of an affirmative answer, I would sign it. Obviously, I was too trusting.
(Bruce's father 331-353)

Sometimes I say, 'No, I'm not going to sign that until it's properly filled in.' (Christine's mother 192-193)

I have to keep asking, 'Have you done it?' (Lucy's mother 159)

The pronoun 'we' appears to be used when representing a shared value, with the implicit expectation that, in the event of the speaker not acting, then the spouse will act.

Even though we did that with Bruce, it wasn't to the extent that I do it with Daniel. (Bruce's mother 328-329)

I wouldn't interfere. We look at their homework books every night.
(Christine's father 127)

We have learned to enquire of him about his homework. We've had an input into trying to get him to structure his work Exam pressures during the past year have meant we have become more involved with his homework. (Michael's father 485-488, 507-508)

I haven't been involved in it at all, I've left it to him. We've told him we would like him to spend half a day each week (during the holidays), we don't think that is too much, when they have all that time off. I don't really mind how he sorts his time out, it doesn't bother me.
(Luke's father 433-437)

We do expect her to do at least an hour when she comes home from school.
(Nikki's mother 192-194)

*Q. What are you signing for? A. I don't know, I suppose we sign to say it has been done. Perhaps we need to check on that.
(Timothy's father 194-196)*

Because we're both English teachers, we always ask to see her English and Humanities homework. (Theresa's father 402-403).

We've never had to keep tabs on Oliver's homework, but with Wilma we have to . (Wilma's mother 367)

'You' appears to be a representation of a value shared not only with each other, but implicitly with the interviewer. Statements with 'you' may be examples of responses generated out of a desire to please, or to present themselves in the best light.

Q. What are you signing for? A. To acknowledge you've actually seen them do the work. (Bruce's mother 331-334)

*If he says 'I've done it,' you can't be checking it all the time.
(Michael's father 495)*

7.4. Parents' Interactions with Schools

After interviews had been coded for the operational category 'parents' interaction with schools', 5 sensitising sub-categories were identified, as indicated in Table 15.

7.4.1. Summary of the Data

All except two of the parents reported attending parents evenings at their children's schools. In 3 interviews parents spoke positively of their experiences on these occasions, in terms of useful feedback about their children's progress. In contrast, parents of four children expressed themselves dissatisfied with their brief, and sometimes fruitless interviews with school staff.

Parents of:	Maths Level	Found Parents' Evenings Negative	Found Parents' Evenings Positive	Visits to School to Discuss Problems	Support at Concerts/ Sporting Events	Active Involvement
Christine (pa)	High	✓				
Bruce (ma)	High	✓				
Brenda	High	✓				
Ben	High	✓				
Anne	High			✓		
Alan	High					✓
Christine (ma)	High		✓			
Bruce (pa)	High		✓		✓	
Luke	Mid		✓		✓	✓
Lucy	Mid			✓	✓	
Melanie	Mid				✓	
Nikki	Mid				✓	
Nicholas	Mid				✓	
Wilma	Low	✓		✓		
Vince	Low			✓		
Timothy	Low			✓		
Theresa	Low				✓	
Vanessa	Low					

Table 15 Parents interactions with schools

However, parents' evenings were not the only point of contact between parents and schools. In 7 interviews parents reported attending sporting events or other performance events such as concerts, school plays etc. in support of their children. However, only Luke's and Alan's parents have been actively involved with schools, through PTAs and as part-time assistants. The parents of 6 children have been in contact with specific members of staff over problems of discipline or academic progress.

These groups of parents tend to be mutually exclusive (see Table 14), only Luke's parents being actively involved and supportive and positive about their children's school.

There was some association between these clusters of parents and their children's mathematical achievement. Of the 4 who found parents' evenings a negative experience, 3 were parents of high mathematics achievers. Of the 6 who visited school to discuss problems with staff, 3 were parents of low mathematics achievers. And of the 7 parents who reported supporting their children at sporting events, 5 were parents of middle mathematics achievers. However, cell numbers were too small for any apparent association to assume significance.

Similarities across groups

Attendance at schools for parents evenings was reported in all but two of the interviews.

Differences between groups

As can be observed from Table 14, interviews tended to cluster in small numbers around each of the sub-categories, and the clusters were almost entirely exclusive. Only 1 case was recorded across 3 clusters, and only 3 cases across 2 clusters.

Three of the 5 references to school contact for discussion of curriculum/disciplinary problems occurred in interviews with parents of the low mathematics achieving group, and 5 of the 7 references to

support at concerts/sporting events came from parents of mid mathematics achievers.

Of the 4 parents who expressed themselves dissatisfied with their experiences of parents evenings, 3 were from the high mathematics achieving group.

7.4.2. Details of parents' comments in interviews

Negative reports of parents' evenings

Christine's father spoke of disliking parents' events at the school. He expressed a poor opinion of teachers generally, and said he found meetings with them a waste of time:

*I never ever feel the need. Shoot me down if you like. They have the parents' evenings twice a year, and you have to see Mr. so-and-so, Mrs. so-and-so, master this and mistress that, and you're queuing outside for half an hour, and you spend three hours in the evening thinking "What the hell am I doing her?" You sit down and get a load of platitudes: "Oh, Christine's doing very well -di - da - di - da." It's a load of twaddle. I honestly feel the teachers themselves don't want to do it - unless they're exercising their bossy powers over the parents. If a child's not doing well, a letter to the parents will be enough to incite a reaction from the parents to do something, or it won't incite anything. Either way, you[the teacher] know what's going on with the parent, a measure of the household, or at least a rough idea. I've been to these evenings at school, and they drive me potty. I generally refuse to go now.
(Christine's father 419-432)*

Any problems that have arisen, father reported as having been solved through his privileged access to the head teacher:

If ever there's been a problem, he's always been very good. Mark you, I always go straight to the top, 'cos I know him. (Christine's father 442-443)

(Christine is the fourth of his five children to pass through the school).

Although Brenda's parents reported always attending parents' evenings together, to demonstrate support for their daughters, they also found the occasions unsatisfactory, since there was never time for detailed discussion. Mother believed that she had better contact with staff and governors at the public library, while she was working there part-time.

After having three children through the school, I know the staff and governors. Most of them come into the library I can chat to them informally Parents evenings aren't very good - never enough time (Brenda's mother 133 137)

Ben's father commutes daily to London, and has rarely been able to attend parents' evenings. When he did so, he too said he found them unsatisfactory:

They talk educational jargon at me (Ben's father 282)

Ben's mother gave mixed reports of her experiences at parents' evenings. While she was impressed by the purposeful atmosphere of the school, she was concerned that the teachers had not noticed that Ben was under-performing against his very high scores on the VR tests administered by the school to new entrants. She believed that Ben has managed to talk himself out of difficult situations

The teachers see that Ben is very verbal. He speaks clearly and concisely, will think ideas through, and argue very forcefully. He can think laterally. I think the teachers have been bamboozled by his verbal ability (Ben's mother 212-214)

Wilma's parents both reported attending parents' and open evenings. Other than a letter mother wrote when Wilma started at secondary school, and a visit to discuss a discipline problem, no other contact with the school was reported. Wilma's mother said she would have liked to discuss Wilma's aural and behavioural difficulties with her class teachers. However, she explained, the school operates a protocol

of direct access only through the House Head, and admitted that this has discouraged her. At parents' evenings, the staff have often spent precious interview time asking after Oliver's progress, rather than discussing Wilma.

With them being at the same school they compare. When we go to the parents' evenings, and we want to talk about Wilma, but they always talk about Oliver, they say "You can't believe that they're brother and sister." (Wilma's mother 353-355)

When teachers have spoken of Wilma's behaviour in class, her mother appears to have received mixed messages, which has further alienated her:

We've just been to parents evening, and apparently she asks questions all the time, because she doesn't understand what the teacher is trying to tell her. We've been told that she mustn't continually ask questions, she must wait until the others have done the work and ask questions then. But honestly I don't know when she's to find time in the class to do that. We went on to the next teacher, science I think, and he said she must ask more questions, but when I asked, and he said anytime, she must ask questions. But the other teacher said she's always wanting praise, and I said that's the way she is. At home she's always wanting praise. The teacher said she has other children to teach as well as Kate, and Kate must produce some work to be praised for. (Wilma's mother 248-257).

Despite her introductory letter, mother reports that staff have repeatedly been surprised to be told, at parents' evenings, of Wilma's hearing difficulties.

Bruce's mother reported that his teachers were not well prepared for parents evenings

There have been one or two occasions when we've gone to parents' evenings, and the teacher doesn't seem to know the child There were definitely times when you sat down, introduced yourself, and they didn't know which your child is. (Bruce's mother 386-391)

Positive reports of parents' evenings

Since her father no longer attends, attendance at parents' evenings, has fallen to Christine's mother and, although she reported no other contact with the school, she expressed satisfaction with the ethos there, feeling she had received sympathetic support from staff in her efforts to widen Christine's horizons:

I spoke to the music teacher, and he's tried to encourage Christine to rejoin the orchestra. She has said that she and her friend will join again after the holidays (Christine's mother 131-133).

After jointly attending parents' evenings, Luke's parents reported discussing issues raised there with him, and attempts to remedy any problems, although they said they were unhappy that such occasions took place at the end of the summer term, when it was too late to address any reported difficulties.

From an assessment point of view it's silly. I would have said that the end of November would be ideal, after they've got through the bedding in process - to make an assessment of what he is like, and if there are any problems, we can work on them over the next few months to put them right. We'll talk to him about things like that, where his weaknesses are, and where he needs to work harder (Luke's father 288-294)

Bruce's father spoke in formal terms of his satisfaction with his sons' school and its staff,

On the whole I've found the school to be generally supportive and efficient in the way it goes about its business. They're quite open, and are usually responsive to any worries or criticisms we may have. They take on board what we say, and usually have something constructive to tell us about the boys, which we then take on board at home. (Bruce's father 393-398)

Contact with the school regarding curriculum or discipline problems

Anne's mother spoke of one or two occasions when she discussed poor reports with Anne's Head of Year. In general, however, their interactions with school staff have been limited to parents' evenings, which they reported attending together whenever possible.

They have been confronted with Anne's difficulties with study skills for two years, but have relied on the school to provide support. The terms in which Anne's father and mother respectively defined her progress were

*Not fulfilling her potential (Anne's father) and
Appalling (Anne's mother 191-193)*

Lucy's parents reported always attending parents', musical and options evenings together. In addition, they reported having spoken independently to Lucy's tutor by telephone.

As mentioned earlier, Lucy's elder sister is an able, self-motivated student, and her parents said they had felt no need to monitor her performance at school. They therefore had no experience on which to draw when it became apparent that Lucy was showing specific learning difficulties. They said that if, hypothetically, they should put another child through school, they would be more pro-active.

But now, having had two children through the system, you know enough about it to keep questioning it (Lucy's father 270 - 274)

*I don't know anything about education theory, and I wouldn't query how they were being taught, but if I had a problem, and I wasn't happy about it, I'd keep going back until I was reassured
(Lucy's mother 270-274)*

Despite their misgivings, Lucy's parents appeared to be happy to accept reassurance from the teachers, rather than seek another opinion or avenue to express their doubts.

Timothy's father bluntly remarked that he has avoided contact with the school, so it has fallen to Timothy's mother to attend parents' evenings, and resolve any difficulties arising. She reported having returned from parents' evenings reassured that Timothy is a bright child who works hard. After discussion with Timothy and her sister (a primary school head), Timothy's mother spoke of a recent visit to the school to enquire why he was in a lower mathematics set than his peers, but she did not pursue the matter. However, having been alerted to a difficulty, she expressed her intention of being more proactive henceforth:

Since then, I've been in supervisory mode, and will liaise more closely with the school in future (Timothy's mother 102-103)

It was reported that Vince has experienced difficulties with the curriculum, with behavioural problems in school and with bullying. His parents, therefore, spoke of a number of interviews with school staff. Mother perceived them as caring and supportive, particularly in the way they handled the bullying problem, but father expressed a low opinion of teachers generally:

For a teacher, pay should not be at the top of the list.... a desire to get the best out of the kids. I see teaching as a vocation, but some of Vince's teachers just do the minimum, and get out as soon as they can. Teachers are not committed to developing the children They are doing a job, and that's it. (Vince's father 72-73, 96-99).

Both parents were unhappy with Vince's mathematics teacher of the previous year.

When he got N for his SAT, I thought, he's been at that school all these years [three years] and he hasn't progressed beyond primary level. So what have they been doing? (Vince's mother 334-337)

Support at concerts, sporting events etc.

Theresa's father reported that both her parents support her when she performs in concerts, and at open evenings. Other than these occasions, and the normal parents evenings, no other contacts with the school were reported. Similarly, Vanessa's mother reported attending parents evenings, but no other contact. She said she found the teachers unsupportive.

Melanie's and Nikki's parents all reported having supported their daughters when they have represented the school at various sports, and that the girls have been glad of the support. Similarly, Nicholas' father reported that he and his wife have both regularly attended at parents' evenings, and have turned out to lend their support when Nicholas or his sister have played rugby or netball. Otherwise there has been no contact, and Nicholas' father does not see his role as overlapping that of the teachers:

My job is to provide for and support my family, so I don't have time to support the school as well (Nicholas' father 155-157)

Active participation in the life of the school

Both of Alan's parents reported being active participants at their children's schools, his mother as a member of the PTA assisting in the presentation of musical evenings and concerts, and his father as having assisted in the preparation of a bid for National Lottery funding. Their attitudes towards their children's present school were positive:

The two things which stood out were the genuine enthusiasm of the teaching staff. They were very keen that we should send the children there, even though we had to appeal, because the school was full, and, secondly, it was clear from the visits we made that discipline was very high on their list of priorities, yet they were also very caring. Everyone was well mannered and well turned out. Rightly or wrongly, I think that is an important part of school life; they've got to learn discipline and respect for other people. Maybe it's not as academic as [Name] school, but [Name] put me off as soon as I crossed the threshold, whereas this school did everything to make me feel glad I was there (Alan's father 264-273).

Having been a clerk to the governor's at her children's primary school, Alan's mother expressed concern at the workload and responsibilities placed on teachers nowadays.

Luke's parents also reported being actively involved at the school, particularly with the PTA. Luke's mother had involved herself from play-school onwards, but father only took up school activities since the boys went to secondary school. After ten years of it, he said he felt he should retire.

I think it's about time some of the others coming up did something. (Luke's father 445-446)

7.5.Parental Aspirations

After the interviews had been coded for the operational category ‘parents’ aspirations for their children’s futures’, 5 sensitising sub-categories were identified, and these appear in Table 16.

		Maths	Get a	Be able	Just be	No	Specific
		Level	Degree	to Choose	Happy	Pressure	Careers
Brenda's	mother	H	✓	✓			✓
Bruce's	father	H	✓				
Carl's	father	H	✓				
Melanie's	father	M	✓	✓			
Nicholas'	father	M	✓	✓			
Timothy's	father	L	✓	✓			
Theresa's	father	L	✓	✓			
Carl's	mother	H			✓		
Luke's	mother	M			✓		✓
Melanie's	mother	M			✓		
Wilma's	mother	L			✓		
Timothy's	mother	L			✓		
Bruce's	mother	H				✓	
Anne's	father	H				✓	
Christine's	father	H				✓	
Luke's	father	M					✓
Nikki's	mother	M					✓

Table 16 Parental Aspirations

7.5.1. Summary of the Data

Fathers tended to respond in terms of going to University, and getting a degree. The reason given was usually that a degree opens up opportunities for choice in a career path.

Only 4 parents had specific careers in mind for their children, but 3 were specific in saying that they would not like their children to feel under pressure to go in any direction, that is they should be allowed to choose for themselves. Mothers tended to respond in terms of happiness, contentment and good self esteem for their children.

In terms of correspondence between parents aspirations and their children's mathematical achievement, the three pairs of parents who were not prepared to pressure their children were all from the high mathematical achievers group. However, fathers' aspirations of University degrees for their children were found equally in all three mathematics achievement groups, high, medium and low, as were mothers' hopes for a happy life. (See Table 16)

Similarities across groups

Only 17 of the parents interviewed felt able or willing to formulate a response when asked about their aspirations for their children's futures. Five of the 8 mothers who did so just hoped that their children would be happy.

Hopes that their children would obtain a degree, or sufficient credentials to be able to choose their career paths, were expressed by 7 parents, 6 of whom were fathers.

These two clusters of responses were made by parents from all three of the mathematics achieving groups.

Differences between groups

A third cluster of responses came only from the parents of high mathematics achievers, who claimed that they did not wish to put any pressure (for achievement) on to their children.

A fourth cluster of responses , of which all but one came from the parents of the mid mathematics achieving group, related to specific careers that parents had in mind for their children. For example, Luke's father said he would like his son to follow him into engineering,

7.5.2. Details of parents' comments in interviews

Get a degree, and have a choice for life

Nicholas' father was one of those expressing the hope that their children would obtain degrees, on the grounds that it would offer them the opportunity to enter on any career of their choosing.

Q. How would Nicholas reply to the question, "What does your father want you to do?" A. I think he would say that Dad would like me to do well at GCSE, do well at A Level, go to University and do something I want to do. (Nicholas' father 171-174)

Brenda's mother reported having pushed all her daughters in the direction of Higher Education, on the grounds that a degree would give them independence and self sufficiency:

I don't think I push it down their throats, we've never had to, but I tend to push them in that directionI've always said, in answer to "What do you want for your children?", that I want them to be independent of a man, i.e. they should be self sufficient in their job,

whatever it may be. I encourage them along the academic road because that seems to open more doors for them initially to be independent (Brenda's mother 152-153, 184-188)

Her father thought that Brenda was probably not yet aware of her potential, since she has spoken of a NVQ in animal care, but her mother remained convinced she would obtain a degree.

I can't see her not going to University, I think it would be a terrible waste if she didn't. She has the ideals and artistic ability to do architecture, or something like that (Brenda's mother 176-181)

However, Brenda's science teacher was reported as wanting her to become a scientist:

Her science teacher thinks she should be a scientist, her talents would be wasted anywhere else (Brenda's mother 177-178)

Carl's father spoke of his expectation that both sons would go to University, although with some reservations over the financial implications;

I'm concerned about the cost if they both want to go to University. (Carl's father 548)

Melanie's parents spoke aspirations for their daughter that were different in kind. Her father said expected her to go on to Higher Education, whilst her mother was concerned that she should do her best, and be content. (166-172)

Theresa's mother and father both said they expect her to go to University, her mother because of the family tradition and environment, and her father because a degree would allow her to make choices in later life:

I think both children think of Higher Education as an inevitability. It's hardly surprising, it's the world in which my husband and I operate. Also, her eldest cousin has gone to University, and the next one is on the way. Family conversations are about A Levels and the sixth form . (Theresa's mother 265-269)

I don't mind what career path she chooses, just so long as she doesn't end up without options to have a good enough education to be able to make choices. There is a family expectation of Higher Education, which Theresa shares. I presume she will make it, not a high flyer, but a good entrant (Theresa's father 452-457)

Like Theresa's, Timothy's parents both work in Higher Education, but they demonstrated the difference in aspirations mentioned earlier. His father expressed concern that Timothy should not miss his opportunities, and hoped he would obtain a degree, earn a comfortable living and broaden his mind through travel. (216-220)

Just be happy

In contrast to her husband's view, Carl's mother said she would be satisfied

.....just so long as they are happy (Carl's mother 546)

Melanie's parents. like Carl's, held aspirations for their daughter that were different in kind. Her father expected her to go on to Higher Education, whilst her mother expressed the hope that she should do her best, and be content. (166-172)

Luke's mother was aware that he has potential career avenues in mind (professional sport, physiotherapy). She claimed to have encouraged all her sons to test themselves in areas they think will make them happy:

I'd just like him to be happy, whatever he chooses to do, engineer, sports injuries physio, or just sport, so long as he enjoys doing it, and isn't financially strapped. Being short of money makes for arguments and unhappiness in the home I tell them all, if you've got a dream, try it. Even if it doesn't work out, at least you can look back and say you've tried it (Luke's mother 444-451)

Timothy's mother claimed not to be ambitious for him, but hoped he too would be happy.

I want him to have good self esteem, to feel positive about himself and his achievements. I don't see us as being ambitious parents in the active sense (Timothy's mother 156-163)

Wilma's parents were aware that she does not have the same academic potential as her elder sibling. Wilma's parents both expected their elder son to go to University, but mother was anxious over Oliver's choice of career. She confessed that all she really hopes for both Oliver and Wilma is that they will be happy, and successful in whatever they choose to do. (443-452)

No pressure to achieve

Christine's parents both insisted they would not pressure their daughter, but would support her in whatever route she chooses to follow. In view of his own negative experiences of education, as reported in Chapters 5 and 6, her father was particularly keen that none of his children should feel obliged to pursue an academic route if they did not wish to:

*If they want to go to University, fine, and if they don't want to go, fine. I wouldn't push them in any way at all [spoken with emphasis].
Q. Why not? A. 'Cos I hated school, so I wouldn't push anybody to that sort of academic..... (Christine's father 251-257)*

... Further Education. But that's up to her. We don't want to tell our children what they should do. (Christine's mother 226-227)

Anne's parents also feel that their daughter will make up her own mind without the need of any pressure from them,

I don't think we put undue expectations on to her. Perhaps having seen her brother and sister and cousin all going to University may be influential in encouraging her, or discouraging her She is contented - not a driven person. (Anne's father 204-208)

This view was shared by Bruce's mother, who rejected any pressure on her sons:

I don't like to put pressure on them, I'd like them to be happy. Whatever Bruce wants to do, I'll support him in it. (Bruce's mother 642-645)

Ben was reported as relating badly to school, and his mother looked no further than his A Level years. His father expressed concern only over the progress of his younger children.

Alan's parents expressed no strong ambitions for any of their three children. The elder son, Mark, is perceived by his father as becoming a well dressed, gregarious man about town, who will succeed wherever he sets his hand. Alan, in contrast, was perceived as being too sensitive and polite for the field of professional sport, but his parents suggested no alternative.

7.6. Activity and Example in the Home Environment

After data had been coded for the operational concept of 'activity/example in the home environment', 5 sensitising sub-categories were identified:

- Interactions with parents;
- Interactions with siblings;
- Siblings either graduates, undergraduates or likely university candidates;

- Structure in the home environment;
- The reading of books.

The occurrence of these sub-categories in the interviews is shown in Table 17.

7.6.1. Summary of the Data

A busy, active environment, in which siblings and parents all interact, were associated with 5 high and 4 mid mathematics achievers, viz. Anne, Kate, Christine, Carl and Bruce, and Nikki, Michael, Luke and David.

Contrasting environments were quieter, more reflective and the study children were often semi-detached from other family members, pursuing largely independent lives. Such environments were associated with all the low maths achievers.

Access to books, the use of literature and a structured environment were reported in both active and quiet households, as were siblings academic success.

Similarities across groups

Structured and unstructured environments, the reading of books and siblings academic successes were described in the homes of all three of the mathematics achieving groups, in approximately equal proportions.

Differences between groups

Two styles of home environment emerged from the interviews. The homes of most of the high and mid mathematics achievers were busy, active places where frequent interactions between household members took place in the areas of sport, intellectual activity, discussion and work. In contrast, the homes of all the low mathematics achievers were quieter places, with fewer interactions between members, and less intellectual and sporting activity (see Table 17).

Case	Maths Level	Type of Environ-ment	Parents Inter-action	Sibling Inter-action	Structured Environ-ment	Reads Books	Sibling Academic
Brenda	High	Active	✓	✓	✓	✓	✓
Christine	High	Active	✓	✓	✓	✓	✓
Bruce	High	Active	✓	✓	✓	✓	
Anne	High	Active	✓	✓			✓
Carl	High	Active	✓		✓		✓
Ben	High	Quiet				✓	
Alan	High	Quiet					✓
Nikki	Mid	Active	✓	✓		✓	
Michael	Mid	Active	✓	✓		✓	✓
Nicholas	Mid	Active	✓				
Luke	Mid	Active	✓		✓	✓	✓
Lucy	Mid	Quiet	✓				✓
Melanie	Mid	Quiet	✓		✓	✓	
Vanessa	Low	Quiet			✓	✓	
Wilma	Low	Quiet			✓		✓
Vince	Low	Quiet					✓
Wayne	Low	Quiet					✓
Timothy	Low	Quiet			✓	✓	
Theresa	Low	Quiet				✓	

Table 17 Activity and Example in the home

7.6.2. Details of parents' comments in interviews

7.6.2.1. Active environment

Sibling Interactions in the Active Environment

Anne, Kate and Christine, the three high maths achieving girls, each has two elder siblings who are graduates or undergraduates. Anne parents described how she used to spend a lot of time in the company of her brother and sister when they were at home, and would be included in many of their activities.

*She loved to be part of a game. In Monopoly, she'd be hanging on by her fingertips, rather than resign and be out of it. She would sit in on a jigsaw session, not doing much, but with one piece concealed in her hand so it would be her who would complete the puzzle.
(Anne's mother 142-146)*

Kate and her two elder sisters were reported to have spent much time together in sporting activities, and all have represented their school in various team and individual sports.

*Rachel played tennis and netball for the school, Kate is in the school hockey team..... Hannah is into netball, hockey, athletics and tennis.
(Brenda's mother 140-141)*

Christine is much younger than her stepbrother and stepsister, who are a mature undergraduate and a primary school teacher respectively. Her mother said that, as a child, Christine spent much time with them before they left home.

*The older ones have always thought the world of the little ones, they've helped and enjoyed them, and the little ones loved having an older brother.. They love it when they come home, or we go to visit them.
(Christine's mother 280-284)*

Carl and Bruce are both high mathematics achievers. Carl's brother, Justin, obtained straight As at GCSE, and has been approached by both Oxford and Cambridge recruiters with career advice. Justin was reported to be very mature for his age, widely read, and does not suffer fools gladly:

If Justin disagreed with you, he'd tell you so in no uncertain terms, and you'd have to prove your point to convince him. (Carl's father 311-312)

Carl, apparently, will not compete academically with Justin, but leads a full sporting life:

He does just enough to get by. If they ask him for two sheets of A4, he'll do exactly two sheets. Justin would give you reams of it. If the pass mark is 60, and Carl gets 61, he's happy. He always seems to just hit the target. He would say, "What more do you want? I'm in the top set, and I got the pass mark." Outside school, in sport, he's mixing with people of (his teachers') age. The teachers won't play against him, 'cos he knocks them clean off the court. (Carl's father 339-340, 401-407, 374-376)

Bruce is the third of four boys, in a close knit family. His eldest brother went from school to the FE College and is now employed, and the second brother is currently in further education. Both still live at home. Activities tend to be of the whole family type, presided over by mother and father:

Last year was the first year we didn't all go on holiday together. We do typical; family things - days out, walks in the country, theme parks, theatre, cinema. (Bruce's father 591-598)

Nikki and Michael are middle maths achievers from the group with an active family environment. Nikki is first born, but her sister Clare was reported as the more outgoing and academically inclined. Nevertheless, they have grown up closely together, and have a wide circle of joint friends. Their mother reported that they are both highly regarded by adults with whom they come into contact:

They're caring, good girls. They're well behaved, and are always asked back. They have consciences, and respect for others. (Nikki's mother 249-251)

The two girls play a lot of sport together, and, until recently, the whole family would enjoy their leisure activities together:

[The girls play] netball tennis, hockey, rounders We go and support them when we can they say they like us to go and watch them. (Nikki's mother 237-239)

We used to do a lot together, swimming, camping, shopping. But they're into clothes and boys and pop music now. (Nikki's mother 227-230)

Michael's elder brother Gareth was studying for A Levels with a view to University entrance. Gareth was described as an eclectic reader, but Michael as disliking reading. The two boys have a common interest in music, and Michael is often invited to join Gareth and his friends in their activities.

Parental Interactions in the Active Environment

Anne, Kate, Christine, Bruce, Alan, Carl, Michael, Nikki and David have all benefited from the home carer role adopted by their mothers. All their mothers gave up work/careers to raise their families, although four have recently returned to part time employment:

I worked as an infant teacher for 3 years, and then had the children. I did some supply teaching, but gave that up some time ago. (Anne's mother 38-39)

.... as PA to the General Manager of [National Company]. I left to have my third child, then when my fifth started school, I went in as a parent helper. (Christine's mother 39-41)

I was a Sister on a kidney dialysis unit for four years then we had the children and I stopped work for fifteen years I'm a medical secretary now. (Michael's mother 59-65)

However, Nikki's mother reported embarking upon a new career in education:

I never thought I would work in an academic environment, and yet here I am, a college lecturer. The ability was there, but wasn't brought out in the early years I'd always trained others in my various (managerial) jobs, so perhaps I always had the ability to teach.
(Nikki's mother 56-58, 65-66)

Most of the fathers of the high and mid mathematics achievers reported having involved themselves in routine family activities outside of their normal employment hours. David and his father play golf and Christine's father is a keen DIY activist, in which he involves whichever child is available to give a hand. Nikki's father spoke of frequent holidays and camping expeditions

We go and watch the town play rugby, and I try to teach him how to stay out of trouble. We both learned to play golf together, but he soon became better than me. We used to play nine holes quite often, but it's some time since we last did. He keeps badgering me to go.
(Nicholas' father 160-164)

Christine's a great one for making things - she made this. Patrick and I make electrical gizmos in the garage. We could buy them, but he prefers to make them. (Christine's father 243, 282-284)

I've played with the boys, always have done. They always liked to rough and tumble with dad, a game of football or whatever. And reading to them, I always read bed-time stories to the boys. (Luke's father 76-79)

As a family, we always used to go swimming, camping and shopping together. (Nikki's father 227-228)

Bruce's father and mother lead the family in local and regional religious devotions.

Books and Reading in the Active Environment

Books were observed in large quantities in the homes of Anne, Kate, Christine, Nikki, Michael and Luke. Four mothers claimed to be regular readers for pleasure, and the fathers of both Christine and Bruce claimed to read widely. But fathers generally tended to be less

inclined to read at home. A common response was that they had to do so much technical reading at work that they had lost the inclination to read for pleasure.

I like to read for pleasure. John doesn't read, he doesn't pick a book up. John reads technical books. (Luke's mother 277-281)

It wasn't until my late teens that I first finished a book he has inherited it. I never enjoyed reading I read a lot of academic literature. (Michael's father 541-552)

I didn't enjoy reading at school. Still don't. I have to read an awful lot of technical and business stuff,. I might occasionally read a best seller, or listen to a book on the radio. (Ben's father 245-247)

Interesting stories. I'm reading a saga at the moment. True stories, I don't like trashy stuff, every five pages the bedroom scene. They bore me to tears. (Christine's mother 57-59)

Fiction and non-fiction, as well as educational stuff. Some brought as presents, some left over from the other girls, and some from the library. Hannah doesn't read much, but Brenda reads a lot. Sara is never without a book, and Rachel is compulsive. At present Sara's into classics, Rachel into blockbusters and Brenda's reading awful pulp horror, Stephen King and the X Files. (Brenda's mother 104-110)

Structure in the Active Environment

There was evidence of a structured environment in the homes of Christine, Bruce, Carl and Luke. Christine had set times for doing homework, and a 'den' above the garage for her projects, father leaves and returns home at fixed times, and the children were encouraged to complete outstanding homework by Saturday, leaving Sunday as a day of rest:

We discourage them from leaving it until Sunday. We'd much rather it were done before Sunday. (Christine's mother 162-164)

Bruce's family are members of a religious sect, and their week is landmarked by meetings and observances:

We attend our religious meetings together, three times a week. We also have conventions three times a year, and we attend those as a family.
(Bruce's father 602-604)

Carl's father is a service officer, and brooked no argument in matters of discipline:

Q. Coming home and starting their homework straight away, is that something they developed for themselves, or did you negotiate it with them? Chorus: We didn't negotiate, we said that's what they had to do.
(Carl's parents 499-503)

Luke's mother gives the impression of a very strong character. She has already seen two sons to University, despite learning difficulties of one son and periodic redundancy of her husband. She reported no problems with Luke over discipline.

We treat Luke as an adult now, not as a child. I can't remember when I last had to smack Luke - years and years ago. He knows the threshold, and if he gets a bit cheeky, I just have to look - he knows where the line is.
(Luke's mother 387-390)

7.6.2.2. Quiet Environment

Sibling Interactions in the Quiet Environment

Whilst four of the study children were first-born in their families, none was an only child, and of the four, only Nikki's family was busy and active. Whilst elder siblings contributed to the activity of the active home environments, the simple presence of elder siblings was not a guarantee of family activity.

For example, Lucy is a mid-maths achiever, with an elder sister Kate studying Physics at Cambridge University. The two girls, however, appeared to have little in common. Lucy was reported to have difficulty accessing the academic regime, yet viewed her parents efforts to help her as unwarranted interference.

She doesn't want help. She doesn't want you to see her work, she doesn't want you to look at anything she has done. As far as she is concerned, as soon as you see anything she's done, you're going to criticise. (Lucy's mother 170-173).

In contrast, her elder sister was self motivated to study, and required no assistance from their parents:

She finds that you're nagging at her, which is something you never did to me, admittedly you never had to. (Lucy's sister 177-179)

Their different feelings for study have led to a distancing in their relationship:

Q. Would she ask you for help, Kate? A. On occasions, but I think she has learned that it doesn't work. We have a slight problem with a personality clash (Lucy's sister 182-185).

Melanie is also a mid maths achiever, with an elder sister Nicola. Like Lucy and Kate above, they have different approaches to study. Her mother said that Nicola made little effort until she left school for FE College, whilst Melanie is strongly motivated to study.

School didn't suit Nicola, like it does Melanie. Nicola surged ahead once she transferred to (FE College), and passed all her modules with distinctions Melanie has a very good attitude to work. She will always go the extra mile. (Melanie's mother 144-147, 117-118)

Melanie appeared to be self contained in her interests. She was reported as playing piano for pleasure and by ear, as having been a

compulsive reader from the age of three, as a member of a local drama group and as having recently completed a six-week course in self defence. None of her activities is shared with other members of the family, and her relationship with her elder sister appeared to be cautious:

They generally get on all right with each other. They talk together, often argue, but they never come to blows. (Melanie's mother 164-165)

Ben and Alan are both high maths achievers. Alan has an elder brother Mark who was studying for A Levels (including mathematics), and was reported to be a good candidate for university entrance who has spoken of Law and Accountancy as possible careers:

Although Alan and Mark have a common interest in team sports, they did not appear to interact with each other very much. Alan was reported as being withdrawn and self-sufficient, but Mark as outgoing and gregarious.

He likes being in his bedroom with his music. Some nights he might spend as much as three hours on his homework. (Alan's mother 197-200)

Mark will always be dressed in the best fashions of the day, mixing in high places. He'll probably be a barrister, or a journalist - something in the media. There'll be enough variety and involvement to tax him, to put him under pressure. (Alan's father 352-355)

In contrast, Ben is first born of his family, and the next is a sister. His younger brother was of infant school age. Ben's social life was reported as revolving around his leadership of a peer group, with very little interaction with other members of his family.

Nowadays, he enjoys doing things that give him a massive thrill and an adrenaline rush. He loves Alton Towers and the cabbage run at the Beacon. (Ben's mother 125-127).

All the low mathematics achievers of the study children were found in the quieter, less interactive households. Although Kate, Wilma, Vince and Wayne have elder siblings, and Wayne, Timothy and Theresa have younger siblings, there is little evidence of interactions, and these low mathematics achieving children appear to lead private lives.

Brenda's elder sister Jane had recently completed her A Levels, and had embarked upon a dedicated fitness regime in anticipation of entering the Fire Service, while Kate was reported as spending most of her non-school time either with her mother, or her church based friendship group. The family is very self-contained, with no relations. Maternal grandparents are dead, and the paternal grandparents have not kept in touch.

Wilma's elder brother Oliver was an A Level student, and player of team sports, whilst Wilma kept a pony and helped her father with his livestock. Her brother's academic achievements have apparently cast a shadow over her at school, where she clamours for attention, and is perceived as a nuisance by her teachers.

When we go to parents' evenings, we want to talk about Wilma, but they always talk about Oliver, they say 'You can't believe that they're brother and sister' Apparently, she asks questions all the time because she doesn't understand. We've been told she mustn't continually ask questions. She's always wanting praise, and I said that's the way she is. At home she's always wanting praise. The teacher said she has other children to teach as well as Wilma (Wilma's mother 353-355, 248-257).

Vince's elder brother was at grammar school, and reported as being committed to his academic work, presently studying for A Levels (including mathematics). In contrast, Vince was reported as having difficulty accessing the academic regime that seems to come easily to his brother.

*I remember piles and piles of work with David, but Vince isn't doing anywhere near that amount. No more than two hours a week.
(Vince's mother 257-260)*

Vince's father said he has always been a solitary child, who didn't interact with the outside world.

*He doesn't read newspapers, or listen to the news, so he doesn't know what's going on in the world. He's just not interested. As a little child, he never wanted to do puzzles, read books, look at pictures. On car journeys, he would sit and look at his fingers. He liked dressing up, and playing fantasy games. At playgroup, when the others did spelling or numbers, Vince would disappear into the Wendy House.
(Vince's father 275-280)*

*He tries to shut the outside world out, and lives in a world within himself.
(Vince's mother 280-281)*

Vince's parents were both concerned, because he looked for approval to his peer group at school. He was described as peer-conformist in terms of clothes and style, refusing to exercise his only talent (like his father, he has a fine singing voice), since the school choir is perceived as 'sissy' by his peers.

With Vince, they all have to wear Doc Marten shoes, wear their shirts in a certain way, speak in a certain way. And their hair !! Everything about them is peer pressure ... he's frightened silly (Vince's father 184-189)

He's not himself. He's what everyone else has made him into. I don't know the natural Vince. I think he's in there somewhere, but the rest comes first. How he's going to be accepted by his peers is more important to him than his homework or anything. (Vince's mother 190-194)

I think singing in the choir is seen as feminine. (Vince's father 202-203)

Wayne was aged 3 years, and the younger of two boys when his mother re-married, and he now has two half siblings. He was reported as being the only sporting member of the family, finding

himself between an academic elder brother, and two younger children, and he can be impatient of their slower pace of life.

*Wayne can't waste time something that stalls him has to be overcome
(Wayne's stepfather 163-164)*

Theresa and Timothy are both first-born. From her parents' descriptions, Theresa is quiet and reflective, enjoying reading and music in her leisure time, whilst her brother was described as outgoing and noisy. The two do not get on.

They niggle each other a lot. Q Elder sister, little mum? A. More like elder sister, intense impatience with little brother. Jack is loud, confident, brash and better at maths than Theresa. (Theresa's father 471-474)

Timothy has two siblings, and both were reported to be more academic than Timothy. However, Timothy has a wide range of interests outside the home. He was described as an excellent swimmer and instrumentalist, and as enjoying the performance situation. He appeared to have little spare time for interaction with his siblings, and is, apparently, more at ease in an adult situation.

He's at ease with adults, so he usually gets picked for representative jobs, like carrying the flag. (Timothy's mother 138-140).

Parental Interactions in the Quiet Environment

Ben and Alan are both high mathematics achievers, and both appeared to have little interaction with their fathers. Alan's father described a rising executive career with an international company, from which he has just retired. He had been unable to spend much time with his

family. He took a poor view of Alan's easy going attitude to school work, seeing in him a lack of time management skills.

Rose through the ranks as Sales Manager, Training Manager, District Manager, Regional Manager, up to now

They never ask me. Either I'm not here or too busy

I think it's odd that he should watch TV from 4 o'clock, have his tea, watch some more TV then go upstairs, maybe at 8 o'clock to do his homework. I'd have done it at 4 o'clock, got it out of the way, and had the evening free (Alan's father 84-85, 247, 201-204)

His mother, however, took a more relaxed approach to Alan's work:

I think, when they've come home from school, and they've worked all day, he doesn't swing the lead at school, he wants a break from it, a chance to watch some TV or go and play football with his friends. (Alan's mother 205-207)

She has not worked since she married.

Ben's father works in London, and commutes daily. He has little time for interaction with Ben, who was reported as spending most of his time with his peer group. This had not always been the case, and father and son used to be members of a local rugby club, where father was a coach. When father stopped coaching, Ben gave up playing.

I used to coach rugby, and Ben would come along. Sometimes I'll join outings to The Forest, or the Beacon, or a bike ride, but not very often. (Ben's father 274-275)

Ben was described as a strong swimmer who used to attend the city swimming club on a regular basis, until other family pressures left him without the necessary transport, and so he has also given up swimming.

The pool is 12 miles away, and we couldn't keep doing the transport (Ben's mother 133-135)

Lucy and Melanie are mid mathematics achievers. Both their fathers are engineers, working for local companies, and each has remained with the same employer all his working life.

I've worked for them ever since, moving between various departments. I'm now senior development engineer, and need more sophisticated maths (Lucy's father 31-33)

I've been there for 29 years. Worked up from craft apprentice, City and Guilds, machinist, setter, programmer, problem solver. I still need my maths (Melanie's father 34-36).

Both mothers gave up full time work to have their children. Lucy's mother then became involved with voluntary organisations, and Melanie's mother works part-time for a small company at an address a few doors away from her home:

Then to Domestic Science College, and took a course in Institutional Management, and afterwards spent five years as a Hospital Dietician. After having the children, I did a lot of voluntary workNow I work for [a national organisation], giving dietary advice to young mothers. (Lucy's mother 54-58, 70-71)

I had no ambition to stay on. My parents weren't wealthy, so we couldn't justify it. I went along to the Building Society and asked for a job, and stayed there until I had the children I was only prepared to work hours that let me be back for when the children came home from school (Melanie's mother 19-24)

Kate and Wayne are low maths achievers, and are the only two of the nineteen study children who do not live with their natural fathers. Brenda's mother remarried recently after her husband left home. She was reserved during the interview, and difficult to draw out. However, she reported that Kate tends to spend her leisure time close to her mother, and has no contact with her natural father.

We're pretty close. She sometimes comes to work with me It's a small family, my parents are dead, and we don't have any contact with her father's parents (Brenda's mother 94-97)

All the family are members of the local church.

Wayne's mother re-married when he was three year old, and Wayne has two half siblings. He was reported as spending time with his natural father, on an amicable basis. Wayne's stepfather spoke of his equal commitment to the whole family, and of much joint family activity, but also admitted to pressures of business which kept him away from home for much of the time.

Now I run my own practice. It takes up morning, noon and night. I've been excessively busy since last summer, and I've been working weekends as well. The remaining few hours [each week] the children figure in them (Wayne's father 68-70)

Brenda's and Wayne's mothers stopped work to have their children, and both returned to part-time work, coincidentally in the same line of business.

Then I went into nursing in [B]. Married at seventeen, had children and moved to [G]. Now I'm a practice nurse in a GP surgery. (Vanessa's mother 19-20)

I trained at [C] and did a year as a staff nurse at [B]. Then in industry for 18 months, then a senior staff nurse at [W]. had a child and went back for one night a week for ten years. After that I was a casualty staff nurse for five years, and now I'm a practice nurse in a GP surgery. (Wayne's mother 44-47)

Wilma, Theresa and Timothy all have mothers who have continued with their careers while raising their families. Wilma's grandmother has always lived close by, and her presence made it possible for Wilma's mother to continue working without a break.

I stayed in the same job for twenty-three years. (Wilma's mother 152)

Timothy's mother has worked hours that fit in with her children's schooling, and Theresa's parents both spoke of the paid carer that they employ to be at home when the children return from school, and

before mother returns from work. She said that her leisure activities are artistic and literary, but that she avoids physical activities:

I go to theatre, and concerts. We go together [she and Theresa]. I enjoy a bit of walking or cycling, but I don't like the idea of having to put special time aside for it. (Theresa's mother 105-107).

Timothy's and Theresa's father are both lecturers in the HE sector, and appeared to be rather disengaged from family life:

I love hiking as a solo pursuit. A sense of achievement, from covering ground and seeing the countryside. I'm also beginning to develop a yen for sailing (Timothy's father 143-146)

I enjoy reading, I like playing chess, I like riding a bike, I like going for a walk in the countryside. But I don't have much time for activities, I'm basically a literary person There are discussions about education, like what is it all for. I say much the same things as I've said to you, then the children think I'm a boring old [pulls up short] ... rather a peculiar old chap who has these ludicrous enthusiasms. (Theresa's father 328-331, 447-450)

Wilma's father is an engineer (as a 'day' job), but also keeps a smallholding, and his wife commented on the late hour at which he often arrived home. However, Wilma was reported to spend some of her leisure time helping father with his livestock.

They had strange bedtimes, because father had to come up here and do all the animals before he came home. (Wilma's mother 210-212)

Vince's mother has not worked whilst raising her family, although she helps out with the local playgroup. His father is a peripatetic representative for his company. Both parents appear to be proud of Vince's elder brother for his academic achievements, but said they have resigned themselves to failure in Vince.

David was reading the Bible at age 5. David fits in well at grammar school, it's ideally suited to him, he had some excellent GCSEs. (Vince's father 111-114)

*He's admitted defeat in maths (Vince's father);
He's admitted he's a failure (Vince's mother);
He's under David's shadow - David's very good at maths
(Vince's father 119-121).*

Books and Reading in the Quiet Environment

Reading for pleasure at home was reported by the mothers of Ben, Melanie, Kate, Theresa and Timothy, and they said that their children follow their mothers' example. The fathers reported reading mainly for professional purposes. In particular Ben's and Melanie's fathers both said that the need to read a lot at work left them disinclined to read for pleasure at home.

*I didn't enjoy reading at school, and I still don't. I read an awful lot of technical and business stuff, but I don't often read for pleasure. Occasionally a best seller, or listen to readings on the radio.
(Ben's father 245-247)*

*I read all day at work, so I don't want to read at home as well.
(Melanie's father 132-134)*

Of this group, only Theresa's and Timothy's fathers said that they read for pleasure.

*I'm basically a literary person, I enjoy reading books.
(Theresa's father 330-331)*

I'm interested in Geography, History, other cultures. Why people do what they do. (Timothy's father 127-135)

Their mothers reported that Ben and Melanie both read fluently before they started school. Melanie was described as 'a compulsive reader', and Ben as presently into poetry and Shakespeare. Kate, and Theresa were described as being 'surrounded by books' and reading widely.

However, reading was not a major activity in the homes of Alan, Lucy, Wilma, Wayne and Vince, and these children's tastes in reading were, according to reports given, narrow. Alan did not read until aged 8 years, and now, his mother says, reads only sporting literature. According to her mother, Lucy reads and re-reads a small selection of favourite and familiar books, and Wilma's mother said she will only read magazines about horses. Wayne had progressed from children's books to pulp fiction, and Vince was reported to read only in the field of ornithology.

He wouldn't read a novel. He's like my eldest son, they both like factual books. Both boys will read any book on sport. (Alan's mother 145-146)

She will buy books for herself, but she reads the same book over and over. She prefers what she knows and is comfortable with. (Lucy's mother 148-150)

The children don't do a lot of reading Wilma'll read a magazine, but they hate it when they have to come home and read a book for school work. They don't mind reference books. Wilma'll read her horse magazine, but actual books ... (trails away). Wilma's mother 209, 219-221)

Wayne read all the Famous Five and secret Seven books, then Joe Devon interactive novels, and now he reads Stephen King. (Wayne's mother 180-181)

He reads what he's got to read. He doesn't read anything unless he has to, for example to find out what a film's about. I'll send him to bed with a book off the shelves, and it'll still be by his bed a year later, with a bookmark in page 4. (Vince's father 291-295)

Vince knows his birds, he'll read books about them. (Vince's mother 366);

Structure in the Quiet Environment

Their parents' reports indicated that Timothy and Wilma lead highly structured lives, and Melanie and Kate lead moderately structured lives. Timothy swam competitively, and played in an orchestra, so he was obliged to organise his life in such a way as to combine academic,

sporting and musical activities. His parents, however, found the logistics difficult to sustain.

*He swims three times a week. We spend a lot of time transporting him around. I know it's for his benefit, but it's a nuisance.
(Timothy's mother 126-128)*

Wilma was reported as being involved with her pony and her father's sheep, and the regular maintenance of livestock gave structure to her out of school life. Her mother said she is reluctant to be adventurous.

We don't do an awful lot together, just mealtimes, but Wilma spends a lot of time with her father, helping with the animals She's not keen. She usually won't go on trips

They joined the Army Cadets, this friend and Wilma, and she really enjoyed it, then this friend stopped going, so Wilma stopped. It's a real shame (Wilma's mother 400-401, 415-416, 429-431)

As already mentioned, Melanie and Kate are close to their mothers, and appeared to derive their structure from their mothers' organisation.

She has a desk in her room, and reference books, but she likes me to be around when she's working. (Melanie's mother 115-117)

We're very close. She sometimes comes to work with me. It's a small family. My parents are dead, and she doesn't have any contact with her other grandparents. (Brenda's mother 94-97)

In contrast, Ben, Alan, Vince and Theresa appeared to be left much to their own devices. Ben's time was largely devoted to peer group association, while his mother claimed to be writing up his course-work assignments for him.

He enjoys doing things that give him a massive thrill, an adrenaline rush. He loves Alton Towers and the 'cabbage run' at Painswick Beacon. He has a good circle of friends His written work varies from being completely illegible He gives me his notes, and I type it up for him. (Ben's mother 125-128, 150-155)

As already mentioned, Theresa returns from school some time before her parents return from work, and she is left to arrange her own priorities.

She gets home from school at 4 o'clock. Between 4 and 6 she may watch some TV, do snatches of piano practice, or a bit of homework. When I get home she has usually finished homework, and is watching TV. I tell her, it's her world, she's in control of it, she just gets on and does it. It's not an issue. (Theresa's mother 187-191, 260-262)

Alan's parents expressed conflicting views over his relaxed attitude to time management. His father said he would like to see Alan more pro-active in structuring his time, but his mother took the view that, so long as the work is done, it doesn't matter when.

I think it's odd that he should watch TV from 4 o'clock, have his tea, watch some more TV then go upstairs, maybe at 8 o'clock to do his homework. I'd have done it at 4 o'clock, got it out of the way, and had the evening free. (Alan's father 201-204)

I think, when they've come home from school, and they've worked all day (he doesn't swing the lead at school), he wants a break from it, a chance to watch some TV or go and play football with his friends. (Alan's mother 205-207).

7.7. Summary of the chapter

This chapter has focused on the educational and familial interactions between the study children and their parents and siblings.

Encouragement and general help from parents and elder siblings were available to children from all three of the mathematics achieving groups, but specific help with mathematics was not available to members of the low mathematics achieving group, as it was to members of other groups. Support at sporting or other performance events was reported by parents of the low and mid mathematics

achieving groups, but not by any of the parents of the high mathematics achieving group

Two themes appeared to converge in discussions of supervision. These were inaction and acquiescence. Parents did not appear to exercise supervision or monitoring of homework on a systematic basis, and fathers in particular were prepared to accept assurances from their children that everything was under control. Fathers were inconsistent in their reporting of supervision, commenting sometimes on monitoring they had undertaken individually, sometimes on monitoring that they believe had been undertaken by their spouses and sometimes on monitoring that they believe ought to have been undertaken. However, none of the sub-categories identified in the analysis bore any relation to the three groupings of the mathematics achievers. Categories all contained a mixture of high, medium and low mathematics achievers.

Attendance at schools for parents evenings was reported in all but two of the interviews, but many of the parents expressed dissatisfaction with the outcome of these visits. Parents' comments about their interactions with schools tended to cluster, almost exclusively, around reports of attendance at extracurricular events (mainly the parents of mid mathematics achievers), parents evenings and special visits to discuss curricular or disciplinary problems (mainly parents of low mathematics achievers).

When speaking of their aspirations for their children, fathers tended to respond in terms of going to University, and getting a degree. The reason given was usually that a degree opens up opportunities for choice in a career path. Three pairs of parents were specific in saying that they would not like their children to feel under pressure to go in any direction, that is they should be allowed to choose for themselves, and these were from the high mathematics achieving group. Mothers tended to respond in terms of happiness, contentment and good self esteem for their children.

Fathers' aspirations of University degrees for their children were found equally in all three mathematics achievement groups, high, medium and low, as were mothers' hopes for a happy life.

A busy, active environment, in which siblings and parents all interact, was associated mainly with high and mid mathematics achievers, while in a contrasting environment, quieter, more reflective study children were often semi-detached from other family members, pursuing largely independent lives. Such quiet environments were associated with all the low mathematics achievers.

Access to books, the use of literature and a structured environment were reported in both active and quiet households, as were siblings academic success.

In the next chapter, the outcomes of these interactions, in terms of the children's motivation and their relations with their teachers and peers, will be discussed.

CHAPTER 8

MOTIVATION, AND RELATIONS WITH TEACHERS AND PEERS

8.1. Summary of the Data

The parents' reports indicated that their children tended to fall into three groups. The largest group (5 girls and 5 boys) was described as lacking in motivation, and these included most of the low mathematics achievers. Those whose parents described them as well motivated appeared to be either extrinsically motivated (all boys) or intrinsically motivated (all girls) (See Table 18)

Reported peer relations mirrored almost exactly the children's motivational levels, with well motivated children reported as experiencing good peer relations, and the poorly motivated children experiencing difficulties in their peer relations.

In addition, those children reported as being of low motivation were also reported as having experienced difficulties with teacher relations at some time.

Case	Maths Level	Motivation	Teacher Relations	Peer Relations
Christopher	H	Extrinsic	Good	Good
Carl	H	Extrinsic	Good	Good
Luke	M	Extrinsic	Good	Good
David	M	Extrinsic	Good	Good
Timothy	L	Extrinsic	Good	Good
Kate	H	Intrinsic	Good	Good
Christine	H	Intrinsic	Good	Good
Melanie	M	Intrinsic	Good	Good
Nikki	M	Intrinsic	Good	Good
Bruce	H	Low	Good	Poor
Anne	H	Low	Poor	Good
Ben	H	Low	Poor	Poor
Michael	M	Low	Good	Poor
Lucy	M	Low	Poor	Poor
Kate	L	Low	Poor	Poor
Theresa	L	Low	Poor	Poor
Wilma	L	Low	Poor	Poor
Vince	L	Low	Poor	Poor

Table 18 Study Children by Mathematics Achievement Grouping, Motivation, and Relations with Teachers and Peers

8.2. Details of parents' comments in interviews

8.2.1. Motivation

Children with low levels of motivation

Vanessa's parents divorced, and her mother recently re-married.

Although Vanessa was reported to spend a lot of time with her mother, apparently they do not discuss her schoolwork. She appeared to lack motivation and enthusiasm, and had problems managing her workload.

I'm not sure how she manages it [coursework]. She seems to keep coming up against deadlines. (Vanessa's mother 73-75)

Wilma was spoken of as very much in the shadow of her more academically able brother. Her teachers were described as making much of the difference in their performance. Wilma's mother said they try to be more balanced, supporting her with the praise that she needs, whilst attempting to play down her brother's successes.

Q. Would you say they need motivating, encouraging to work?

A. Wilma does, but with Oliver we have to tone it down. He should have more praise, because he does achieve very well. In his bedroom he has twenty-eight commendations on his board, with certificates for other things. Wilma finally got one commendation. (Wilma's mother 345-350)

Vince was also described as in the shadow of his academically able elder brother. However, his parents reaction to his lower ability were quite different from that of Wilma's parents. They tended to be more critical and judgmental, and expressed a loss of patience with Vince's lack of motivation.

When [his elder brother] said he would look at his homework, Vince didn't want to know. If they were wrong, he didn't want to know. That indicates, to me, a lack of interest. (Vince's father 152-154)

Lucy, Michael, Theresa, Anne and Ben were all described by their parents as lacking in curiosity, drive, enthusiasm or any form of motivation for their work. The parents appeared to accept these as manifestations of their children's personalities.

Lucy seems to lack curiosity. She doesn't seem to want to know more than she knows at the moment. She wants to be successful, but doesn't like the hard work beforehand. (Lucy's mother 190-194)

He's not motivated to work hard, but he does so because he's amenable to teachers' authority and supervision. (Michael's father 650-651)

*Theresa dislikes mathematics. She would gladly never do another sum in her life, and just tries to get the work over with as quickly as possible My impression is that she is willing enough, but is not going to show enthusiasm for any bit of it.
(Theresa's father 370-373, 465-466)*

She is contented. Not a driven person. (Anne's father 208)

*He doesn't want to do the nitty-gritty. There's definitely something mismatched in him, - in his ability and his application.
(Ben's mother 190-193)*

Well motivated children

Of the remaining nine children, the four girls were all described in terms indicating intrinsic motivation:

*She spends hours over it [homework], especially Art and Design Technology. She had an outstanding report She doesn't need pressure, but if you applied it she would stall.
(Brenda's mother 117-120)*

I don't know whether she's self-motivated, or just doesn't like to be second best, but she enjoys doing it, and seems to do most of her work with ease. (Christine's mother 183-185)

*She has a very good attitude to work. She'll go the extra mile.
(Melanie's mother 117-119)*

She gets As for effort. (Nikki's mother 184)

In contrast, the five boys were described in terms which indicated that they required extrinsic pressures to motivate them. Alan and Carl were reported as responding to threats to their self esteem under the possibility that they might be demoted to lower sets:

*Alan is highly competitive, he wants to be in all the top sets and do well in exams, so that drives him on. Recently, he was threatened with being dropped a set if he continued just coasting, so he got his head down, revised for the maths exam, and got the top mark.
(Alan's father 234-236)*

He likes to be in the top sets. When he was threatened with being dropped out of the top [mathematics] set, he was suddenly on to it, and his grades took him straight back up. (Carl's father 394-396)

Nicholas also reacted to competitive pressures, but in his case they arose from within his family rather than his peer group:

*Q. What do you think caused Nicholas to change gear academically?
A. I think it was about the time that Laura did well in her GCSEs, and if there's one thing that spurs Nicholas on. It's competition. I think a big factor is sibling rivalry. (Nicholas' father 139-143)*

Luke's motivation appeared to lie in the pleasure he was reported to derive from certain subjects, and in his teachers' approval. Without these, he appeared to lack the motivation to work:

If he finds it easy, you don't have to badger him to do it, but if he's tired, and the weather's been very hot, it's an effort to get down to it In Geography, he doesn't have to put the effort in, 'cos it's natural, and the teacher says he's a 'treasure' to teach. He loves it. (Luke's mother 314-315, 259-262)

Timothy, like Luke, was reported as enjoying the approval of the teachers of subjects he enjoys, music, languages and science, but disliking other subjects such as history and mathematics, with whose teachers he does not get on so well. His father expressed concern that neither he nor the school put Timothy under sufficient pressure, and acknowledged that this is necessary to motivate him:

The lack of expectations at school means there will be no external pressure on Timothy, and he needs external pressure. I wonder if I'm demanding enough. Timothy lacks the self-motivation that would counteract that. (Timothy's father 208-209, 222-223)

8.2.2. Peer Relations

Poor peer relations

Nearly all the children with low motivation were reported as having little interaction with their peer groups. Vanessa and Lucy appear to have suffered some mild bullying.

It's very important for Lucy to have friends and be accepted. She has one particularly close friend, but normally she's on the fringe. At the moment she's being teased by her group. (Lucy's mother 141-143)

She has a different group of friends at school, but she's unhappy there. They've both been bullied [Vanessa and her elder sister]. Only verbal, nothing physical..... She doesn't want to join the school orchestra, 'cos none of her friends are in it. (Vanessa's mother 65-67, 85-87)

Wilma and Michael and Theresa found that house moves disrupted their friendship groups:

We moved [house] about six years ago, and Wilma did find it difficult to make new friends, although her schoolmates were the same. (Wilma's mother 276-277)

Theresa has school friends, but there are no children around where we live. Her friendship groups are all small, two or three groups of 3 or 4 each, all girls. At this school, there's no bullying, but she used to be teased [in Liverpool] for talking posh and liking classical music. (Theresa's mother 341-344)

He's happy at school now, although when he first went to secondary school, he missed his friends. There are no problems now, no bullying. (Michael's mother 616-618)

Michael's elder brother is at the same school, and he and Michael get on very well, so he may well exercise a protective influence over Michael's peer relations in school.

Luke has had a long term close friend, described by his mother describes as “my fourth son”, but otherwise seemed independent of peer relations:

Although he's popular at school, he doesn't seem to have any particular friends. (Luke's father 203)

As already mentioned above, Vince has difficulties relating to his peers. He has been quite severely bullied, and has tried to be part of the ‘in crowd’ through an obsessive attention to the detail of his dress and appearance. He has rejected the opportunity to become part of a smaller group, the school choir, for fear of the ridicule of the larger crowd, whose opinion he appears to value.

He has a good singing voice, naturally musical, but that is seen as being totally naff.....Peer pressure reigns supreme with Vince. They all have to wear Doc. Marten shoes, wear their shirts in a certain way, speak in a certain way, and their hair Everything about them is peer pressure. He's frightened silly. (Vince's father 173-174, 182-189)

He's not himself, he's what everyone has made him into. I don't know who he is, the natural Vince. I think he's there somewhere, but the rest comes first. What he looks like, how he's turned out for the day is more important to him than his homework or anything. How he's going to be accepted by his peers is more important to him. (Vince's mother 190-194)

I suppose you could argue, if you're good at maths you become a swot at school. There's no likelihood of him wanting to be a swot, no likelihood of him achieving - maybe it's not the done thing. (Vince's father 195-197)

Ben's mother believes he does not interact with groups at school, and dislikes the regimentation of the classroom situation. He is the leader of a friendship group of boys who spend their leisure time apparently just ‘hanging around’, or bicycling. However, they are reported to have rejected the deviancy often associated with this sort of behaviour.

*Going to school was a major change He didn't like being one of a group, and having to do as he was told, not doing his own thing..... He still finds this hard..... He enjoys doing things that give him a massive thrill - he loves Alton Towers and the 'cabbage run' at the Beacon [a testing grass track used by mountain bikers]..... He's given up rugby and swimming, and won't do anything that's organised..... He has a good circle of friends, of a wide range of intellectual abilities. They've all rejected the advances of the local drug dealers.
(Ben's mother 119-129)*

Good peer relations

In contrast, the well motivated children (both intrinsically and extrinsically) appeared to enjoy good peer relations:

She makes friends easily and, within her peer group, there's no sign of [shyness]. (Anne's father 133-134)

She's forever having friends to stay Friday nights and weekends. And an amazing number of parties. (Christine's father 358-359)

Both the girls get on well with their peer group (Nikki's mother 170-171)

He's in lots of groups at school. The rugby group, his academic group, his local friends. Also him and John [younger brother] constitute a group. (Nicholas' father 121-125)

*Since we moved house, he's started walking home with some much better companions, and he's now settling down to his work properly.
(Alan's mother 188-190)*

*He enjoys the company of his friends from primary school. One of them plays the euphonium with Timothy. He plays rugby for the school. He's quite popular, quite an achiever.
(Timothy's father 159-162)*

*He is not easily led. He often decides not to do what others are doing, although he does like the approval of his peers.
(Timothy's mother 135-136)*

8.2.3. Relations with Teachers

Poor relations with Teachers

Eight of the study children appeared to have experienced difficulties with one or more teachers, and Ben in particular was described as confrontational. Six of these were from the poorly motivated group described above.

*He has challenged teachers over [their] inaccuracies. He really is very arrogant. Discretion is not in his vocabulary.
(Ben's mother 166-168)*

I can't help [with the mathematics], because I don't understand either. The teacher's not much help. (Vanessa's mother 46-47)

She's more concerned with whether a teacher is effective than whether she likes him or her. Last year's maths teacher was not sympathetic to her. (Theresa's mother 163-165)

Her written work, English, isn't good. Spelling is a problem. She came across a teacher in the third year who didn't suit her, and her confidence plummeted If she encounters a teacher who appears to bully, and she's afraid, she's got no confidence even to move. She's so frightened of doing it wrong. (Lucy's mother 108-109, 122-123)

Wilma's mother also described difficulties with a number of her teachers. She had been on report for 'pestering' some teachers for confirmation, whilst others had reported that she does not participate enough in classes. Wilma was reported as having a particular aversion towards her games teacher, and being in a foul mood on mornings when she was to be taught by her. Wilma has had recurrent hearing difficulties, which her parents have reported to the school, but which have not, apparently, been advised to teachers who have to deal with her:

We've just been to parents' evening, and the teachers were surprised when we mentioned her hearing. Apparently she asks questions all the time, because she doesn't understand what the teacher is trying to tell her. We've been told she mustn't continually ask questions. We went on to the next teacher, science I think, and he said she must ask more questions. "But when," I asked, and he said any time, she must ask questions. The [other] teacher said she has other children to teach as well as Wilma, and Wilma must produce some work to be praised for. (Wilma's mother 248-257)

Luke and Ben were reported as having difficulties managing their relationships with certain subject teachers:

If it's German, at the moment he won't do [his homework] at all, 'cos he's got a personality problem with the teacher. (Luke's mother 310-312)

One of his teachers had a nervous breakdown - maybe Ben contributed to it.... (Ben's mother 169-170)

Carl's parents described him as a mature sportsman, who has difficulty establishing the boundaries between his social and academic lives. In addition, a number of his teachers compare his academic progress unfavourably with that of his elder brother:

Outside school, he's mixing with people of [his teachers'] age. He finds it difficult to be on first name terms outside school, and submitting to their authority in school. He's rebelling about that. (Carl's father 330-333)

He must be very frustrating to teach. They all say he's got it there, but he does just enough I think it's quite hard to follow Justin. From quite an early age they used to compare their school reports. Teachers used to say, "Oh yes, you're Justin's brother." (Carl's mother 398, 409-412)

Vince's parents described their son as having a particularly difficult time at school. He appears to have a low self esteem, and is highly susceptible to peer group fashions. His parents believe he may be dyslexic, but have not exerted pressure on the school to provide support, as they are afraid the associated 'labeling' will demean his

self-esteem even further. As described earlier, Vince and his parents have reconciled themselves to his failure. His teacher's, however, believe that Vince is not making the effort he should.

The maths teacher said at the parents' evening, "He's a lazy tyke, isn't he?" (Vince's father 74)

He didn't get on with his maths teacher last year, and now he's gone down a set. (Vince's mother 144)

His parents believe that fear of an adverse peer group reaction has prevented Vince from exercising his real talents.

He has a good singing voice, naturally musical. The music teacher wants him to join the choir, but he believes he will be ribbed by his classmates. The one thing he could really shine at is deliberately suppressed, because of what his 'mates' might think about it. (Vince's father 173-178)

Good relations with Teachers

Three of the study children were reported as having excellent relations with their teachers:

She received an outstanding school report. (Brenda's mother 118)

Her teachers all say she's doing very well. They wish all were like Christine. (Christine's mother 180-181)

They say he is charming, and at least one offered to adopt him His English teacher says he has some wonderful ideas. (Michael's mother 635-636, 653-654)

None of the remaining eight children was reported as having difficulties with teacher relations. The example of Bruce appears to capture the essence of normal relations with teachers:

They get on better with some than with others. Usually they're painted as some dreadful ogre, then when you go along to parents' evenings, you don't recognise them from the descriptions. There have never been any clashes, and none of them has ever felt picked on or victimised. (Bruce's father 412-417)

However, a number of inconsistencies were reported. Theresa's mother believed her daughter to have a low opinion of her teachers, yet the teachers appeared to have a high opinion of Theresa:

She is very sharp on spotting teaching strategies, "She gave us a test today, because she hadn't prepared a lesson." She is also very critical of her teachers' style of dress. She is more concerned with whether a teacher is effective, than whether she likes him or her The teachers always seem very keen on her. She is polite, quiet and well mannered. (Theresa's mother 160-164, 348-349)

Reports of Luke's relations with his Geography and German teachers were at the extremes:

The [Geography] teacher says he's a treasure to teach If it's German he won't do [the homework] at all, 'cos he's got a personality problem with the teacher. (Luke's mother 260, 310-312)

Timothy's different reactions to teachers in different disciplines were also noted. He was reported as getting on well with his music, language and science teachers, but not getting on with his mathematics or history teachers.

8.3. Summary of the chapter

Levels of motivation as reported by the parents, were varied. Low levels of motivation was reported by the parents of most of the low

mathematics achievers, whereas the high and mid mathematics achievers tended to be well motivated. Girls were reported to respond to intrinsic motivators such as commitment and personal satisfaction, whilst the boys responded to extrinsic motivators such as competitive pressures and teacher approval.

Peer relations mirrored the children's motivational levels, with well motivated children enjoying good peer relations, and poorly motivated children experiencing difficulties in their peer relations. Also, and perhaps not surprisingly, those children with low motivation were reported by their parents as experiencing difficulties with their teacher relationships at some time.

As can be seen from Table 18, other than Timothy, Bruce and Michael, the well motivated children with good peer and teacher relations were to be found in the high and mid mathematics achieving groups, while the poorly motivated children with poor peer and teacher relations were to be found in the low mathematics achieving group. Timothy appeared, from his parents reports, to be well rounded, in that he plays rugby, performs in an orchestra, swims well and is not under much pressure to perform academically. Bruce, however, appears to be uncommitted outside the home, where there is a strong religious and family structure to his life. Michael, although of low motivation, was described by his teachers in very positive terms. Michael's father

believes that his son is very amenable to authority, and that may, perhaps, counteract his apparent lack of self motivation, and act as an extrinsic motivator.

Although high and mid mathematics achievers were observed to have varying combinations of motivation, peer and teacher relations, all but Timothy of the low mathematics achievers were observed to have low motivation AND poor peer relations AND poor teacher relations.

This concludes the series of chapters beginning with Chapter 5, in which, through the interviews, parents' educational backgrounds and attitudes to mathematics and education in general were traced through their engagement with their children's education, and their activities and examples in the home, through to the outcomes in terms of their children's motivation and relations with the world they inhabit. In the next, and final, chapter all the above issues will be brought together for discussion.

CHAPTER 9

DISCUSSION AND CONCLUSIONS

The findings

The project begins with a re-analysis of findings from the National Child Development Study (NCDS). A group of family variables was investigated, using samples of boys and girls with unusually high or low scores on tests of mathematics and reading comprehension (see Table 3). Most of the family variables showed significant associations with both mathematical *and* reading achievement. Little evidence was found, however, for association between family variables and mathematics achievement alone. Of particular interest was a significant association between teachers' subjective assessment of parents' interest in their children's education at age 7, and the children's achievement four years later at age 11 years.

This led to the second phase of the project, where parents of 14/15 year old girls and boys in high, moderate and low mathematical achievement groups were interviewed, and invited to discuss, among other issues, their involvement in and views upon their children's education, with particular emphasis on mathematics.

Analysis of these interviews indicated that children with a high achievement specifically in mathematics were more likely to be found in families where:

- both mother and father had continued their education, at least to O Level examinations;
- a history of educational achievement (beyond O Level), in the parents' wider families was reported;
- parents appeared to take a broad view of education in general, each citing a number of its advantages e.g. as having intrinsic worth, as a preparation for adult life, as a route to academic credentials;
- from the parents' reports in the interviews, home environments appeared to show high levels of parent/child/sibling interaction (members joining together for a number of different activities);
- the parents reported their children as being well motivated to pursue all their studies, and enjoying good relations with both teachers and peers.

In contrast, family influences associated with low mathematical achievement appeared to be as follows:

- usually neither, or only one parent had stayed on at school after the statutory school leaving age to take O Level examinations;
- there appeared to be little history of educational achievement beyond O Level in the parents' wider families;
- most parents expressed views which suggested that education has few advantages;
- parents' reports in the interviews suggested that home environments showed little parent/child/sibling interaction;

- the children's motivation to study was reported to be low, and relations with both teachers and peers were reported to be poor.

Relation to previous research

Previous analyses of data from the earlier phases of the NCDS had suggested that children's achievement at school was linked to a number of family variables (Davie et al., 1972; Davie, 1973; Fogelman, 1975; Ferri, 1976, Fogelman, 1983), and in particular, that parental class and education, family size and experiences of pregnancy and delivery were all related to children's achievements in both reading and mathematics. Lareau (1987, 1989) studied two schools serving different catchment areas of middle and working class parents, and interpreted her data as confirmation of a positive relationship between parents' class and children's educational achievement. Entwisle and Alexander (1992) sought to link home environment to mathematical achievement, by comparing the 'summer break set-back' of children from different racial and economic groups. Their findings were interpreted to suggest that home environments of children in economically disadvantaged households (irrespective of race) may have been responsible for a 'falling back' in their mathematical achievement during the summer vacation.

However, such studies have tended to be quantitative in design, and their findings have focused on descriptive statistics based on group means and correlations.

In the re-evaluation of the NCDS data reported earlier, and for the first time in studies of this nature, boys and girls whose mathematical achievements were particularly high or low were distinguished and separated from those whose reading achievements were high or low. This was achieved using multiple regression techniques (Fletcher et al., 1994) to identify cases with high residual discrepancies on their mathematics test scores at age 11 years. Small groups of girls and boys were identified, high and low mathematics achievers, but whose other cognitive and educational skills were within the middle range. Also identified were male and female groups of a similar size whose reading comprehension skills were high and low when compared with their other cognitive and educational skills.

When the family variables were examined from the vantage point of these carefully selected groups, most of the findings appeared to be group specific, rather than general to the whole cohort.. For example, where it has previously been suggested that parents' social class and mothers' histories of pregnancy were associated with children's patterns of attainment (Fogelman et al., 1978), and mothers' levels of education was also linked to their children's patterns of attainment

(Fogelman ed., 1983), in the present study it appeared that fathers' social class was significantly associated only with high achieving girls, mothers' level of education only with high achieving boys, and mother's prior pregnancy-free interval only with girls' levels of achievement.

More importantly, nearly all those family variables associated with children's mathematical achievement were *also* associated with reading achievement. Parents' class and education, size of household and sibship rankings, and mothers' histories of pregnancy evidenced no relationships with children's mathematical achievement alone, when other dependent variables were controlled.

It is suggested, therefore, that the authors of studies grounded in quantitative paradigms (e.g., Fogelman, 1978; Ferri, 1976, 1993) tended to examine only family variables that were quantifiable; specifically those variables already mentioned. However, the following authors have focused on other, less quantifiable variables. Campbell et. al., (1994) report an international project where parents in a number of countries were interviewed about their attitudes to mathematics and the manner in which they interact with their children within the framework of their mathematical development. Coleman (1988, 1991) spoke of 'social capital', i.e. good relationships and interactions between children and parents, as a conduit through which the

children can access the benefits of their parents' education and culture. Steinberg et al., (1992) and Fletcher et. al.,(1995) have suggested that an 'authoritative' parenting style (where firm standards are set and maintained within a caring ethos) is consistent with high school achievement in children. Following from these studies, and the re-analysis of the NCDS data reported in Chapter 3, the second phase of the present study, therefore, focused on interviews with parents of 14/15 year old boys and girls whose mathematical achievements were unexpectedly high or low when compared with their other cognitive and educational skills. Parents of a third group, pupils whose mathematical achievement levels were similar to their other educational achievements, were also interviewed. The interviews were structured so as to encourage parents to talk in the above areas, i.e. attitudes towards mathematics in particular, and education in general, levels of intra-family interactions, and the way parents perceived and fulfilled their responsibilities in terms of educational support and supervision.

Analysis of the interview transcripts lent support to Coleman's (1988) model of social capital. High mathematics achievers were more often found in families where both parents had achieved at least O Level credentials, where a history of educational achievement (beyond O Level) in the parents' wider families were reported, and parents reported high levels of intra-family interaction. In contrast, low

mathematics achievers were more often found in households with low levels of intra-family interaction, and little reported evidence of educational achievement in the wider families. Support was also found in the transcripts for some of the findings of the Campbell et al. (1994). They observed that high levels of pupils' achievement were likely to be associated with positive parental attitudes toward education, and high levels of support at home, and these findings were replicated to some extent in the present study. However, other findings in the present study appeared to highlight some contradictions in the suggestions of Campbell et al. (1994), Wentzel (1994) and Steinberg et al. (1992). Whereas all these researchers were in agreement that parental involvement in children's homework tends to promote higher achievement, they also suggested that such involvement can only be undertaken within an 'authoritative' family environment. Otherwise it may be counterproductive, and be rejected by their children. In the present study, examples of such 'hostility' were found, in which parents' involvement was perceived as unwarranted 'intervention' or 'interference'.

Finally, analysis of the transcripts indicated that children who were reported as well motivated towards their studies experienced good relations with their teachers and peers. The former is not surprising since, presumably, teachers are well disposed toward keen students. The relationship between high motivation and good peer relations

(and its obverse, the relationship between low motivation and poor peer relations) is broadly in line with findings from work by Harris (1995, 1998) and Fletcher et al. (1995). Harris (1995) has proposed that, once a child starts school or even nursery school, its true environment is its peer community, rather than the family. However, Fletcher and colleagues argue that children from similar family environments form peer groups. Thus, education oriented parents associate with one another, leading to their children forming peer groups with similar values (Fletcher et al. op. cit.). In the present study, it was clear that those children who had not integrated into their peer group, appeared to have low levels of motivation toward their studies, and poor relations with their teachers. However, although nearly all the low mathematics achievers appeared in the 'low motivation' category, children from the high and mid achievement groups were also reported as having low motivation. The link proposed by Harris (1995, 1998) between peer group relations and school achievement may not be as clear cut as she has suggested.

One other area was explored, the mothers' experiences of pregnancy and delivery, and the children's health during their development. A few examples were reported of anomalies in pregnancy and delivery, and each child concerned was reported to suffer from a small number of health problems. However, these children came from different groups of mathematics achievement, so no associations could be

observed. A brief description is included in Appendix 8. Although the work of Kawi and Pasamanick (1958), Broman et al. (1987) and Broman (1989) suggested that 'reproductive casualty' was associated with learning difficulty, the effect was small (less than 10% of variance was noted), and it was not observed in the present study.

Implications for the future

Experimental research can be used to make predictions and ascribe causality. However, predictions within the designs normally used in the social sciences can be made only for percentages of populations (e.g., 10% of children born in the UK this year will be left-handed). Within a social science experiment, predictions cannot normally be made for individuals, nor for small groups (e.g. in a group of ten children one is sure to be left-handed), and effects that have been reliably observed in quantitative, cohort studies within the social science statistical/empirical paradigms may not be observed in a qualitative study that focuses on selected groups. Conversely, any effects that are observed, and have not hitherto been reported, cannot be generalised with any confidence until they are found in a larger scale replication of the study.

Despite these acknowledged difficulties, however, there are elements of the present study which are substantial enough to warrant

investigation on a larger scale to assess their predictability and/or causality, i.e.

- both parents of most high mathematics achievers had stayed on at school up to or beyond O Level examinations;
- the majority of the low mathematics achievers:
 - lived in households where low levels of intra-family interaction were reported;
 - had low levels of academic motivation;
 - had poor relations with their teachers;
 - had poor relations with their peers.

If such findings are sufficiently reliable to be repeated in a larger study, it might be reasonable to conclude that low levels of family interaction, motivation, teacher relations and peer relations are all associated in some degree with low levels of mathematical achievement. The strength of the association would dictate the confidence with which predictions could be made. For example, a very strong association might lead to schools paying particular attention to the mathematical achievement of pupils who have poor peer relations. Or, where children who show early signs of difficulty with mathematics are identified, their parents might be invited to participate in a series of training sessions aimed at encouraging more interaction at home. Perhaps more controversially, teachers might become aware they have a stereotypical tendency to be well disposed toward good mathematicians among their pupils, while being less well disposed toward the poorer mathematicians.

Ascribing causality presents a different set of problems from prediction. To correctly ascribe causality (variable A leads to variable B, or alternatively, variable B is a result of variable A), requires the elimination of the impact on A or B of other variables. Thus, suppose a sample of age matched pupils were identified who

- live in busy, active households,
- enjoy good peer relations;
- enjoy good teacher relations;
- are well motivated in their studies.

If, in such a sample, those pupils whose parents had both attained O Level credentials or better were mainly high mathematics achievers, and those with lower levels of parental education were found to be low mathematics achievers, then it would be permissible to ascribe causality between parents' level of education and their children's mathematical achievement.

Next steps

The next step would be to repeat the quantitative selection process on a larger scale, to obtain larger samples. Parents would be circulated with a survey style questionnaire, focusing on the issues of their own education and that of their family members, the levels of activity in their households, and the teacher and peer relations experienced by

their children. By working with this more tightly focused list of variables, it might be possible to demonstrate ways in which children can be helped to better achieve their potential in the specific area of mathematics.

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APPENDICES

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Appendix 1

Left Handedness, Learning Disorders and Allergies: Sampling and the GBG Hypothesis.

John Wilkin & Colin Terrell (1995)

Left Handedness, Learning Disorders and Allergies: Sampling and the GBG Hypothesis.

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Abstract

Geschwind and Behan (1982) reported an anomalous distribution of learning disorders and immune disorders among left handed subjects in London and right handed subjects in Glasgow. Attempts to replicate their work have met with mixed levels of success. Using a nation-wide population drawn from the NCDS study, we have shown that the distribution of allergic disorders is not the same across the two geographical regions sampled by Geschwind and Behan. There is a possibility, therefore, that their dyadic variations in health by handedness and health by learning disorders have been confounded with variations in health by region.

Introduction

During the course of an investigation into learning difficulties, using as background the National Child Development Survey (NCDS), variables relating to handedness and allergies were used as part of an evaluation of a report by Geschwind and Behan (1982) into associations between handedness, allergies and learning difficulties, and a subsequent series of related reports and critiques by other researchers over the past decade. The sampling techniques reported in the original studies by Geschwind and Behan (op. cit.) are open to criticism, and this may explain why difficulties have been experienced in replication studies.

Background

Geschwind and Behan (op. cit.) reported an elevated frequency of immune conditions and learning disorders (positive responses to questions relating to dyslexia and stuttering) among left-handed subjects. They proposed that their results may be explained by the effects of testosterone on neuronal and immune development in utero. In three further papers Geschwind and Galaburda (1985a 1985b 1985c) elaborated the biological mechanisms underlying neuronal development, and in particular cerebral dominance, into a theoretical model since known as the Geschwind-Behan-Galaburda (GBG) model.

For their studies, Geschwind and Behan developed a questionnaire which combined a modification of the Oldfield Handedness Inventory (Oldfield 1971) with the addition of a series of questions into personal and family history.

In the first part of the study they distributed 500 of these questionnaires in a shop in London which supplied items for use by left-handed people. From among the responses they selected 253 individuals who reported themselves to be entirely left handed. Questionnaires were also completed by convenience samples in Glasgow, i.e. participants in nurses' and teachers' conferences, civil service applicants and customers in a local shop, of which 253 were selected. These matched the London sample by age, sex and degree of left handedness. Frequency of immune conditions and learning difficulties were also self-reported.

In the second part of their study, conducted in Glasgow only, a further 247 entirely left handed individuals were selected, using the convenience sampling methods as before. Reported immune conditions, in contrast to the first part of the study, were included only if they had been diagnosed in a hospital. (The immune conditions reported were celiac disease, dermatomyositis, diabetes, Hashimoto's thyroiditis, myxedema, Crohn's disease, rheumatoid arthritis, thyrotoxicosis, ulcerative colitis and uveitis.)

In an unrelated second study, the same questionnaire was administered to 146 patients with migraine and 98 patients with myasthenia gravis, presenting and diagnosed in Glasgow's neurological clinics, and again to a group of 1,142 controls from the general population of Glasgow, convenience sampled as before. In this study extreme left handedness was not a selection criterion, but frequency comparisons were made between cases with three levels of left handedness, as reported in the modified Oldfield Inventory.

The authors reported that, in part one of the first study, the incidence of self-reported immune diseases in the London left handers was 27 (10.7%) compared with 10 (4.0%) in the Glasgow right handers, and that the incidence of self-reported learning disorders (dyslexia or stuttering) was 24 (9.5%) in London left handers compared with 2 (0.8%) in Glasgow right handers.

In part two of the first study, conducted in Glasgow only, the incidence of hospital diagnoses for immune conditions was 13 (5.3%) in left handers and 15 (2.3%) in right handers. The incidence of self-reported learning disorders was 27 (10.9%) in left handers and 8 (1.2%) in right handers.

In the second study, left handedness was found to be significantly more frequent among both migraine and MG patients than among the controls, but the elevation was not significant among those cases who were strongly left handed. Learning disorders were not assessed.

Satz and Soper (1986), in a critique of the Geschwind and Behan study, point out weaknesses in the methodology. They raise the question of bias in the left handed samples from the first study, and point out that all the variables are self-reported and unverified. Further, the second study, although addressing the problem of verification, was not comparable with the first study in terms of extreme left handedness.

Satz and Soper (op. cit.) quote Annett (1972) in pointing out that the incidence of extreme left handedness is rare in the normal population, being approximately 4%. It would be unlikely that a reliably large selection of extreme left handers could be observed in such a small sample as is used in this study. Nor did the second study address the incidence of learning disorders.

Pennington et al. (1987) studied 14 extended families with histories of dyslexia. From these families they selected 87 dyslexics and 86 non-dyslexics. They observed a significant association between immune conditions (such as those described by Geschwind and Behan) and dyslexia, but found no elevation of left handedness among dyslexics. At the same time they did observe, among dyslexics only, frequencies of allergic conditions such as hay fever and asthma that were significantly elevated above the population norms.

Since the 1982 paper a considerable number of studies have been undertaken in the hope of replicating the Geschwind and Behan results, with very little success. Bryden, McManus and Bulman-Fleming (1994) surveyed 26 such studies published between 1984 and 1993 looking for empirical evidence to support or otherwise the GBG hypothesis. In addition they performed a meta-analysis of all the reported data, and concluded that empirical evidence in favour of the hypothesis was signally lacking. Somewhat acerbically, they suggest that "psychologists and physicians have more useful things to do than carry out further assessments of the (GBG) model". They acknowledge, however, that in the absence of any stronger proposals that may drive it out, the GBG model remains popular by its attractiveness and breadth.

One of the major problems of investigating a triadic relationship such as that between left handedness, immune disorders and dyslexia is that all of the variables occur in only small percentages of the population. Even in a sample as large as 1,000, dyadic groups of positives are not likely to exceed 20, and may be as small as 5. χ^2 tests with such disparate cell sizes

are known to be unreliable (Stevens 1986). It has been suggested that a sample of at least 20,000 would be required to provide a reliable χ^2 analysis.

Among the studies evaluated by Bryden, McManus and Bulman-Fleming (op. cit.) only one was made of a population of a size anywhere near that quoted above. Bishop (1986) used the data from the NCDS study of 1969 (N = 17,000) to look for associations between handedness, allergies and cognitive status (gifted, normal or speech impaired) among all the 11 year olds born in one week of March, 1958. She acknowledged that the NCDS was inadequate for testing the GBG hypothesis, since specific immune disorders were seldom coded, but maintained that the data was adequate for testing the hypothesis of a link between allergies and handedness.

Bishop concluded that

"None of these diseases was significantly associated with left handedness in either sex Nor was there any support for the idea that left handedness is more frequent in gifted or speech disordered children, or for the idea of a link between allergy and giftedness."

There were, however, large discrepancies in cell sizes in Bishop's data, despite the large sample. In choosing a group for 'giftedness', for example, and then dividing it into sub-groups suffering from eczema, asthma, psoriasis, migraine and diabetes, Bishop found cell sizes of only 3, 3, 1, 0, 0 respectively. The 'speech disordered' group of children also had small cell sizes of 12, 4, 2, 0, 0. These figures are from a whole population sample of about 15,000, so that numbers in 'control' cells were disproportionately large. Cell sizes for varying degrees of non-right handedness among the 'gifted' children were also in single figures.

Nevertheless, so large a data-set as that available from the NCDS study may be particularly adequate for testing the GBG model by virtue of its geographic breadth. The cases consist of

17,000 people who were born in one week in 1958 in the three countries of England, Wales and Scotland. Data on their handedness and medical history were collected in a follow up study in 1969, when the children were aged 11. Case mortality and inefficient or omitted coding reduced case numbers to between 12,000 and 16,000, depending upon the variables to be studied.

Method

In this study of the NCDS data, approximately 12,000 cases were found with the following variables reported (among others):

Reported in	Handedness
parental interviews:	History of asthma or breathing problems
	History of hay fever
	History of eczema or like conditions
	History of migraine or headaches
Reported by doctors	History of asthma
	History of eczema or like conditions
	Handedness on square marking *
	Handedness on match sorting *
	<i>* These variables used by Bishop (1986)</i>
IQ tests conducted	Verbal
by schools	Non verbal
	Reading comprehension
	Arithmetic
Encoded in case numbers	Region of Great Britain in which birth took place

If Geschwind and Behan's results in their first study are to be considered reliable, at least one aspect of their sampling technique needs to be addressed. That is, how important is the geographical separation of the two groups, experimental and controls? To test this with the NCDS sample, the null hypothesis, therefore, was that the incidence of hypersensitive conditions and of learning disorders was uniform across Great Britain, and in particular between the regions of the north that surround Glasgow, and the region that comprises London and the Southeast. A sub-hypothesis was that any associations between handedness, hypersensitivity and learning disorders would be of similar strength in the different regions.

Region

A frequency breakdown of the variable 'place of birth' by region showed that the largest group came from London and the Southeast, and the smallest group from Scotland. Indeed, the number of births in Scotland during the week in question was only 569 and, at age eleven, the number of left-handed asthmatics, for instance, was only 2.

Glasgow, however, is in the south of Scotland, and adjacent geographically to areas in the north of England. Therefore, with reliability of subsequent analysis in mind, the regions of North England and North West England were amalgamated with Scotland to provide a sample size substantially the same as that of London and the South East of England.

Allergies

A comparison of the reported frequencies of hypersensitive disorders found that they tended to be more widely reported by the parents than by the doctors. Further, Bishop (op. cit.) showed that the doctors' reporting of left handedness using skill tasks (*see above) was variable, and so, for the purpose of consistency, this study has relied on parental reporting for both handedness and hypersensitivity.

Following the Geschwind and Behan (op. cit.) method of 'bundling' their immune disorders, this analysis did not identify separately cases reporting asthma, hay fever, eczema or migraine, but bundled together all those reporting one or more of the conditions.

Reading and Numeracy

Multiple linear regression was used on the IQ test data to identify cases whose residuals (the difference between the actual and predicted scores) on both reading and arithmetic tests were greater than +/- 1.5 standard deviations from the mean. The choice of this level of cut-off is discussed in Fletcher et al (1994) and in Lewis et al (1994).

Using these parameters it was possible to compare incidence of hypersensitivity, left handedness and learning disorder across regions, without running into the problem of single figure cells.

Results

At the single variable level the incidence of left handedness, hypersensitivity and learning disorders were compared across the two selected regional groups. For the purpose of brevity these two regional groups will be referred to as the North and London. Left handedness was found to be roughly the same in the North (11 %) as in London (12%). Incidence of allergic disorders was significantly higher ($p < .001$) in London (28%) than in the North (14%). There was no difference between the North and London in the incidence of reading disorder, but arithmetic disorder was significantly ($p < .001$) more prevalent in London (6.8%) than in the North (4.4%) (Table 1)

At the bivariate level, no association was found between handedness and reading disorder, neither at national nor at regional level. Nor was any association found between handedness and arithmetic disorder at any level.(Table 2)

Handedness and allergies were not found to be significantly associated over the population as a whole. The rate of allergic reaction in London (28%) was the same for both left and right handers. In the North, allergies were reported by 21% of left handers and by 24% of right handers, but this difference was not significant (Table 2).

	<u>LH</u>	<u>RH</u>		<u>Allergic</u>	<u>Not</u>	<u>N =</u>
<u>Scot and N'th</u>	356 (11%)	2891		***778 (24%)	2469	3247
<u>London and SE</u>	302 (12%)	2223		***723 (28%)	1802	2525
<u>Population</u>	1411 (11.6%)	10756		3204 (26%)	8963	12167

	<u>Read. Disord</u>	<u>Not</u>		<u>Arith. Disord</u>	<u>Not</u>	<u>N =</u>
<u>Scot and N'th</u>	162 (5%)	3085		***144 (4.4%)	3103	3247
<u>London and SE</u>	125 (5%)	2400		***173 (6.8%)	2352	2525
<u>Population</u>	677 (5.5%)	11490		720 (5.9%)	11447	12167

*** p < .001

Table 1 Distribution of Handedness, Allergies and Learning Disorders by Region

		<u>Allergic</u>	<u>Not</u>		<u>Read. Dis.</u>	<u>Not</u>		<u>Arith. Dis.</u>	<u>Not</u>	<u>N =</u>
<u>LH</u>	<u>Scot and N'th</u>	74 (21%)	282		16 (4.5%)	340		13 (3.6%)	343	3247
	<u>London and SE</u>	86 (28%)	216		18 (6%)	284		18 (6%)	284	2525
	<u>Population</u>	363 (26%)	1048		84 (6%)	1327		79 (5.6%)	1332	12167
<u>RH</u>	<u>Scot and N'th</u>	704 (25%)	2187		146 (5%)	2745		131 (4.5%)	2760	3247
	<u>London and SE</u>	637 (28%)	1586		107 (4.8%)	2116		155 (7%)	2068	2525
	<u>Population</u>	2841 (26%)	7915		593 (5.5%)	10163		641 (6%)	10115	12167

Table 2 Distribution of Allergies and Disorders by Handedness and by Region

Reading disorder and allergies were significantly associated in the population as a whole, although significance is more readily observable in large samples. In the regions, however, where numbers of allergic *and* reading disordered children are smaller (36 in London and 26 in the North) the association did not reach significance.

Arithmetic disorder and allergy were significantly associated in the regions ($p < .05$), despite the smaller numbers, as well as in the population as a whole ($p < .001$). (Table 3).

	Allergic	Not		Allergic	Not		N =
<u>Reading.</u> <u>Disabled</u>	26 (15%)	150	<u>Arithmetic</u> <u>Disabled.</u>	39 (24%)	123	Scot and N'th	4302
	36 (26%)	103		* 54 (27%)	147	London and SE	3445
	** 175 (24%)	566		*** 215 (26%)	597	Population Tot	16204

<u>Not</u> <u>Disabled.</u>	753 (18%)	3373	<u>Not</u> <u>Disabled.</u>	740 (18%)	3400	Scot and N'th	4302
	697 (21%)	2609		679 (21%)	2565	London and SE	3445
	3020 (20%)	12411		3012 (20%)	12380	Population Tot	16204

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 3 Distribution of Allergies among Learning Disordered by Region

Discussion

This study does not attempt to replicate either Geschwind and Behan (op. cit.) or Bishop (op. cit.), rather it attempts to present an evaluation of their methodologies. Where Geschwind and Behan bundled together a number of conditions under the heading "immune disorders" we have bundled together a number of allergic conditions that can be similarly described. Although Bishop relied upon medical opinion for variables to avoid the problem identified by Satz and Soper (op. cit.) of unverifiable self-reporting, the left handedness variables in the NCDS study are often contradictory, and could not be shown to be more reliable than the parent-reported variable. Arguing for consistency, therefore, we used the parental reports for both handedness and allergic variables. Identification of reading disorder and arithmetic disorder has been statistically transparent in our study, which used multiple linear regression on scores from five IQ tests administered across the population. Geschwind and Behan (op. cit.) relied upon self-reporting of dyslexia and stuttering, while Bishop (op. cit.) relied upon medical reporting of speech impairment.

Problems associated with small cell groupings were largely overcome in the design of this study, which sought to match cases by region, rather than by handedness, hypersensitivity or learning disorder.

No associations were found between handedness and allergies, between handedness and learning disorder, nor between allergies and reading disorder. A significant association was observed between allergies and arithmetic disorder (Wilkin and Terrell in preparation). When analysed by region, Londoners of both left and right handedness were found to be equally susceptible to allergies, and small differences in allergic reaction between left and right handers were not significant in the North

Our original null hypothesis, that the incidence of allergies is the same in the regions comprising London with the South East and the North of England with Scotland, cannot be sustained statistically, and is rejected. The sub hypothesis, that the strength of any associations between handedness, allergies and learning disorders is the same across the regions cannot be rejected, since only one association was found (between allergies and arithmetic disorder), and that was similar in both the North and London.

Conclusion

A significant difference was observed between regions in the incidence of allergies. In 1969, eleven year old children living in London and the South East were more likely to have suffered from allergic conditions than those living in Scotland and the North of England. For whatever reason, a sub-population from which Geschwind and Behan drew their small sample of left handers can be shown to have a different medical profile from the sample of right handers drawn from another sub-population. Although the bundles of conditions were different, the allergies of asthma, hay fever, eczema and migraine are also considered to be manifestations of immune disorder. Since the NCDS data appear to indicate that the

incidence of such conditions is variable between regions, and particularly the regions comprising Scotland with the North of England and London with the South East, there is a presumption that the incidence of Geschwind and Behan's conditions will also be variable across the two regional groupings. If this is the case, there is the distinct possibility that the first part of Geschwind and Behan's study was doing little more than measuring the relative health of the inhabitants of two geographically separated communities.

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Appendix 2

Regression Equations

Regression Equations (Chapter 3)

Regression analyses were conducted for boys and for girls, using the score on the Reading Comprehension (C) as the dependent variable, and again using the score on the Mathematics test (M) as the dependent variable. Scores on the Verbal (V) and Non-Verbal (NV) sub-tests were the other independent variables. Regression equations were obtained as follows:

$$\text{Boys predicted C} = 0.298519 \cdot V + 0.242997 \cdot M - 0.029709 \cdot NV + 6.371392$$

$$R^2 = 0.58839 \quad F = 0.2513 \quad p < 0.00005$$

$$\text{Boys predicted M} = 0.426928 \cdot V + 0.501352 \cdot C - 0.349500 \cdot NV - 7.510428$$

$$R^2 = 0.67003 \quad F = 0.5354 \quad p < 0.00005$$

$$\text{Girls predicted C} = 0.271629 \cdot V + 0.229927 \cdot M + 6.091592 \quad (\text{NV not sig.})$$

$$R^2 = 0.58637 \quad F = 0.3736 \quad p < 0.00005$$

$$\text{Girls predicted M} = 0.364001 \cdot V + 0.565581 \cdot C - 0.367730 \cdot NV - 8.955805$$

$$R^2 = 0.66997 \quad F = 0.3567 \quad p < 0.00005$$

Appendix 3

**CONTINGENCY TABLES
of**

**Significant differences in distribution of
experimental and control groups**

SAMPLES

B = boys (N: 5274) G = girls (N: 5271)

STUDY GROUPS

(each approximately 2.5% of each sample)

**LR = Low Reading HR = High Reading
LM = Low Maths HM = High Maths**

CG = COMPARISON GROUP

(approximately 95% of each sample)

(nnn) = variable number

Cell numbers are percentages

43		B	G	CG	LR	HR	ChiSq	df	p <
Mother's interest in child's education, as reported by teacher (child aged 7)	V. interested	B		42	41	58			
	Little interest	B		58	59	42	11.78	2	0.01
	V. interested		G	45	32	63			
	Little interest		G	55	68	37	18.49	2	0.0002
					LM	HM			
	V. interested	B		42	33	55			
	Little interest	B		58	67	45	9.97	2	0.01
	V. interested		G	45	34	55			
	Little interest		G	55	66	45	11.15	2	0.01

44		B	G	CG	LR	HR	ChiSq	df	p <
Father's interest in child's education, as reported by teacher (child aged 7)	V. interested	B		41	32	55			
	Little interest	B		59	68	45	7.78	2	0.03
	V. interested		G	44	30	58			
	Little interest		G	56	70	42	9.37	2	0.01
					LM	HM			
	V. interested	B		41	26	53			
	Little interest	B		59	74	47	10.73	2	0.005
	V. interested		G	44	40	58			
	Little interest		G	56	60	42	5.55	2	0.07

186		B	G	CG	LR	HR	ChiSq	df	p <
Mother reads books (or technical journals)	Regularly	B		35	37	50			
	Occasionally	B		22	22	20			
	Hardly ever	B		43	41	30	11.55	4	0.03
	Regularly		G	34	23	48			
	Occasionally		G	22	23	25			
	Hardly ever		G	44	54	27	16.99	4	0.002

187		B	G	CG	LR	HR	ChiSq	df	p <
Father reads books (or technical journals)	Regularly		G	51	38	58			
	Occasionally		G	21	15	20			
	Hardly ever		G	28	47	22	12.77	4	0.02

194		B	G	CG	LR	HR	ChiSq	df	p <
Father stayed on at school beyond statutory leaving age	Yes		G	25	16	34			
	No		G	75	84	66	7.35	2	0.05
					LM	HM			
	Yes		G	25	25	36			
	No		G	75	75	64	6.23	2	0.05

414		B	G	CG	LR	HR	ChiSq	df	p <
Skin abnormality at age 7 (Medical report)	Yes		G	21	33	27	8.76	2	0.02
	No		G	79	67	73			
					LM	HM	5.31	2	0.1
	No		G	21	12	20			
	No		G	79	88	80			

496		B	G	CG	LR	HR	ChiSq	df	p <
Mother's weight at birth of child	Over 9 stone	B		56	72	49	8.55	2	0.02
	under 9 stone	B		44	28	51			
					LM	HM	5.72	2	0.06
	Over 9 stone		G	56	68	54			
	under 9 stone		G	44	32	46			

502		B	G	CG	LM	HM	ChiSq	df	p <
Mother smoked while pregnant	Non-smoker	B		61	60	72	5.67	2	0.06
	Smoker	B		39	40	28			
	Non-smoker		G	59	62	70	5.63	2	0.06
	Smoker		G	41	38	30			

527		B	G	CG	LR	HR	ChiSq	df	p <
Length of first stage of labour	Up to 12 hrs	B		65	75	54	8.79	2	0.02
	Over 12 hrs	B		35	25	46			
	Up to 12 hrs		G	65	79	65	6.55	2	0.05
	Over 12 hrs		G	35	21	35			

532		B	G	CG	LR	HR	ChiSq	df	p <
Time elapsed since birth of previous child	Over 10 years		G	2	5	0	20.88	4	0.0005
	3 to 10 years		G	20	35	15			
	Under 3 years		G	78	60	85			

537		B	G	CG	LR	HR	ChiSq	df	p <
Mother stayed on at school beyond statutory leaving age	Yes	B		26	25	38	8.8	2	0.02
	No	B		74	75	62			
	Yes		G	26	19	32	4.35	2	N/S
	No		G	74	81	68			
					LM	HM	11.99	2	0.003
	Yes	B		26	20	39			
	No	B		74	80	61	5.57	2	0.07
	No		G	26	29	36			
	No		G	74	71	64			

553		B	G	CG	LR	HR	ChiSq	df	p <
Mother's age at birth of child	Under 27	B		47	45	30	15.31	2	0.0005
	Over 27	B		53	55	70			
	Under 27		G	46	63	33			
	Over 27		G	54	37	67			

932		B	G	CG	LR	HR	ChiSq	df	p <
Pupils' (aged 11) expectations of their future at age 16	Get a job	B		23	25	13	14.52	4	0.006
	F-time study	B		28	15	38			
	Don't know	B		49	60	49			
	Get a job		G	16	11	10			
	F-time study		G	31	18	50			
	Don't know		G	52	71	40			
					LM	HM	31.1	4	0.00001
	Get a job	B		23	15	18			
	F-time study	B		28	23	35			
	Don't know	B		49	62	47			
	Get a job		G	16	23	6			
	F-time study		G	31	20	37			
	Don't know		G	52	57	57	15.39	4	0.005

958		B	G	CG	LR	HR	ChiSq	df	p <
Pupils' (aged 11) expectations of their class of job at age 25	Class I & II	B		22	21	46	27.3	4	0.00002
	Class III	B		56	62	36			
	Class IV & V	B		22	17	18			
					LM	HM	8.35	4	0.08
	Class I & II	B		22	15	31			
	Class III	B		56	55	45			
	Class IV & V	B		22	30	24			

1117		B	G	CG	LR	HR	ChiSq	df	p <
Number of children living in the home (child aged 11)	One or two	B		41	33	60	19.94	4	0.0005
	Three	B		23	27	18			
	More	B		36	40	22			
	One or two		G	41	23	52	26.2	4	0.00005
	Three		G	23	24	28			
	More		G	36	53	20			

1118		B	G	CG	LR	HR	ChiSq	df	p <
Sibling status	First or sole	B		38	40	51	10.39	4	0.05
	Second	B		33	35	30			
	Other	B		29	25	19			

1120		B	G	CG	LR	HR	ChiSq	df	p <
Number of younger siblings	None or one	B		62	55	74			
	Other	B		38	45	26	8.87	2	0.02
	None or one		G	64	54	76			
	Other		G	36	46	24	11.98	2	0.003

1175		B	G	CG	LR	HR	ChiSq	df	p <
Father's Social Class (at Sweep 2)	Class I & II		G	24	16	30			
	Class III		G	57	57	56			
	Class IV & V		G	19	27	14	7.95	4	0.1
					LM	HM			
	Class I & II		G	24	30	39			
	Class III		G	57	48	49			
	Class IV & V		G	19	22	12	17.11	4	0.002

1305		B	G	CG	LR	HR	ChiSq	df	p <
Ever had asthma or bronchitis	Yes	B		14	24	17			
	No	B		86	76	83	4.9	2	0.1
					LM	HM			
	Yes	B		14	21	8			
	No	B		86	79	92	6.68	2	0.05

1342		B	G	CG	LR	HR	ChiSq	df	p <
Hay-fever in last 12 months	Yes	B		9	14	15			
	No	B		91	86	85	4.68	2	0.1
					LM	HM			
	Yes		G	7	14	7			
	No		G	93	86	93	6.79	2	0.05

1533		B	G	CG	LR	HR	ChiSq	df	p <
Skin abnormality at age 11 (Medical report)	Yes	B		29	17	27			
	no	B		71	83	73	4.84	2	0.1

1760		B	G	CG	LR	HR	ChiSq	df	p <
Pupil's motivation at age 16	High	B		33	25	50			
	Medium	B		36	50	42			
	Low	B		31	25	8	37.1	4	0.0001
					LM	HM			
	High		G	28	36	38			
	Medium		G	24	30	20			
	Low		G	48	34	42	12.04	4	0.02

2363		B	G	CG	LR	HR	ChiSq	df	p <
Are there elder brother type figures in the household?	No	B		56	43	72			
	Yes	B		44	57	28	16.1	2	0.0005

2365		B	G	CG	LR	HR	ChiSq	df	p <
Are there elder sister type figures in the household?	No	B		58	52	69			
	Yes	B		42	48	31	6.6	2	0.05
	No		G	59	46	55			
	Yes		G	41	54	45	5.66	2	0.06

2375		B	G	CG	LR	HR	ChiSq	df	p <
Status of male head of house	Nat/ Adopt	B		65	50	74			
	Other	B		35	50	26	9.61	2	0.01
					LM	HM			
	Nat/ Adopt	B		65	58	72			
	Other	B		35	42	28	5.05	2	0.08

Appendix 4

Interview Schedule

Interview Schedule

Section 1 Parent and family background

1.1 Tell me something about your own schooldays?

When you were at school, which subjects did you like the best?
Which subjects did you not get on with?
What was it about them that you liked/disliked?

1.2 At what age did you finish your schooling?

Probe for exams taken, further education, qualifications obtained,
career to date

1.3 How confident do you feel handling numbers today?

Probe for money handling, statistics interpretation

1.4 Can you tell me about your own family? Were you an only child?

Probe for place of birth

Probe for siblings, academic success, careers

Probe for nephews, nieces academic success

Probe for parents' occupations, academic success, careers, house moves,
where born

----- x -----

Section 2 Child's early development

Can we talk about (NAME'S) development from earliest days?

2.1 Is there anything special you can remember from when you were carrying (NAME)?

Probe for health status, weight, gap since last, smoking, post natal status,
weight changes.

2.2 When NAME was tiny, how did s/he get on with things like learning to crawl, sit up, stand up, walk, talk, draw and so on?

Probe for tying laces, knotting ties, any hearing or vision problems

2.3 Children love games, word games and number games. Can you remember any that NAME used to play?

Probe for nursery rhymes, counting games, car games

2.4 When did you come to live here? How did NAME settle down?

Probe for friendships, Individual and groups, Leader?

----- x -----

Section 3 Child’s present status

3.1 Where does s/he do the homework?

Probe for the accommn. available now and in previous homes?

Probe for facilities in room - TV, Radio, Video Computer, Games,
Educnl software, since early years?

3.2 Can you give me an idea of what books he has?

Probe for number of books now, use of library, early years books,
bedtime stories?

3.3 Has NAME spent HISHER own money on books?

Probe for presents (Xmas, birthdays etc.) Reward (special attainment,
academic achievement, history from early years)

3.4 Where would NAME usually read or study?

Probe for use of own room, family room, study room, with or without
competing attractions, with or without supervision

----- X -----

Section 4 Parents’ interaction with child’s education

4.1 How much homework has to be done?

4.2 How do you negotiate with NAME for time and place of homework?

4.3 How much can you keep an eye on what s/he is doing?

Probe for monitoring, supervision, book review, adult presence.

4.4 Does s/he often ask for help?

Probe for assistance, initiative.

4.5 Do you feel able to help in maths homework?

Probe if not, how do you explain this to HIMHER

4.6 Are you happy with the school?

Probe for understanding school processes, discipline, academic standards,
pastoral care

4.7 How often do you go to the school?

Probe for parents evenings, concerts, PTA, open days, fetes, sports days

Probe for additional contacts, parent initiated, school initiated and why

4.8 How much use is all this education?

Probe for attitude to maths as well as education in general

----- X -----

Section 5 Present family environment

5.1 Can you give me brief idea of what you do at work?

Probe for how much maths involved

5.2 Do you discuss your work with NAME?

Probe for case's knowledge of parent's doings, visits to parent's workplace

5.3 What are you most likely to read at home?

Probe for how much, how often, whether in private or visible

5.4 What sort of things get discussed as a family?

Probe for sport, politics, money, books, ethics, decision making.
How often?

5.5 What sort of leisure activities do people get involved in?

Probe for interest in art, sport, music, literature, politics etc., whether independently or en famille

Probe for involvement of NAME in these interests or activities, and of siblings

5.6 Have your interests changed over the years?

Probe for inherited attitudes, in both directions

----- x -----

Section 6 Child's present profile

6.1 Does NAME need to be pushed to make progress?

Probe for press to achieve, which areas need pressure and which don't

6.2 Could you give me some idea how NAME feels about school?

Probe for enthusiasms

6.3 How well is NAME getting on at school?

Probe What do the school reports say? main subjects (Have a look)

6.4 How does NAME get on with the teachers?

Probe for relations with specific subject teachers

6.5 How did s/he get on at Primary school?

Probe for relations with teachers, areas of difficulty, special needs

6.6 Would you say that NAME is happy at school?

Probe for friendships, peer groupings, bullying, sporting activities

6.7 How does NAME get on with HISHER brothers and sisters?

Probe for general relations, specific relations

6.8 What would you like to see NAME do in the future.

Probe for gender attitudes, stereotypes, concrete ideas, vague comments

6.9 What would you say are NAME's strengths?

Probe for specific skills, generic skills, weaknesses

Appendix 5

Interview Measures

Case Identity

Interview Date

Background

Tick
Box

[Ma Pa]

Comments

101	Parent's Birthplace	England			
		Other			
102	Parent's Schooling	Stayed on			
		Left			
103	Parents' Career	Mgmt/Profn			
		Other			
104	Male Head Status	Nat/ Adopt			
		Other			
105	Wider family Education	Pos. Academic			
		Other			
106	Pregnancy	Anomalous			
		Normal			
107	Gap since last child	< 3 years			
		> 3 years			
108	Smoking while pregnant	Yes			
		No			
109	Smoking now	Yes			
		No			
110	Weight now	Normal			
		Obese			
111	Child's Health & Development	Normal			
		Anomalous			

Support

		Tick Box			[Ma Pa]		Comments
201	Number toys/ games as child	Yes					
		No					
202	Computers (early)	Provision					
		None					
203	Books (early)	Few/none					
		Yes					
		Lots					
204	Learning Environment	Family Room					
		Bedroom					
		Study/Dining room					
205	Reward	Systematic					
		Sporadic/none					
206	Parents' inter- action with school	Parents' eve's					
		do + social, PTA etc.					
		do do + additional					
207	Parent's attitudes to education	Positive					
		Half-hearted/ Negative					
208	Parent's attitudes to mathematics	Positive					
		Half-hearted/ Negative					

Supervision of Homework etc.

		Tick Box	[Ma Pa]	Comments
310	Time management	Negotiated		
		Laissez Faire		
302	Oversight	Regular		
		Occasional/none		
303	Review of books	Regular		
		Occasional/none		
304	Involvement in homework	Frequent		
		Occasional		
		None		
305	Regulation	Priority overall		
		Negotiated		

Example

		Tick Box	[Ma Pa]		Comments
401	Parent's Occupation	Mgt/Prof			
		Other			
402	Parent's reading habits	Reads regularly			
		Other			
403	Family Discussions	Regularly			
		Occasional/None			
404	Leisure Interaction (groups)	Yes			
		No			

Outcome

		Tick Box	[Ma Pa]	Comments
501	Motivation	High		
		Moderate/Low		
502	Enthusiasm	High		
		Moderate/Low		
503	Academic success	High		
		Moderate/Low		
504	Relations with teachers	Excellent		
		Moderate/Low		
505	Relations with peers	Excellent		
		Moderate/Low		
506	Relations with siblings	All good		
		One only		
		Poor		
507	Parent's aspirations for child	High (Univ. etc.)		
		FE/Trade etc.		
		Just be happy		
508	Skills	Polymath		
		Some		
		Few		

Appendix 6

Wilkin J (1997)

Using a Computer for Qualitative Analysis.

**In M. Saunders, P. Lewis and A. Thornhill, *Research
Methods for Business Students.***

London: Pitman.

12.8 USING A COMPUTER FOR QUALITATIVE ANALYSIS

Computer software performs four basic and useful functions. These help you in your role as a qualitative analyst by acting as an aid to:

- project management;
- coding and retrieval;
- data management;
- hypothesis building and theorising.

What programmes do, and do very well, is file, retrieve, cut and paste, and display your data in useful and helpful ways. The fact that they do all this very quickly means that you, the researcher, have more time to think about linkages and their meaning. The qualitative analysis programme is a tool, rather like a washing machine. It performs tedious and time consuming operations, thus releasing you and your brain for creative thinking and the generation of ideas.

Software as an aid to project management

The four basic operations of managing qualitative data are file, retrieve, cut and paste. Your data, whether in the form of text, or other non-textual 'documents' (such as video tapes, audio tapes, photographs etc.) need to be organised in such a way that access to them is both quick and accurate. In so doing, a good qualitative analysis programme will display an index of documents, with facilities to select and retrieve individual documents. On-line documents (i.e. text based in a format accessible to the programme) can be displayed in full, and chunks of text can be selected, for operations such as editing, indexing (coding) or note making (memos), simply by highlighting, and without affecting the primary document.

Perhaps one of the most powerful tools in a qualitative analysis programme is the ability swiftly to search any number of documents for specified words, phrases or codes. Such a process would, if undertaken manually, require the reading through of each document - a burdensome process if there are many documents in the project.

Furthermore, the ability to use the programme to cluster together the units of text containing the words you select, and to display the cluster in a window together with reference to primary documents, replaces the tedious and expensive process of multiple photo-copying, slicing copies into dozens of little paper slips and annotating each one before sticking them on to data cards and filing them in piles, or sticking them in appropriate places on a vast 'clipboard'. This process can be undertaken without any damage to your primary data, which are still held in the original documents.

Software as an aid to retrieval and coding

If all your data are word processed, or in some other computer readable form, it will be possible for your primary documents to be accessed 'on-line', that is the programme can search the text itself and allocate codes to specified units of text. The more powerful programmes such as ATLAS/*ti* and NUD.IST can display the documents on screen in your chosen format.

The identification of text units is usually by line number, although more powerful software such as ATLAS/*ti* and NUD.IST offer the facility of choosing the most appropriate size of text unit for your type of data (e.g. sentence, paragraph, utterance)(12.3) simply by highlighting the appropriate section of text in the document window.

Data are encoded by selecting a unit of text, and directing it either to a new or to an existing code 'address'. A text unit may be directed to any number of code addresses. For example, the text unit: "... and I wouldn't dream of changing doctors, because I wouldn't have confidence in the youngster he has just taken on as partner." could be encoded under 'attitudes to change', 'trust', 'health', 'older respondents' etc. In order that categories (or codes) in a hierarchical system can be readily traced by their location in the hierarchy, they may also be allocated a code number. (see Figure).

Some programmes offer an 'off-line' facility with which you can encode data such as video tapes, audio tapes, maps, photographs, or archive texts.

Software as an aid to data management

As your project progresses your programme, like a snowball, will quickly gather more and more data. This needs to be managed in such a way that it can readily

be accessed and reviewed. You will have primary data, index codes and memos. The qualitative analysis programme will retrieve and display all or any of these individually, in specified groups or clusters, and will indicate cross references or links between them. Some more powerful software, such as ATLAS/*ti* will incorporate a linked window system whereby the selection of a unit of text from the primary document results in the automatic display of its code, any memos associated with it, and the text of cross references from other primary documents. 'System closure' should also be available, whereby your notes and memos are themselves open to the same search and retrieve procedures as the primary documents.

Software as an aid to hypothesis building and testing

The foundation of hypothesis building lies in discovering links between elements of your data. The development of a theory is then the process of making sense of these links. Only you can do the latter, but the qualitative analysis programme can help you to discover the links and, with graphic facilities, can display them for you. Two basic ways of organising and linking your data are available:

- Hierarchical organisation, where your data may be classified in a few broad themes, then each theme classified into a number of sub-categories, and each of these into sub-sub-categories, and so on. (see Figure 12.1 For example, you may classify your data under the broad themes of 'Values(1)', 'Concepts(2)' and 'Strategies(3)'. Upon reviewing all the data under 'Strategies(3)', you may wish to divide them into 'Mature(3,1)' and 'Immature(3,2)', or 'Long term(3,3)' and 'Short term(3,4)'. Your 'Values(1)' theme may fall naturally into, say, 'Internal(1,1)' and 'External(1,2)', and then you may identify several sub-categories such as 'Duty(1,2,1)', 'Trust(1,1,1)' and 'Liking(1,1,2)' (see Fig. 1). An alternative approach is to code each section of data as you work through it, and then, later on, discover ways of gathering together like categories that can be grouped together under common headings, which can in turn be grouped together in broad themes, and so on. For example, in the case above you might identify the concepts of 'Duty', 'Trust' and 'Liking' from your reading of the data, and then decide to group all these under a common heading of 'Values'. Later you may wish to have distinct sub-headings under 'Values' which you call 'Internal' and 'External', allocating to them your original categories accordingly. NUD.IST, ATLAS/*ti* and INSPIRATION, for instance, all offer this style of organisation.

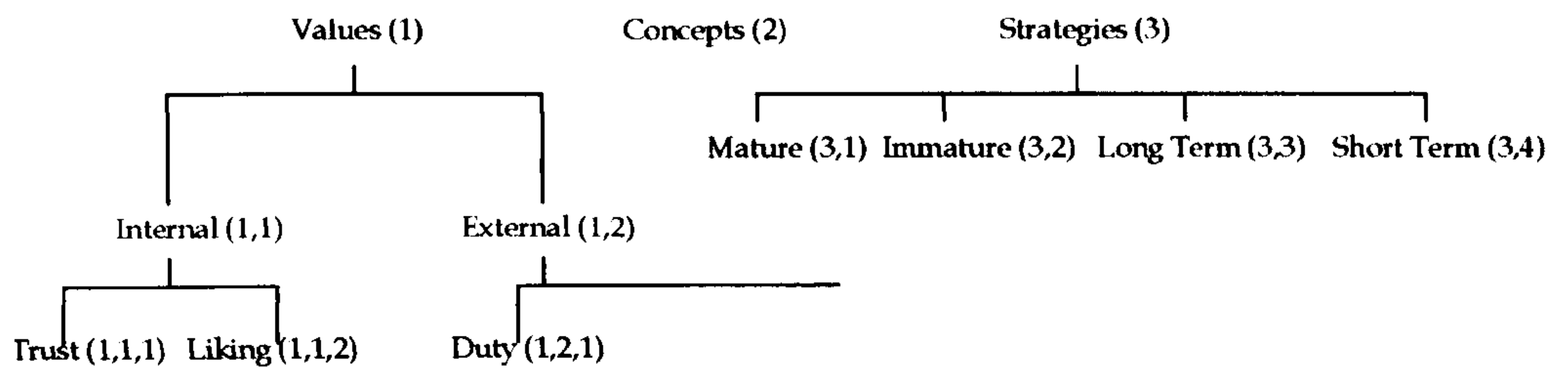


Figure 12.1 Specimen hierarchy of themes, categories and sub-categories

- Network Organisation where your categories may be more flexibly linked to one another, without the rigidity implicit in the hierarchical structure. In particular, the ability to represent your project in graphical form can be a very powerful aid to theory building, and INSPIRATION offers an extremely varied network facility, with publishable quality printing. ATLAS/ti has, in addition, a library of code and linkage icons, so that you can see at a glance the nature of the relationships between categories (e.g.

"is the cause of"
 "contradicts"
 "justifies"
 "explains" etc.)

Networks can be re-arranged in whatever way suits the developing project, simply by 'click-and-drag' on the elements of the network. INSPIRATION and ATLAS/ti offer both networks and hierarchies, with tools for automatically moving between them.

Choosing appropriate software

Weitzman and Miles (1995) review over twenty programmes, from straightforward text retrievers and managers, through to conceptual network builders, and you are advised to consult this review. Your choice of software will be dictated by the following factors:

- cost,
- type of data,
- your own preferred style of analysis.

It is worth trying some of them out before you commit your entire project. A search of the Internet will uncover opportunities to obtain public domain demos for quite a few of these programmes, including NUD.IST, ATLAS/ti, and INSPIRATION.

Check with the I.T. Managers at your university to discover which software is already available on site, and test it out. Some institutions offer introductory courses, often presented by the authors of the programmes, which you could attend, although there is usually a fee to be paid.

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Appendix 7

Letters

to

Parents

**Specimen letter to parents, requesting their participation,
together with pre-printed response slip**

College Logo and Address

[Case Number]

Date

Dear [Parents' Name],

[Head teacher's Name] has kindly allowed me to send a letter home with [Child's Name] to ask if you would be prepared to help in connection with research that I am doing here at the [Name] College. My research is looking at the ways in which children learn mathematical skills, and I am working with a number of secondary schools in the county.

At the present stage of the work, I need to talk to parents about their attitudes/opinions on mathematics and education in general. The school is fully aware of the nature of the research, and is supportive. However, as is the case with all research of this nature, anything that you say to me will be completely confidential.

Would you be prepared to take part in the project by talking to me for about 30 to 40 minutes, either at some time during the next two weeks, or early in the New Year? I should be quite happy to visit you at home. If that is most convenient. Your views of and insights into your own and your children's education are of enormous value in helping schools and teachers plan how best to manage the curriculum in future years. A great amount of similar work has been done in connection with parents' views on their children's reading, but very little has been done in connection with parents' views of mathematical education, and it is obviously important that this should be done.

Your contribution would be of great help.

If you are willing to take part in the project, will you please **complete and return the attached slip in the stamped, addressed envelope**, and I shall contact you again to arrange a time and place.

I look forward to hearing from you.

With kind regards,

Yours sincerely

John Wilkin

[Case Number]

[College Address
for response]

Dear Mr. Wilkin,

We shall be glad to take part in your project.

Signature

{please write your address and telephone number here before
returning the slip.}

..... Tel

..... Best time for me to ring

.....

Appendix 8

Mothers' Pregnancy-free Interval

and

Childrens' Health Record

Pregnancy free Interval

Four of the study children were firstborn, Ben, Nikki, Theresa and Timothy. According to parents reports, Anne and Lucy were born four years after their elder siblings, and the remaining thirteen children were born between two and three years after their elder siblings.

Normal Pregnancies and Post-natal Development

Fourteen normal pregnancies and deliveries, with no subsequent health anomalies were reported. Anne's and Luke's mothers reported continuous nausea throughout their pregnancies, but otherwise their pregnancies and births were normal.

Of the sixteen study children whose mothers reported normal deliveries, Melanie did not thrive, and caused great anxiety during her first year, Alan has been totally deaf in one ear since birth and Wayne developed cross-laterality.

Anomalous Pregnancies and Post-natal Development

Three mothers reported anomalous pregnancies: Nikki's mother suffered from toxemia, followed by a six-week premature delivery; Wilma's mother reported that both her children were delivered by Caesarean section; and Ben's mother was a late prima gravida, and he was delivered with forceps and suction, whilst sustaining some skull damage. The three children involved in anomalous delivery were all reported to have suffered from hearing problems into their early school years. In addition, Ben was described as a difficult baby, who had to be carried around by his mother continuously for his first year, Wilma's mother spoke of digestive problems and allergies, and Nikki developed as left handed. Both Nikki's and Wilma's mothers admitted to smoking during pregnancy.

In summary, the distribution of aural problems and minority laterality showed no association with the groupings for mathematical achievement. Nor was there any association between mathematical achievement grouping and mothers’ experiences of pregnancies and delivery (see Table 19).

Maths Level	Aural Problem	Cross Lateral/ Left Handed	First Born	Pregnancy Free Interval 2/3 years	Pregnancy Free Interval 4+ years	Normal Pregnancy /Delivery	Anomalous Pregnancy/ Delivery
High	2	0	1	5	1	6	1
Mid	1	1	1	4	1	5	1
Low	1	1	2	4	0	5	1

Table 19 Mathematical Achievement Groups by Pregnancy and Development