Abstract

This paper makes use of the substantial information about the psychological and behavioural development of children by age ten in the 1970 Cohort to predict later, economic outcomes, namely qualifications, employment and earnings. It is found that this previously unobserved individual heterogeneity has very substantial implications for the labour market. The returns to education are not significantly reduced by this omission bias but there is evidence of substantial returns to the production of non-academic ability. The paper also finds that different age ten abilities and attributes have implications for different adult outcomes so that human capital production should not be considered by economists as a simple one-dimensional process. Age ten conduct disorder predicts male adult unemployment particularly well but it is self-esteem that predicts male earnings. For women the locus of control variable is particularly important. Finally, whereas age ten maths ability is a good predictor of subsequent educational development for children from high SES families, reading is the stronger predictor for children from low SES groups. The implications of these results for education are developed. Parental attitudes are much more important than raw indices of social class for the explanation of the age ten scores. Schooling curriculum may be important.

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The Relative Economic Importance of Academic, Psychological and Behavioural Attributes Developed in Childhood

Leon Feinstein

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Leon Feinstein is a Lecturer at Sussex University and an Associate of the Centre for Economic Performance, London School of Economics.

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It is well known that the observed academic ability of school children is associated with subsequent earnings even conditioning for qualifications obtained. It is also established that omission of ability leads to over-estimates of the return to schooling or qualifications. Only recently, however, have economists begun to address the importance of what has been called "psychological capital" for productivity and hence wages and this research is still at a very early stage. There has as yet been no longitudinal investigation of the relative importance of the academic and non-academic abilities developed in childhood for subsequent economic outcomes including wages.

This paper considers a wide range of assessments of the abilities that children have already developed by age ten and uses a sequential analysis to consider the importance these different aspects of age ten ability have for subsequent development and economic success. The social class a child is born into has a strong bearing on how well he or she performs at school, qualifications attained and subsequent productivity and earnings[1]. The paper explores how the development of children by ten influences subsequent educational and economic progress differently for children from different social backgrounds. This wider set of abilities and attributes, therefore, also enables an assessment of the role of the wider range of childhood attributes and skills as channels for intergenerational transmission of education and earnings. By showing that measures of psychological and behavioural attributes provide important signals about future economic outcomes, the paper suggests that schooling should not be too narrowly assessed. The paper also makes use of the age ten scores to show how different are the processes of human capital development and the determinants of individual productivity in work.

The data come from the 1970 British Cohort Study (BCS). This is a longitudinal study of all the children born in the UK in the first week of April 1970 and surveyed again in 1975, 1980, 1986, 1991 and 1996. Particular use is made of the 1980 Child Health and Education Study (CHES) and 1996 sweeps. At age ten, under the supervision of the Department of Child Health at Bristol University, the children were tested for standard maths and reading ability but also for the psychological attributes of self-esteem and locus of control described below and for the behavioural attributes of conduct disorder, peer relations, attentiveness and extraversion. Age twenty-six information is then available on highest qualification attained, earnings and periods of unemployment.

The first section describes the methodology and data. The second considers the importance of age ten attributes and abilities for subsequent educational progress, the third for labour market outcomes. Having then established their importance, the fourth section considers the production of the age ten abilities themselves and concludes.

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[1] See Coleman *et al*, 1966, for an influential early study that effectively dis-regarded the contributions of schools or Plowden, 1967, for the major investigation in the UK context. Some recent studies and reports such as those of Krueger, 1998, OFSTED, 1998, or the National Commission on Education, 1995, have re-emphasised the importance of schooling while still accepting that parenting and background is important context.

1. Data and Methodology

1.1 Estimation methodology

This paper undertakes a sequential analysis of the development of the 1970 cohort. The age ten scores discussed below are used to predict subsequent educational and economic outcomes. Step-wise regression analysis assesses the size and significance of age ten intellectual and psychological parameters vis-a-vis each other and relative to standard indices of family background. We show that different psychological scores predict different aspects of economic success or failure. In other words, there is not one single measure of age ten success that predicts all aspects of adult performance, rather that different aspects of development have importance for different facets of adult, economic life.

The established explanations for the strong association between educational ability and social class range through cultural, genetic and financial causes. Cultural explanations have focussed on variations in family human capital and associated methods of child-rearing or psychological interactions between mother and child (see, for example, Bowlby, 1953, Mortimore and Blackstone, 1980, or Bee, 1969). Genetic explanations associate the social class of parents with their genetic endowments to children (for example, Wilson, 1977). Financial explanations such as those of Becker, 1967, make the assumption that children from poorer families have less easy access to finance and so higher marginal costs of education after minimum leaving age. This affects their motivation at earlier stages and presumably might interact with the cultural forces already mentioned in that a high opportunity cost of education might lead to a low valuation of education within the cultural sphere of the family and wider community. Thus, it is possible that pro and anti-education cultures could grow up on the basis of, perhaps, false or out-dated evaluations of the return to education. In any case, it is clear that there might be more than one channel for the perpetuation of inter-generational educational inequality.

The second empirical section looks at labour market outcomes, in particular unemployment probabilities and earnings. We show that productivity is less influenced by family background than is educational progress but that age ten psychological attributes are, in fact, more important.

1.2 The psychological and academic test scores

There has been substantial scepticism about the use of subjective data in economics. Goldsmith *et al*, 1997, ascribe this to doubts about valid measurement or interpersonal comparison and to a lack of familiarity with psychological testing. However, psychologists are less cautious about such testing and have established strong links between psychological test scores and subsequent outcomes such as schooling achievements (Purkey, 1970, Thomas, 1973, Keltikangas-Jarvinen, 1992), criminality (McKinney *et al*, 1978) or psychiatric disorders (Rutter *et al*, 1970). The causal relations, however, are unclear and may remain so. As the psychiatrist Rutter, 1970, puts it in the context of a relation between his score for anti-social behaviour and subsequent educational failure, both may be a response to similar, unidentified, underlying deviance. There is also, clearly, two-way causality between educational ability and psychological attributes such as self-esteem, the development of each facilitating the development of the other. Nonetheless, if the psychological test scores do predict subsequent outcomes, economists should test their implications for economic outcomes, especially considering the economic importance that may be attached to the traits one is hoping to

measure. The first objective must be to test whether the scores carry information about labour market outcomes or not. If the psychological scores are not genuinely measuring the conceptual ability for which psychologists have developed them, it then remains for critics to explain what is actually being identified. This paper is concerned to establish their predictive power and so enables an initial assessment of the degree of previously omitted individual heterogeneity.

It is important, however, to be as clear as possible about what is being tested and there are a number of guidelines that have been established in the psychological literature. Test scores should satisfy four particular requirements. Firstly, scores from any given test for a particular psychological attribute must give similar results to other tests for that attribute (convergence). Responses to individual items within the test must be highly correlated (reliability). There is a third requirement of good discrimination between children. Finally, there is the requirement of re-test stability. These requirements are met by the psychological tests developed by the CHES[2]. Summary statistics for the tests are given in Table 1.

Table 1. Age ten abilities and attributes

Variable	Obs	Mean	Sd	Min	Max	pc:20	pc:80	20/80 range
Academic scores								
Maths	11719	0	1	-3.43	2.22	-0.81	0.87	1.67
Reading	12790	0	1	-2.91	1.92	-0.98	0.95	1.93
Psychological scores								
Locus of control (CAROLOC)	12444	0	1	-2.64	2.72	-0.97	1.05	2.01
Self-esteem (LAWSEQ)	12519	0	1	-2.93	1.87	-0.93	1.07	2.00
Behavioural scores								
Anti-social behaviour (RUTTER)	12757	0	1	-1.51	4.39	-0.81	0.69	1.50
Peer relations	12757	0	1	-3.45	2.02	-0.83	0.92	1.74
Attentiveness	12757	0	1	-2.93	1.78	-0.95	0.96	1.91
Extraversion	12757	0	1	-3.07	2.11	-0.85	0.91	1.76

Notes: The final two columns of Table 1 show the 20^{th} and 80^{th} percentiles of distributions. The 20/80 range is used in the analysis, below, to assess relative magnitudes of test score associations.

The use of academic ability scores has a strong history in economics so little more need be added here. The maths test was created by the Department of Child Health, Bristol University who supervised the surveys in 1975 and 1980. The reading test is the Edinburgh Reading Test. Both show good properties of discrimination without censoring although there is some bunching at zero for the maths score.

1.2.1 Psychological capital; self-esteem and the locus of control

The CAROLOC score for the locus of control (Gammage, 1975) and the LAWSEQ self-esteem score (Lawrence, 1973, 1978) are based on childrens' responses. Both scores satisfy the requirements of re-test stability, reliability, discrimination and convergence to similar test frameworks[3].

[2] See Butler *et al*, 1982.

[3] The LAWSEQ score has been shown to have a four month re-test corelation of 0.64 and a high correlation with the Coopersmith Self-esteem inventory (r=0.73). See Hart, 1985, for these and other tests of the performance of the LAWSEQ scale. The Caraloc test of the CHES closely mirrors the locus of control test of Nowicki and Strickland, 1973. It was initially piloted on 800 children and tested for reliability, uniqueness and discrimination.

Self-esteem can be regarded as a fairly well-established notion (at least outside the psychological literature where it is more problematic). Lawrence, 1981, who developed the test used here, has defined self-esteem as "the child's affective evaluation of the sum total of his or her characteristics both mental and physical." Brockner, 1988, reports that managers perceive workers with high self-esteem to have higher productivity in work as a result of using time more effectively, requiring less guidance and considering a wider range of solutions to problems. Self-esteem should, therefore, increase wages directly. It might also lead to a higher probability of employment if job searchers are more confident in interviews.

The locus of control is, perhaps, a more vague notion referring to an individual's sense of control of their own destiny. Rotter, 1954, isolates four aspects of this sense of self. Individuals with a high locus of control are better able to process information from the outside world, are concerned to improve both their circumstances and themselves and, finally, are more stable in response to external influences. It might be expected that such individuals will make better decisions about educational and career choices and have a higher degree of patience.

In a rare paper considering psychological capital in the field of economics, Goldsmith *et al*, 1997, observe self-esteem concurrently with wages at two dates, using the NSLY. They estimate both simultaneously using the locus of control score as an instrument for self-esteem in the wage equation. This approach has the virtue of recognising the reverse causality between earnings and self-esteem but relies on a fairly dubious exclusion restriction. The required assumption described by Goldsmith *et al* is that self-esteem is the more unstable of the two aspects of the individual's psychology and that the locus of control is well-established by adulthood, unlikely to change but a good predictor of the more time-variant variable, self-esteem. Although Goldsmith *et al* refer to psychologists to support this assertion it is equally possible to find psychologists who would resist it[4]. Goldsmith *et al* follow Rosenberg, 1965, who treats self-esteem as a relatively unstable feature of personality rather than a permanent trait. However, Coopersmith, 1967, views self-esteem as fairly stable after an individual is seven to ten years old. Damon and Hart, 1982, suggest that locus of control will influence choices (and hence earnings) not solely through self-esteem but also directly. Shavelson and March, 1986, discuss the difficulties of distinguishing the two notions empirically.

Rather than making strong psychological identification assumptions, this study will investigate the relative predictive power of the two test scores. Although they are clearly related, Gamage, 1982, who developed the score used here, is strongly resistant to the idea of equating self-esteem and locus of control. Goldsmith *et al* make the strong assumption that whereas self-esteem is fairly changeable, locus of control is time-invariant and unaffected by earnings later in life. This exclusion restriction is rejected by the data presented here. In fact, this study finds that the two variables have different predictive properties for different variables of interest and for different groups of the sample. A further advantage of the current study is that we test the relative influence of these psychological variables on education decisions and success and unemployment as well as on earnings.

1.2.2 Behavioural scores; anti-social behaviour, peer relations, attentiveness and extraversion

The Rutter score for anti-social behaviour (Rutter, 1967) is based on the responses of class teachers to questions about conduct disorder such as whether children bully, tease or quarrel

[4] It is surely not more surprising that the nature and measurement of the self is a problematic research issue for psychologists than, say, the relationship between macro- and micro-economics is not yet sewn up for economists.

with other children. It has been found to predict ratings based on a standard psychiatric assessment and children with a high score have been found to be at risk of psychiatric deviancy[5]. The other behavioural scores are also based on teachers' responses, hypothesised by CHES to indicate aspects of behaviour, taken from particular items of the behaviour scales developed by Rutter, 1967, and Conners, 1969. Each score is the standardised result of principal components analysis conducted on individual items, described in more detail in Osborn & Milbank, 1987.

As stated above, anti-social behavior may be both the result and the cause of educational failure. The interest here, however, is particularly in how age ten social/anti-social behaviour predicts employment outcomes. Are children who are well behaved more likely to find work, either through increased desire to do so or better social skills? It may be that some underlying psychological issue is the root cause of behaviour and employability but a positive correlation between them would clearly signal the economic importance of assessing and confronting childhood behavioural problems. In fact, some work in the psychiatric and sociological literature has already concluded that conduct disorder is likely to predict problems in entry to the labour market, seen as a crucial threshold in adolescent development (Caspi *et al*, 1998, Sanford *et al*, 1993). However, such studies have not considered wages and do not have the range of scores available in these data[6].

The peer relations and extraversion scores are interesting because of recent concern by Human Resources consultants about the importance of "key skills" in the workplace. The importance of good communication and the ability to work in teams is being increasingly recognised (e.g. CBI, 1995, DfEE and Cabinet Office, 1996.) In a hedonic wage equation, Green, 1998, finds an 8% wage return to verbal skills for women but only 3% for men. However, these figures were based on self-reported skills, given contemporaneously to earnings so that, although the analysis suggests that the market appears to value good communication skills and team-working, it cannot discriminate between genuine skill and the self-esteem that is assessed in the BCS data and might lead both to higher wages and higher self-assessments of skill. Moreover, the data does not control for the background of employees. Clearly, therefore, further studies are required to build on this work.

Attentiveness is obviously important for the development of human capital but it may also be that children who do not intend to stay at school or do not have high expectations of success are already beginning to pay less attention by age ten. The attentiveness variable might have implications, therefore, not just for educational development but also as a proxy for the student's interest in education.

Table 2. Correlation coefficients amongst age 10 attribute variables and regression on occupational classification of fathers

	Maths	Reading	Locus of C	Self-esteem	Anti-social	Peers	Attentive	Extravert
Maths	1.00							
Reading	0.74	1.00						
Locus of C	0.40	0.41	1.00					
Self-esteem	0.20	0.19	0.44	1.00				

[5] It has also been found to have a re-test reliability over a two-month interval with a product-moment correlation, +0.89 and a reliability for re-testing by a different set of teachers after two months with correlation, 0.72, see Rutter, 1967.

[6] My thanks are due to Barbara Maugham of the Institute of Psychiatry for introducing me to this literature.

Anti-social	-0.20	-0.23	-0.11	-0.14	1.00			
Peers	0.23	0.24	0.19	0.20	-0.39	1.00		
Attentive	0.50	0.54	0.31	0.20	-0.55	0.48	1.00	
Extravert	0.09	0.10	0.10	0.05	0.19	0.42	0.10	1.00

	Est.	t-	Est.	t-	Est.	t-	Est.	t-	Est.	t-	Est.	t-	Est.	t-	Est.	t-
SES1	99.8	21.8	100.8	23.1	64.8	14.2	38.1	8.3	-40.2	8.8	34.1	7.4	68.9	15.2	16.9	3.7
SES2	68.6	20.5	70.7	22.0	45.7	13.6	30.8	9.1	-27.2	8.1	27.1	8.1	45.3	13.7	19.4	5.8
SES3nm	62.7	15.1	63.6	16.1	38.5	9.3	19.3	4.6	-26.8	6.5	23.2	5.6	44.1	10.8	9.4	2.3
SES3m	19.6	6.5	19.4	6.7	12.3	4.1	7.8	2.6	-14.8	4.9	13.2	4.3	15.3	5.1	4.6	1.5
SES4	5.8	1.6	7.9	2.2	4.9	1.3	5.4	1.4	-9.1	2.4	2.4	0.6	11.1	3.0	1.7	0.4

Table 2 shows that the maths and reading scores are strongly correlated. Attentiveness and locus of control are also well correlated with the academic scores. There is less association of self-esteem or anti-social behaviour with age ten academic ability: although the correlations take the sign one would expect, the coefficients are not large in magnitude. Children with good peer relations also tend to be slightly better at maths and reading, as are extrovert children although, again, correlation coefficients are not large.

Self-esteem is moderately correlated with locus of control but not particularly with the other behaviour scores. Extrovert children are considered by teachers to have better peer relations but, although the peer relations and attentiveness scores are quite strongly positively correlated, extraversion and attentiveness are not. This suggests, as CHES hypothesised, that these behaviour scores pick up quite different aspects of behaviour.

The bottom panel of Table 2 shows that all the age ten scores are strongly associated with social class, with expected signs. The associations are of larger magnitude for the academic ability scores than for non-academic scores but children in higher SES groups score more highly in tests of psychological and behavioural attributes. This might be the result of psychological production in the home due to easier material circumstances or the particular child-rearing abilities or aspirations of middle class families. Alternatively and less substantively, this might merely reflect the higher confidence of middle class children in educational environment or the prejudices of teachers. Because a wide-range of indicators of social class are observed, regressions can control for biases that might result from the teacher prejudice explanation. I also test whether these assessments made by teachers transfer to the labour market in which case they would have value as important indicators for schools.

In conclusion, the non-academic scores clearly provide information about the development of children that is associated with academic scores but not collinear with them. The scores also show the propensity to channel intergeneration social capital.

1.3 The outcome variables

Section 2 considers the predictive power of the age ten scores for three sets of outcomes. The first outcome variable is educational progress assessed as the achievement of the three levels of qualifications shown in Table 3. It should be pointed out that the attainment of at least one O'Level is a qualitatively different form of success than the other two levels of attainment in that it only represents an educational choice to the extent that students have to choose to apply themselves to study. It is more in the manner of a minimal test of human capital accumulation.

A'Level and Degree attainment, however, represent active choice on the part of students to postpone labour market entry.

Table 3. Outcome variables in the BCS

Outcome	Mean	s.d.	obs	Min	max
Educational Qualifications					
At least one O'Level	0.77	0.42	8422	0	1
At least one A'Level	0.36	0.48	8422	0	1
Degree	0.21	0.40	8422	0	1
Labour market					
Unemployment	0.30	0.46	8678	0	1
Long-term unemployment	0.39	0.49	2581	0	1
Earnings at 26: net hourly wage	1.57	0.38	6080	0	4.61

Notes: The three educational qualifications are not exclusive. Children with a positive outcome for degree will also have positive outcomes for the O' and A'Level dummy variables.

The labour market outcomes considered are unemployment probabilities and hourly wages. It is expected that these outcomes may be more strongly correlated with the psychological and behavioural scores than are the educational outcomes since, although, productivity should be rewarded in the labour market, it is hypothesised that educational progress is more closely linked to academic ability than is market productivity. Hence, it should also be the case that the predictive power of academic scores will be less for the market than for the educational outcomes.

Appendix Table 1 shows that the BCS earnings data matches that of the LFS for 1996 by gender and qualifications and can be taken, therefore, to be a reliable measure of wages. Sample members are, however, at an early stage of the age-earnings trajectory. Given that, as is well known, the slope of the average wage profile increases with education, returns to education and possibly age ten attributes might, if anything, be biased downwards. The unemployment variable is derived from a job history variable generously provided by the CLS[7], broadly indicating length of longest period of unemployment. I have coded the unemployment variable to take the following values: 0=continuously employed or unemployed only intermittently and never for more than four months, 1=longest period of unemployment more than four months. Individuals who have never been employed are dropped. The long-term unemployed are defined here in the form of a conditional expectation, namely those who have experienced unemployment of more than four months duration for whom that unemployment has also been of over one year's duration. Although this is an unusual interpretation of long-term unemployment in that it censors those individuals who have not experienced any substantial unemployment, the intention is to examine the power of age ten attributes to differentiate individuals at risk of long-term unemployment from those whose unemployment is not so likely to be long-lasting[8]. The relative values and significance of parameters in the analysis are robust to different transformations of these unemployment probabilities.

[7] This variable was derived by Pierella Paci at the Centre for Longitudinal Studies, Institute of Education. See Bynner *et al*, 1997.

[8] An alternative coding would be a variable that ranged from 1-5, increasing in the banded lengths of unemployment durations. Ordered probit regression on this variable would allow for non-linearities in the contribution of the age ten scores to the estimated probabilities of membership of any of the five bands. Marginal effects could then be calculated for the contributions of each age ten score to the probability of

2. The Association of Age Ten Abilities and Attributes with Educational Progress

This section considers two issues. Firstly, which age ten attributes and abilities predict educational attainment? As stated above, because of the rich cross-sectional data in the BCS, it is possible to consider this issue while also controlling for a great variety of background factors. This will enable us to see the extent to which children's backgrounds have direct effects on their educational attainment but also how children have already internalised these factors by age ten in terms of self-esteem, attentiveness, academic ability and so on. Secondly, the consideration of the prediction of educational qualification by age ten abilities for particular sub-groups suggests that different abilities have predictive power for different groups of the population. It is hypothesised that on the basis of differential reading of childrens' abilities and differential knowledge of the labour market, parents and schools form different expectations for children and influence them in different ways.

2.1 The importance of age ten abilities for education probabilities

Table 4 reports marginal effects from probit regressions of minimum educational qualification, O'Level, A'Level and Degree, on age ten abilities and attributes, controlling for gender.

Academic ability is the most important age ten predictor of subsequent educational qualifications. Since the ability scores are scaled with standard deviation equal to one, it can be observed, for example, that an increase of one standard deviation in reading ability is associated with a 9% increase in the individual's likelihood of gaining at least one O'Level. Of the psychological scores, self-esteem is not a significant predictor of academic progress in contrast to the locus of control. Attentiveness is particularly important. An increase in attentiveness of one standard deviation is associated with a 6% increase in the O'Level probability and a similar increase in the probability of getting a degree[9]. Going from the 20th decile of attentiveness to the 80th adds 16% to the probability of getting an A'Level and in terms of locus of control 80th percentile children are 9% more likely to get an A'Level than children at the 20th percentile.

Table 4. Age ten attributes and abilities as predictors of minimum educational qualifications, marginal effects from probit regressions

	O'Level		A'Level		Degree	
	dF/dx *100	(S.E.) *100	dF/dx *100	(S.E.) *100	dF/dx *100	(S.E.) *100
Girl	2.73	(1.1)	-0.97	(1.4)	-2.23	(1.0)

being in any group. However, this procedure would constrain the weights in calculation of the marginal effects to being the same for each age ten score, namely the probability of being in the grouping. Instead, the procedure adopted loses information by dropping individuals who have not been unemployed but simplifies the estimation process and allows particular age ten scores to influence long-term the long-term unemployment probability without influencing the short-term probability. It also gives more easily derivable standard errors.

[9] These regressions were run across gender. If two separate models are estimated the only significant changes is that maths is more important for boys than for girls as a predictor of the A'level and degree probability (at 1%). The marginal effects for boys are 14.3% and 10.2% as opposed to 10.4% and 7.4% for girls.

Maths	7.19	(0.8)	12.45	(1.1)	8.55	(0.8)
Reading	9.42	(0.8)	12.43	(1.1)	7.63	(0.8)
Locus of Control	2.88	(0.6)	4.30	(0.8)	2.88	(0.6)
Self-esteem	1.19	(0.6)	1.14	(0.7)	0.30	(0.5)
Anti-social	-0.08	(0.7)	-0.89	(1.0)	0.11	(0.8)
Peer relations	-1.21	(0.7)	-1.46	(0.9)	-1.39	(0.6)
Attentiveness	6.19	(0.8)	8.40	(1.1)	6.07	(0.8)
Extraversion	-0.78	(0.6)	-1.38	(0.8)	-0.06	(0.6)
Observed Probability	0.77		0.35		0.20	
Observations	5968		5992		5979	
Pseudo R-squared	0.22		0.21		0.21	

Notes: Parameters and standard errors are multiplied by 100 to give percentage increase in probability of getting qualification for one standard error change in age ten score. As well as the variables listed, a control variable is introduced for children assessed as being in the special educational category in the medical examination file. This is never significant once age ten scores are also introduced.

However, although these range effects seem fairly large, it is not yet possible to put these magnitudes into relative context because the regressions in Table 4 take no account of family background. It is also possible that the age ten attributes are merely picking up the effects of social class and other background influences but without providing any additional information. If teachers assess middle class children as more attentive, for example, due to the ratings bias discussed above, the score might only be important because it proxies for parental wealth and education in the home. In Table 6 background variables are introduced. Occupational classification (SES), parental education, average weekly income, parental interest in education, SES of grand-parents and ethnicity are all assessed when the sample children were ten years old and are standard background variables in regressions of this kind. These variables have all been shown to be strongly associated with subsequent academic and sociological outcomes[10].

First, for descriptive purposes, Table 5 reports cell mean attainments for children stratified by background variables. Results are reported by row from fourteen separate probit regressions conditioning only on the row variable listed in the first column. Thus, it can be seen, for example, that without conditioning on age ten abilities or any other background variables, sample girls are nearly four percentage points more likely than boys to get at least one O'Level but one point less likely to get at least an A'Level and three points less likely to get a degree.

Table 5. Cell mean probabilities of minimum educational qualifications for children by family background

	O'Level dF/dx *100	p-value	A'Level dF/dx *100	p-value	Degree dF/dx *100	p-value
Girl	3.61	0.001	-1.24	0.320	-2.71	0.010

[10] See Haveman and Wolfe, 1995, for a summary, Leslie and Drinkwater, 1999, for a recent consideration of the staying-on rates of ethnic minorities in the UK and Hill and O'Neill, 1994, for an analysis of third-generation effects.

Bottom income range	-12.66	0.000	-15.88	0.000	-13.33	0.000
Top income range	15.83	0.000	30.76	0.000	27.80	0.000
Father SES1	19.40	0.000	40.11	0.000	35.33	0.000
West-Indian parents	-2.45	0.701	-5.90	0.412	-11.25	0.057
Asian parents	13.68	0.002	20.58	0.000	18.65	0.000
Father O'level/vocational	0.39	0.726	-0.61	0.638	-2.11	0.051
Father A'Level	10.57	0.000	9.48	0.000	6.38	0.001
Father degree	19.57	0.000	43.27	0.000	37.74	0.000
Mother O'level/vocational	11.54	0.000	12.31	0.000	7.12	0.000
Mother A'Level	16.04	0.000	29.91	0.000	29.51	0.000
Mother degree	21.39	0.000	51.77	0.000	52.66	0.000
Father's father SES1	17.79	0.000	33.64	0.000	27.29	0.000
Mother's father SES1	15.02	0.000	33.82	0.000	36.42	0.000
Average probability	0.77		0.35		0.20	

Notes: The three educational attainment variables are each regressed by probit, separately on each of the background variables listed in the first column. Marginal effects are reported. Parental education dummy variables represents maximum attained and so are mutually exclusive categories.

In terms of these raw cell mean associations, income is clearly important, there are strong associations of children's education attainments with parental education and also with grand-fathers' SES. The association with mother's degree is particularly strong. Only 3% of the 224 children whose mother has a degree failed to get at least one O'Level and nearly three-quarters went on to get a degree themselves. Children from Asian families are much more likely to stay on and achieve further qualifications than those from the ethnic majority. Children from West-Indian families are less likely to get these qualifications, although this association is not significant. These are standard results.

In Table 6, we control for all of these background factors together with a wider range of variables and the age ten attributes and abilities[11]. Table 6 reports the results from regression on the full set of independent variables. Some collinearity is clearly to be expected with so many background variables. However, this procedure allows us to see which background variables dominate and still assess the extent to which age ten scores merely pick up background effects but have no further predictive power once we control for background directly. Broadly, how much significant human capital has been accumulated by age ten and how are future educational attainments then influenced by background factors? Measurement error will reduce the magnitude of age ten scores and so the results in answer to the first question can be thought of as a descriptive lower bound. We find that although there is a significant reduction in some of the age ten score parameters the broad picture remains. Moreover, controlling for age ten abilities highlights a number of interesting features of the

[11] We condition, for example, not just on SES1 but on dummy variables for all SES groups. Similarly finer specifications are introduced for the parental education and grand-fathers' SES variables. The "general family background" variables are number of older and younger children, parental interest in education, the mother's age, absent parents and a dummy variable on children being in a residential home.

importance of family background and illuminates the nature of the intergenerational transmission of educational inequality.

Table 6. Probit regression of minimum educational qualifications on family background, and age ten attributes and abilities

	O'Level dF/dx *100	(S.E.) *100	A'Level dF/dx *100	(S.E.) *100	Degree dF/dx *100	(S.E.) *100
Maths	5.60	(0.8)	9.79	(1.2)	5.81	(0.7)
Reading	7.64	(0.8)	10.34	(1.2)	5.21	(0.8)
Locus of Control	2.51	(0.6)	4.12	(0.8)	2.28	(0.5)
Self-esteem	0.64	(0.5)	0.18	(0.8)	-0.35	(0.5)
Anti-social	0.51	(0.7)	0.07	(1.1)	0.68	(0.7)
Peer relations	-1.00	(0.7)	-1.14	(0.9)	-0.98	(0.6)
Attentiveness	5.50	(0.7)	7.73	(1.1)	5.26	(0.7)
Extraversion	-1.08	(0.6)	-2.33	(0.9)	-0.41	(0.5)
Selected other variables						
Girl	2.91	(1.0)	-0.24	(1.4)	-2.46	(0.9)
Number of older siblings	-2.11	(0.5)	-3.36	(0.8)	-2.11	(0.5)
Income (£100)	2.17	(1.1)	3.88	(1.4)	2.67	(0.8)
Mother's age	0.40	(0.1)	0.84	(0.2)	0.63	(0.1)
West-Indian parents	12.11	(1.5)	42.60	(7.3)	24.56	(10.5)
Asian parents	14.32	(0.9)	46.66	(6.2)	35.00	(8.2)
Father SES1	7.13	(2.9)	17.99	(6.9)	12.89	(7.0)
Mother O'level/vocational	4.27	(1.2)	7.86	(1.8)	6.05	(1.2)
Mother A'Level	5.43	(2.0)	12.01	(3.2)	12.47	(2.6)
Mother degree	10.69	(2.8)	24.37	(6.0)	20.16	(4.7)
Father O'level/vocational	-0.96	(1.3)	2.38	(1.9)	1.32	(1.3)
Father A'Level	3.12	(1.9)	1.42	(2.8)	1.06	(1.8)
Father degree	2.95	(2.5)	14.50	(3.4)	6.36	(2.3)
Mother's father SES1	3.13	(4.3)	13.78	(6.5)	11.67	(5.1)
Father's father SES1	7.45	(3.8)	6.26	(6.4)	2.26	(3.8)
P-value of Control						
General family background		0.000		0.000		0.000
Ethnicity		0.000		0.000		0.000
Father's SES		0.040		0.000		0.007
Mother's SES		0.040		0.003		0.054
Mother's quals		0.001		0.000		0.000
Father's quals		0.123		0.000		0.008
Mother's father's SES		0.854		0.170		0.000
Father's father's SES		0.095		0.011		0.330
Region		0.000		0.000		0.444
Observations	5968		5992		5979	
R-squared	0.27		0.30		0.33	

Notes: When either parent was absent parental variables were set at zero and dummy variables were introduced as a control. Missing values are set to the variable's average value and indicated by a 0/1 control variable. This reduces standard errors. Parameter estimates for these dummy variables are not reported but do not have large or significant effects on results.

Academic ability tests pick up the influence of personal background quite strongly because of their stronger correlation with the added variables. The maths and reading score parameters fall by between 1.9 and 3.4 standard errors in the three regressions. However, overall, even conditioning on all this background information, academic scores still carry considerable additional forecast information. Only 35% of children in the bottom quintile of age ten reading scores, for example, are predicted to get even one O'Level or CSE equivalent as compared with 95% of top quintile children. Thus, even knowing about the family background of children, performance by age ten is itself crucial for further development[12].
Moreover, non-academic scores at age ten also still provide predictive power and the broad pattern described above is maintained. The attentiveness score falls by only just over one standard error in the degree regression and less elsewhere. The extraversion score becomes significantly negative for the A'Level probability. The other age ten scores, in particular attentiveness and locus of control, are not simply proxies for background effects, although they are, to some extent, channels for them[13].

Family background, however, is still a strong predictor of educational progress, even given age ten ability. SES matters but parental education has a still more substantial effect. Having a mother with a degree adds 11, 24 and 20 percentage points to the probabilities of attaining an O'Level, A'level and degree, respectively, controlling for the age ten scores and all background variables. These are very large magnitudes, roughly equivalent to four standard deviations gain in maths ability for the degree probability of the sample child. The education of the father is also important, although less so than that of the mother. A child whose parents are both educated to degree level is 39 points more likely to get at least one A'Level than a child with the same level of age ten ability but whose parents do not have any qualifications.

The magnitude of the parental education parameters compared to that of the SES variables is important because it is currently standard Ofsted practice to control, broadly, for the average SES of a school's intake when estimating the quality effect of individual schools. The residual element of school performance that cannot be explained by SES is considered to be the result of the school quality. Failure to consider sufficient conditioning variables will, on this evidence, clearly allocate value-added responsibility to schools that is actually due to the education levels of the parents of the schools' intake. Income is also important. Increasing family income by £100 adds four points to the probability of a child getting at least one A'Level. The age of the mother and the number of older children also proved to be important.

[12] The equivalent A'level probabilities are 4% for the bottom quintile and 62% for those in the top reading quintile by age ten. The degree probabilities are 1% and 41%.

[13] That they are channels can be observed from the discovery that with no age ten scores entered the marginal effect of having a father in SES1 on the O'Level probability is 16.2 (standard error, 1.8). When age ten scores are entered this falls to 9.5 (standard error, 2.4), a change significant at 1%. Even when only non-academic age ten scores (i.e. those other than maths and reading) are entered this falls to 12.9 (standard error, 2.0), a change also significant at 1%. The reductions in the association of SES1 with A'Level and degree probabilities when all age ten scores or only non-academic abilities are included are also significant at 1%. The combined test of changes in both SES1 and SES2 associations are all also significant at 1%. In fact, even when the non-academic scores are added to regressions that include the academic scores the change in association with SES1 is significant at 1% for the A'Level and Degree probabilities and at 5% for the O'Level probability. Similar levels of significance are recorded for the joint tests of changes in both SES1 and SES2 associations.

The child of a mother ten years older than average will be six points more likely to get a degree. Each older sibling reduces this probability by two points[14].

It is striking (though a standard finding) that when we condition for age ten ability, children of West-Indian parents are much more likely to gain qualifications than are children from the ethnic majority. Thus, as Table 5 shows, although they are nearly six points less likely than the default group to get a degree overall, West-Indian children are twenty-five points more likely to get a degree, once we control for age ten ability[15]. More generally, given their age ten performance children from all ethnic minorities are more likely to stay on and do well at school than children from the ethnic majority. This might reflect extra pressure for children to gain qualifications to overcome discrimination or poor contacts in the labour market or, alternatively, a higher degree of educational culture within families. It also suggests that ethnic educational inequality begins in primary school or earlier.

Region at age ten appears to be important for O' and A'Level probabilities but is insignificant even at 20% for the degree probability. This is mainly due to the fact that Scottish children have much higher O' or A'Level equivalent probabilities than English children and that this advantage is not maintained to degree level.

Another interesting feature of these data is that we have information not just on the occupational classification (SES) of fathers but also of paternal and maternal grandfathers. This enables us to identify effects across three generations. To the extent that staying on decisions are influenced by the opportunity cost of education, it is commonly expected (for example, Card, 1995, and Becker, 1967) that children from poorer families will be more likely to decline educational possibilities. Family income will, therefore, be positively associated with educational probabilities as we find in Table 6 for this reason as well as due to other material benefits. Our family income variable, however, is only a snapshot of family income (in 1980) and might not be a good proxy for wealth. The SES of grandfathers will contain some proxy information on wealth through inheritance and so might be important for the educational probabilities of sample children. Grandfather's SES will also provide information about cultural capital. Table 6 shows that children whose maternal grandfather was in SES 1 are twelve points more likely to get a degree than other children of the same age ten ability. This is significant at 1% and equivalent to two standard errors of age ten maths ability[16].

Overall, then, although the age ten test scores are important predictors of subsequent educational attainment family background continues to play an important role through a number of channels. Children from more wealthy, more educated and professional families are more likely to progress academically, even given their age ten academic ability. As we see below in Section 3 this is a different picture to that for the inter-generational transmission of wages.

2.2 The importance of age ten abilities for the education probabilities of children in different SES groups

[14] The number of younger siblings was not significant, neither were the other family control variables. Feinstein & Symons, 1999, found parental interest to be the most important determinant of educational success but this was using NCDS data which has better measures of parental interest and for which parental interest is assessed at age sixteen.

[15] This is not an artefact of conditioning on the other background variables but can be reproduced by conditioning solely on age ten reading and maths scores. It is not due, therefore, to the fact that parental education is commonly not observed for ethnic minority parents.

[16] It is interesting that it is the effect of the mother's father that dominates for the A'Level and degree choices, counter to simple explanations by genetic endowment. The difference between parameters on the two grandfathers is, however, not significant.

However, first we ask whether the age ten attributes play different roles for children from different kinds of background, in other words, whether there is evidence of important interaction terms. Table 7 presents the results of probit regressions of qualification level on age ten skills and attributes interacted with terms for two groups of children, stratified by the social class rating of their families as assessed by the SES of fathers and grand-fathers[17].

Table 7. Predictive power of age ten reading, maths and attentiveness scores for children from different parental backgrounds

	O'Level		A'Level		Degree	
	dF/dx *100	p-value	dF/dx *100	p-value	dF/dx *100	p-value
High SES						
Level	10.75	0.000	31.99	0.000	26.59	0.000
* Reading	5.85	0.121	3.96	0.344	3.11	0.219
* Maths	9.38	0.006	19.22	0.000	10.05	0.000
* Attentiveness	2.35	0.457	6.16	0.000	5.73	0.003
Medium SES*						
* Reading	9.78	0.000	14.03	0.000	8.32	0.000
* Maths	5.98	0.000	12.71	0.000	10.13	0.000
* Attentiveness	5.35	0.000	8.79	0.000	5.50	0.000
Low SES*						
Level	-3.70	0.040	-9.07	0.002	-7.53	0.003
* Reading	8.49	0.000	19.20	0.000	10.97	0.006
* Maths	3.95	0.089	-0.16	0.678	-0.06	0.987
* Attentiveness	6.95	0.012	9.18	0.007	5.42	0.095
Obs	4202		4202		4202	
Observed Probability	0.80		0.37		0.21	
P-value, H_o: High SES*Maths= High SES*Reading & LowSES Maths=LowSESReading						
	0		0		0	
	.412		.001		.051	

Notes: Table 7 reports marginal effects for maths, reading and attentiveness scores from probit regressions of educational probabilities on these three age ten scores each interacted with membership of the three SES sub-groups. The default group is medium SES.

For the high SES group the age ten maths score predicts A'Level and degree probabilities more effectively than does the reading score but for the low SES group this picture is reversed. Thus, a standard deviation of maths ability is associated with a 19% increase in A'Level probability for the high SES group, on top of the 32% gain for membership of that group. A standard deviation of reading ability, however, adds only 4%. For the low SES group, on the other hand, the reading gain is 19% and the maths gain is zero.

This finding suggests that children, families and/or schools differ in how they respond to ability in forming expectations and support for further schooling. Thus, children in the high

[17] The high SES group had either a father or a grand-father in SES1. The low SES group had fathers either in SES4 or SES5 and no grand-fathers on either side in SES1 or SES2. Results are robust to weaker or stronger restrictions on pooling.

SES group are particularly likely to progress academically if they are performing well at maths at age ten rather than reading but for children from low SES backgrounds, the age ten maths score is not even a significant predictor of A'Level or degree probabilities[18]. A number of hypotheses suggest themselves. It may be that reading is more easily observed by low SES parents and so they are more likely to push or support children who are doing well at reading but may miss the signals provided by good maths performance. Another possibility is that, rather than differential information about age ten performance, families differ in their knowledge of the labour market and the returns to ability. It is also possible that, for whatever reason, maths is not well taught in the secondary schools attended by most of the low SES group and so the early ability is not developed.

Although it is not possible to identify the cause of this interaction, it does suggest a possible and hitherto unexplored channel for the perpetuation of educational and hence economic inequality. Future research must be based on better information about the formation of child and parental expectations.

It is also interesting to note that the attentiveness score is particularly important for the O'Level probability of low SES children. The high SES children are likely to get O'Levels whatever their level of attentiveness early on but, one presumes, are more likely to progress after this if their interest in education is high. Low SES children, however, need to show attentiveness early on or risk being effectively selected out of education by O'level.

3. Labour Market Outcomes

We now consider the question of whether age ten skills provide any predictive information for labour market outcomes. We consider first how age ten attributes and abilities influence participation.

3.1 Age ten scores and employment at age twenty-six

Discounting any initial unemployment in the three months after leaving full-time education, 35% of the twenty-six year olds in this survey had been in continuous employment since leaving education. A further 35% had experienced intermittent unemployment, the remainder having experienced spells of unemployment of over four months duration. Table 8 reports marginal effects of the age ten scores in predicting unemployment probabilities. Although we have omitted family and background variables they do not change the results in any substantive way. In line with the sequential methodology, we should also omit qualifications as they are obtained after the age ten scores. However, we include them in order to counter the observation that test scores might only be important for unemployment probabilities because of their implications for qualifications attained. It is also important to control for individuals with degrees because we find, for example, that males with degrees are 9% more likely to be unemployed for a period of over four months duration (significant at 1%) but of those males, graduates are 14% less likely to experience a spell that lasts more than a year (significant at 10%). This suggests that some unemployment is due to confidence about job search, leisure or delaying entry into the labour market. In any case, results are robust to the inclusion of

[18] This finding is not due to there being more collinearity of maths and reading for children in the low SES group. The correlation coefficient for these children is 0.69 as opposed to 0.70 for the high SES children. It is also not the case that there are fewer low SES group children performing well at reading than at maths. Of 944 low SES group children, 121 were in the top quartile for maths, 131 for reading.

qualifications. We also control for the age ten Local Education Authority as a proxy for local labour market conditions.

Table 8. Probit regression of unemployment duration variable on age ten attributes and abilities

	Boys				Girls			
	(1) Unemployed > 4 months		(2) Unemployed > 12 months if column(1)=1		(1) Unemployed > 4 months		(2) Unemployed > 12 months if column(1)=1	
	Coef. *100	(S.E.) *100	Coef. *100	(S.E.) *100	Coef. *100	(S.E.) *100	Coef. *100	(S.E.) *100
Maths	-3.68	(1.6)	-2.05	(3.2)	-4.17	(1.3)	-3.63	(3.4)
Reading	0.66	(1.6)	-3.54	(3.2)	1.63	(1.3)	0.77	(3.1)
Locus of Control	0.47	(1.2)	3.88	(2.4)	-1.23	(1.0)	-5.00	(2.5)
Self-esteem	-0.83	(1.1)	-4.52	(2.3)	-1.53	(0.9)	6.19	(2.2)
Anti-social	4.14	(1.3)	-2.11	(2.6)	-0.05	(1.2)	3.66	(2.9)
Peer relations	-1.79	(1.2)	-3.49	(2.5)	-2.85	(1.1)	1.51	(2.8)
Attentiveness	-1.24	(1.4)	-0.59	(2.8)	-2.90	(1.3)	-3.39	(3.1)
Extraversion	-3.41	(1.2)	2.25	(2.3)	-0.19	(1.0)	-1.16	(2.5)
At least one O'Level	-6.75	(2.6)	-17.93	(4.9)	-8.97	(2.3)	-13.73	(5.1)
At least one A'Level	-2.74	(3.1)	2.18	(7.0)	-6.59	(2.3)	-12.18	(6.7)
Degree	9.22	(3.5)	-13.58	(6.6)	13.49	(3.3)	4.55	(8.6)
Observed probability		0.32		0.39		0.25		0.38
Pseudo R-squared		0.07		0.12		0.08		0.13
Observations		2604		789		3187		733

Notes: See discussion of Table 3 for the precise derivation of the dependent variable. As well as the specified variables controls are also introduced for the 123 age ten Local Education Areas. Parameters and standard errors are multiplied by 100 as in previous tables.

First, the age ten maths score dominates the reading score as a negative predictor of both male and female unemployment, although reading ability becomes more important for reducing the conditional male long-term unemployment probability. Second, the anti-social behaviour score is as strong (and more precise) a predictor of male unemployment as the maths score. Going from the 20^{th} to 80^{th} percentile of the anti-social disorder range adds 6% to the likelihood of experiencing a serious episode of unemployment, i.e. of more than four months. This is roughly equivalent to the effect of getting at least one O'Level and might reflect influences of behaviour on success in interviews or be the result of the underlying disaffection that turns the individual away from labour market activities, making them both less attractive to employers and less interested. It might also be that boys who were anti-social at age ten have higher entry rates to unemployment later on. In fact, we observe in column (2), within the group of those who have experienced a significant spell of unemployment, boys who were anti-social are not more likely to suffer a very long-term spell of unemployment. This supports the suggestion that boys with high anti-social scores are getting jobs and then losing them.

Third, extrovert boys are much less likely to experience unemployment, again with substantial range effects.

Fourth, anti-social behaviour and introversion are not strong predictors of shorter-term female unemployment which depends more on poor peer relations and inattentiveness. These effects may reflect a choice against paid work by individuals who are un-interested in school, their peers and labour force activity or they might indicate that it is harder for such individuals to find paid work.

Locus of control and self-esteem have important effects that differ between genders. For males, low self-esteem is a particularly strong indicator of the difference between those whose unemployment will be relatively short and those more likely to experience long-term unemployment. For those males who have been unemployed for more that four months, a standard error of self-esteem will reduce the probability of longer-term unemployment by 4.5%. The 20/80 range effect is 9%. For girls, on the other hand, self-esteem is positively associated with the long-term unemployment probability and it is the locus of control score which predicts with the expected sign. Thus, girls with higher self-esteem are more likely to have long periods of unemployment. This result is robust to excluding girls who have had episodes out of the labour force, to excluding students or to controlling for the presence of children. The experiments with functional form, however, have shown that the finding may be due to differences between the tails of the distribution. When we include the dummy variables for being in the top or bottom decile of all eight scores we find that the self-esteem parameter is effectively zero (-2%, standard error, 3) but that the marginal effects are -27% (standard error, 5) for the lowest self-esteem decile and 43% (standard error, 11) for those in the highest decile. It may be, then, for these groups self-esteem gives the confidence to stay out of work longer.

3.2 Age ten scores and earnings at age twenty-six

We next address earnings, first without addressing any endogenity issues or conditioning on other intervening variables, although the regressions do control for region at age ten. The question being asked is: however sample members move through the maze of adolescent and early adult choices, what can we know about their future earnings from their age ten test scores? Methodologically, the approach adopted is to ignore the path through future choices such as industry sector or location and to consider how age ten attributes predict the subsequent economic outcome. Thus, sample members may choose to move into, for example, well-paid industries but, to the extent that this choice is correlated with the age ten attribute, this is taken to be part of the return to that attribute[19].

Table 9. OLS regression of log wages on family background, and age ten attributes and abilities

	Boys				Girls			
	Coeff *100	(S.E.) *100	Coeff *100	(S.E.) *100	Coeff *100	(S.E.) *100	Coeff *100	(S.E.) *100
Maths	3.76	(1.3)	3.10	(1.3)	5.77	(1.3)	4.91	(1.3)
Reading	4.00	(1.3)	2.87	(1.3)	4.05	(1.3)	3.18	(1.3)
Locus of Control	0.94	(1.0)	0.64	(1.0)	2.93	(0.9)	2.09	(0.9)

[19] It should be noted that only a small proportion of wage variance is explained because no age 26 environmental characteristics such as firm size, tenure, region of employment and so on, are included and qualifications are also so far omitted. Including regional and industry dummies as well as variables for the number of children and qualifications increases the R-squared to 0.36 for boys and 0.38 for girls.

Self-esteem	3.15	(0.9)	2.78	(0.9)	1.22	(0.8)	0.93	(0.8)
Anti-social	-0.85	(1.1)	-0.78	(1.1)	2.77	(1.3)	3.00	(1.3)
Peer relations	0.62	(1.0)	0.51	(1.0)	2.52	(1.1)	2.69	(1.1)
Attentiveness	1.95	(1.2)	2.13	(1.2)	3.53	(1.3)	3.32	(1.3)
Extraversion	1.26	(0.9)	1.19	(0.9)	-0.55	(0.9)	-1.09	(0.9)
Selected other variables								
Number of older siblings			0.49	(0.8)			-0.68	(0.9)
Income (£100)			5.54	(1.6)			7.61	(1.5)
Mother's age			-0.12	(0.2)			0.13	(0.2)
West-Indian parents			0.73	(11.2)			23.78	(9.9)
Asian parents			11.28	(8.8)			4.20	(8.2)
Father SES1			11.00	(6.5)			6.90	(6.6)
Mother O'level/vocational			1.39	(2.0)			1.39	(1.9)
Mother A'Level			8.45	(3.5)			-2.42	(3.2)
Mother degree			0.17	(5.1)			9.26	(5.2)
Father O'level/vocational			3.92	(2.2)			-1.57	(2.1)
Father A'Level			4.04	(3.1)			-4.59	(3.0)
Father degree			6.77	(3.4)			-1.13	(3.4)
Mother's father SES1			-2.80	(6.2)			2.00	(5.9)
Father's father SES1			4.45	(6.3)			5.98	(7.1)
P-value of Control								
General family background				0.008				0.000
Ethnicity				0.307				0.283
Father's SES				0.290				0.553
Mother's SES				0.040				0.931
Mother's quals				0.101				0.123
Father's quals				0.179				0.496
Mother's father's SES				0.880				0.814
Father's father's SES				0.879				0.382
Region		0.000		0.000		0.000		0.000
Constant	169.1	(1.5)	151.0	(12.3)	158.2	(1.5)	138.6	(11.7)
Observations		2019		2019		2171		2171
R-squared		0.12		0.16		0.14		0.18

Notes: As in previous tables parameters are multiplied by 100 to give percentage returns for one standard deviation change in age ten score. Observations with unreported qualifications or family background are dropped. Absent parents or missing values were treated as in Table 6.

Whether or not we control for background variables, it can be seen in Table 9 that the age ten maths, reading and self-esteem scores strongly predict male market wages. In terms of the family background effects, the statistical effect of going from the 20th decile of self-esteem to the 80th is a 5.6% increase in the hourly wage, equivalent to the effect of increasing family income by £100 a week or moving from a family headed by a male with no qualifications to one with A'Levels or a degree. These are very large effects.

For female earnings, however, self-esteem does not play a significant role but the locus of control and behavioural scores are much more important. Controlling for parental background, the effect of going from 20th to 80th decile of attentiveness is a 6.3% increase in

wages, the same as the 20/80 range effect for the reading distribution and roughly equivalent to £100 per week more family income during childhood. The range effect of increasing the peer relations score is also high at 5%. All of these results are robust to controlling for part-time working. It is interesting that the anti-social score enters positively for female wages, suggesting that teachers rate more motivated or ambitious girls as less "social". Thus, it may be that the underlying attributes assessed by the age ten scores have different labour market rewards for men and women but also that the underlying attributes are themselves gender-specific.

Taken together, Tables 8 and 9 suggest strongly that more attention might be paid to the non-academic behaviour and development of children as a means of identifying future difficulties and labour market opportunities. It also suggests that schooling ought not be assessed solely on the basis of the production of reading and maths ability. There might be economic returns to thinking more imaginatively about the role of schooling and the way schools interact with families and children in generating well-educated, productive but also well-rounded and confident individuals. We consider this issue in the concluding section below.

It is also important to note that the effect of the family background variables is much weaker for market productivity than for educational progress. There are a number of interesting differences. Family income plays a much more substantial role for wages than for education. Mother's education and grand-parents' social class is much less important although mother's degree does carry substantial weight for the prediction of daughters' wages. Children of older mothers are not predicted to earn more even though they are predicted to progress further educationally. The p-values in Table 9 show that fathers' qualifications or SES, ethnicity and grandfathers' SES are not significant sets of controls in the earnings equation although they were very important in the qualifications regressions in Table 6.

Future earnings appear, on this analysis, to be governed by a different set of factors than future educational progress which is influenced to a greater extent by family background factors that proxy the cultural environment of the child. Market productivity is not, therefore, the later correlate of education production, governed by the same factors, simply transferred to the labour market. This picture is supported by the fact that different age ten tests scores are important for predicting the two sets of achievements. For educational progress, the locus of control and attentiveness are particularly important. For income, peer relations and self-esteem plays a much greater role. Moreover, whereas anti-social behaviour is strongly associated with male unemployment probabilities, it plays little role for earnings.

I emphasise the distinction between productivity and the production of productivity in order to bring attention to the social and psychological complexity of each. This is important to modern economics. Human capital is central to much endogenous growth theory, for example, as well as to the analysis of inequality, yet, so far, economists have been unable to make an empirical connection between differences in national educational inputs and growth rates. This must be at least partly due to the complexity of the process of human capital production on the one hand and the links between what is produced and productivity, on the other.

3.3 The returns to education

From Table 10 it is apparent that a number of the age ten scores are important for wages even conditioning on qualifications.

Table 10. Wage equations with qualifications

	Males	**Females**

	Coef. *100	(S.E.) *100	Coef. *100	(S.E.) *100
Maths	1.96	(1.3)	3.69	(1.3)
Reading	2.46	(1.3)	1.34	(1.3)
Locus of Control	0.64	(0.9)	1.86	(0.9)
Self-esteem	2.86	(0.9)	1.01	(0.8)
Anti-social	-0.64	(1.1)	3.04	(1.3)
Peer relations	1.01	(1.0)	2.88	(1.0)
Attentiveness	0.72	(1.2)	2.34	(1.3)
Extraversion	1.28	(0.9)	-0.41	(0.9)
At least one O'Level	4.81	(2.1)	9.09	(2.3)
At least one A'Level	5.19	(2.3)	10.76	(2.1)
Degree	7.67	(2.6)	5.82	(2.4)
Pseudo R-squared		0.14		0.18
Observations		2019		2171

Notes: Coefficients and standard errors are multiplied by 100. Standard errors in brackets.

Academic ability scores are less important when qualifications are taken into account although there is some direct earnings return to academic ability in addition to the indirect return through qualifications. Conditioning on qualifications, self-esteem is the most quantitatively important age ten test score for male earnings. The parameter estimate is not significantly reduced when qualifications are introduced into the model. The estimate on locus of control for female earnings falls by more because of its strong association with educational progress but is still significant (at 5%) and of non-negligible magnitude. There does, therefore appear to be a return to locus of control for women in addition to the indirect benefit that it is associated with higher levels of education.

Omission of maths and reading scores leads to ability bias in estimates of the return to education. This is well-established (see, for example, Dearden, 1998). However because of the relatively low correlation of non-academic ability and qualifications, no significant bias arises from omission of the psychological and behavioural scores so long as academic ability is included[20].

It might be argued that since age ten academic ability is measured with error, the non-academic variables are biased upwards. As a check of robustness, therefore, experiments have been made in which the intellectual ability scores are instrumented by earlier scores taken at age five. The maths and reading scores were replaced by a single ability measure, the British Ability Scale, a composite test of maths and reading, see Butler, 1987. This means that only one variable needs to be instrumented. The instruments are test scores from the earlier (1975), age five sweep of the data. There was some evidence that measurement error is important but

[20] In our data, when no age ten scores are included, the returns to the three educational qualifications for males are 9.6%, 8.1% and 10.0% respectively, where returns to higher qualifications must be added to those already attained so that the degree return, for example, is 27.7%. These fall to 5.5%, 5.7% and a further 7.9% when the maths and reading scores are included. The degree return falls, therefore, to 19.1%. The test that the changes are not jointly significant is rejected at 5%. However, adding the other age ten scores only reduces the education returns to 4.9%, 5.1% and 7.6% and the test of no joint change is not rejected even at 20%. The parameters do, however, all fall in magnitude which highlights the difficulty of measuring any precise investment return to education.

only for the male wage equation. In neither case, however, was there any significant and substantive change in the important psychological or behavioural age ten scores[21].

4. Conclusions

This paper has found substantial labour market returns to non-academic human capital production. Although this does not in any way offset the importance of Government programmes to improve literacy and numeracy, it does suggest that there is a possible economic return to thinking more broadly about the benefits and possibilities of schooling.

To summarise, attentiveness in school has been shown to be a key aspect of human capital production, also influencing female wages even conditioning on qualifications. Boys with high levels of conduct disorder are much more likely to experience unemployment but higher self-esteem will both reduce the likelihood of that unemployment lasting more than a year and, for all males, increase wages. The locus of control measure of psychological development is an important predictor of female wages reflecting, perhaps, the fact that the observed self-esteem of boys is higher than that of girls. Good peer relations are important in the labour market, particularly for girls, reducing the probability of unemployment and increasing female wages.

Moreover, these behavioural and psychological measures have been shown to be important channels of the inter-generational transmission of inequality. Although it is far from being the case that these scores explain all the variance in outcomes that would otherwise be proxied by social class differences, they have been shown to do so to a significant extent. Given the implications of these observations for inequality and growth the question is whether or not Government-led interventions can influence how children develop in the ways assessed by these tests. The two main institutions for achieving this are, of course, families and schools, although peer groups and wider communities are important links and conditioning factors between these two. That parenting is the crucial arena for the development of the kind of human capital emphasised in this paper can be seen from Table 11 which reports reduced form, ordinary least squares regressions of age ten scores on proxy measures of schooling and parenting quality.

Table 11. Estimation of age ten scores

	Maths		**Locus of control**		**Self-esteem**		**Conduct disorder**	
	Est.	(s.e.)	Est.	(s.e.)	Est.	(s.e.)	Est.	(s.e.)
Girl	-0.09	(0.02)	-0.18	(0.02)	-0.24	(0.02)	-0.25	(0.02)
Schooling								
Good peers	0.15	(0.02)	0.03	(0.03)	0.01	(0.03)	-0.02	(0.03)
Bad peers	-0.20	(0.02)	-0.05	(0.02)	-0.03	(0.02)	0.06	(0.02)
No instructional reading	0.21	(0.04)	0.15	(0.04)	0.09	(0.04)	-0.19	(0.04)
No sport in curriculum	-0.16	(0.02)	-0.12	(0.02)	-0.12	(0.02)	-0.01	(0.02)
Parental attitudes								

[21] F-statistics from regression of the instruments on the endogenous variable are, not surprisingly, very high, 45.0 and 30.6. Exclusion restrictions are also clearly satisfied with sargan tests of instruments on residuals of 0.925 for the male regression and 0.996 for the female wage equation. This is, again, not surprising given the plethora of age ten information. The self-esteem parameter for males is unchanged as were the locus of control and peer relations parameters for women. The attentiveness score becomes much smaller in the male wage equation but was in any case not significant at 5% in Table 9. The Hausman test t-statistic for change in instrumented variable is 2.3 for males, 0.5 for females.

Mother hostile	-0.18	(0.15)	-0.26	(0.17)	-0.41	(0.17)	1.48	(0.16)
Father hostile	-0.43	(0.18)	-0.36	(0.20)	-0.10	(0.20)	0.67	(0.19)
Father's interest in education	0.36	(0.08)	0.39	(0.09)	0.32	(0.09)	-0.53	(0.08)
Mother's interest in education	0.90	(0.07)	0.63	(0.08)	0.33	(0.08)	-0.79	(0.08)
Parental background								
No mother	-0.07	(0.11)	-0.08	(0.12)	-0.30	(0.12)	0.34	(0.12)
Number of siblings	-0.04	(0.01)	-0.03	(0.01)	-0.03	(0.01)	0.01	(0.01)
High SES	0.45	(0.05)	0.36	(0.05)	0.16	(0.06)	-0.03	(0.05)
Medium SES	0.21	(0.05)	0.20	(0.05)	0.06	(0.05)	-0.01	(0.05)
Mother O'level/vocational	0.18	(0.02)	0.15	(0.02)	0.06	(0.02)	0.00	(0.02)
Mother A'Level	0.38	(0.04)	0.27	(0.04)	0.09	(0.04)	-0.01	(0.04)
Mother degree	0.60	(0.06)	0.42	(0.07)	0.23	(0.07)	-0.10	(0.07)
Constant	-0.87	(0.07)	-0.67	(0.07)	-0.26	(0.07)	0.90	(0.07)
Observations	9699		9959		10017		10257	
R-squared	0.22		0.11		0.06		0.09	

Notes:

(i) Children at special educational institutions excluded.

(ii) Schooling and parental attitude variables reported by teachers.

(iii) Good peer group is a dummy variable indicating children in classes that have a high proportion of parents in professional occupations, a low proportion of parents in manual occupations and a high proportion of children judged by the teacher to be of good academic standard. The bad peer group indicates the opposite environment.

(iv) The parental interest variables range from 0 to 0.75.

The estimated model groups boys and girls which obscures important differences between genders in the influence of the background and schooling variables. Crucially, however, the broad findings are the same across gender. Firstly, explanation of the psychological and behavioural variables is even less than that of the maths score. The production of these aspects of human capital is even more random and subject to unobserved heterogeneity than is the production of academic ability. The very large effect of maternal hostility on conduct disorder and the insignificance of standard measures of SES and maternal education reflect the importance of only marginally systematic shocks to the development of individuals, relevant to economic outcomes as has been shown but subject to very individual-specific environmental influences. Social class and maternal education are more important for psychological capital but the R-squareds for these regressions are still lower than that for the explanation of maths.

Second, the explanatory role of schooling variables is substantially less than that of measures of parental interest and hostility. Partly, this may be due to the point just made that influences on behaviour and psychological development are very proximal to the individual. School peer groups, which have substantive and significant associations with maths ability, play no role in explaining psychological development. However, even for maths, parental attitudes are substantively more important than peer groups. These attitudes may well be linked to SES, poverty, housing and other aspects of material well-being since bad housing and the stress of low income, for example, are likely to lead to tensions in households that will be picked up by children. However, it is the tensions and attitudes that are the mediating factors in the production of human capital[22].

[22] Although results are presented for regressions grouped by gender there were a number of interesting distinctions. Particularly revealing was the fact that for every score except conduct disorder maternal interest was more important for girls than for boys and paternal interest less important. Thus for maths, for example, the highest level of father's interest increases boys' scores by 0.52 (s.e.: 0.11) and girls' scores by 0.15 (0.11). The highest level of mother's interest increases boys' scores by 0.73 (0.11) and girls'

Third, schooling does appear to matter. Standard measures of school quality such as class size and school expenditures are commonly shown not to be statistically significant predictors of educational outcomes. In Table 11, instead, aspects of curricula are introduced. Children at schools which emphasise non-instructional teaching of reading, emphasising instead creative reading or reading for pleasure can be seen to score better in all four scores. To an extent, this may reflect selection effects but regressions do control for peer groups. In fact, the results hold for models run only on children in good peer groups. This suggests that the way children are taught can make a difference to their general development as well as to the production of academic ability. Similarly, children at schools in which no sport was scheduled in the curriculum also score worse for maths and the psychological variables. The effect on maths scores emphasises the fact that selection effects are important here and that the curriculum variables are also proxy measures for unobserved school quality and neighbourhood. However, the results imply that what happens in school is important.

Traditionally, the school and the local area have commonly been seen as the arenas most amenable to Government intervention. Most schooling is Government funded and much intervention to alleviate what used to be called poverty has been at the area level. Recently, however, the Government has emphasised early years as crucial and this has led to funding of the Sure-Start programme to support parenting skills. This is, in many ways, a new venture for Treasury-supported policy but the evidence of this paper is that there are perhaps more considerable returns to such funding if schemes can influence behavioural and psychological development as well as the academic ability of children. It is not obvious that parental hostility, for example, can be seriously influenced by (self-selected) parenting classes but interventions at the margins may make a difference and the programme will, at the very least, be an important step towards better understanding of mechanisms for positively influencing the formative experiences of children. The contribution of this paper is to show that the attempt may be worth making even in the purely economic terms of the Exchequer costs of unemployment or the generation of wealth.

Evidence has also been presented to suggest that different aspects of non-academic human capital are important for different labour market outcomes. For example, anti-social behaviour strongly predicts unemployment for males but self-esteem is more important for wages. Similarly, different academic abilities are important predictors for different groups of the population. Human capital is not, therefore, a single entity that develops along a single trajectory influencing every aspect of economic life. Skills and their production are much more diverse than this.

Finally, the findings of the paper suggest that schooling choices and successes are not influenced solely by productivity forecasts but also by individual preferences, perhaps shaped by financial constraints and household attitudes. On these grounds, this paper concludes that human capital production is a much more subtle and complex process than it has so far been possible to assess. A child of a given level of age ten ability has been shown to be 40% more likely to go on to A'Levels if his or her parents have degrees. On average such a child will have better knowledge of the returns to education, better access to finance and a lower opportunity cost of earnings and time foregone. The experience of the child, however, is of the preference or willingness to stay-on. These tastes are obviously heavily influenced by the home environment. It will be left to further research to consider whether the actual returns to education depend on such preferences and how the tastes themselves are determined in the

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scores by 1.07 (0.10). The maternal interest parameter was significantly higher in girls' maths scores than in those of boys at 1%. The reverse was true for the paternal interest parameter, again at 1%.

context of information about individual-specific potential returns based on knowledge of personal productivity.

Appendix Table
Mean wages by education and gender in the Labour Force Survey and BCS

	LFS		BCS70	
	mean	s.d.	Mean	s.d.
Male				
All	5.77	0.19	5.47	0.06
None	4.54	0.21	4.22	0.09
Other	4.76	0.25	4.57	0.11
Lower vocational	5.57	0.26	5.25	0.11
Middle vocational	5.81	0.33	5.34	0.15
A Levels	5.86	0.42	5.75	0.16
Higher vocational	6.79	0.43	5.99	0.16
Degree	7.33	2.02	6.30	0.30
Female				
All	5.28	0.19	4.97	0.07
None	3.85	0.24	4.24	0.05
Other	4.22	0.26	4.60	0.07
Lower vocational	5.13	0.26	4.73	0.09
Middle vocational	5.27	0.27	5.15	0.13
A Levels	5.60	0.27	5.18	0.26
Higher vocational	6.36	0.49	5.33	0.58
Degree	6.99	1.14	5.97	0.98

Notes: The table reports mean wages for all individuals aged between 24 and 30 for the LFS in the first quarter of 1996 and for all BCS individuals who are all aged 26 in 1996 sweep.

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