The impact of early cognitive and non-cognitive skills on later outcomes[1]

Pedro Carneiro
University College London, Institute for Fiscal Studies
and Georgetown University

Claire Crawford
Institute for Fiscal Studies

Alissa Goodman
Institute for Fiscal Studies

31st December 2011
Draft paper – not for citation without permission

Abstract

When describing the determinants of economic or social outcomes, economists often focus on cognitive skill. Failure to take into account other dimensions of skill may misguide policy design. In this paper, we analyse the consequences and determinants of cognitive and non-cognitive (social) skills at age 7, using data for Great Britain from the National Child Development Study. We find that an overall measure of non-cognitive skills is important for a host of later outcomes, including educational attainment, employment status, wages, smoking, truancy, teenage pregnancy, involvement in crime and health. In many cases, we find that the importance of social skills is greater for individuals from low socio-economic backgrounds than it is for individuals from high socio-economic backgrounds, suggesting that investment in non-cognitive skills may reduce inequality. Finally, our work suggests that social skills may be more malleable than cognitive skills, which – if true – suggests that there may be scope for policy to affect social skills and hence outcomes.

[1] We are grateful to the Department for Education and Skills (now the Department for Education) for funding this work through the Centre for the Economics of Education and for co-funding from the Economic and Social Research Council via the Centre for the Microeconomic Analysis of Public Policy at IFS (grant number RES-544-28-0001). Carneiro gratefully acknowledges financial support from the Economic and Social Research Council through the ESRC Centre for Microdata Methods and Practice (grant reference RES-589-28-0001), and the hospitality of Georgetown University and the Poverty Unit of the World Bank Research Group.

1. Introduction

Each of us is endowed with a unique set of skills that we use in all aspects of our everyday life. If we were asked to name the skills that we thought were valuable, we would find ourselves enumerating a never-ending list of attributes. Nevertheless, when describing the determinants of economic or social outcomes – or even the learning process – economists often have a very simplified view of skill. Failure to take into account the fact that skill is intrinsically a multidimensional object is not only nonsensical, but also misguides both research and the design of social policy.

In this paper, we analyse the consequences and determinants of cognitive and non-cognitive (social) skills at age 7, using data for Great Britain from the National Child Development Study (NCDS).[2] We document the importance of these skills for schooling attainment, labour market outcomes, and social behaviours at various ages, and analyse the role of family background, the home learning environment and school quality in the formation of these skills. We find that non-cognitive skills are very important for a host of outcomes, including schooling, social behaviours, and labour market success. We also find that the early home environment is an important determinant of non-cognitive skills and that these skills appear more malleable than cognitive skills between the ages of 7 and 16.

This paper now proceeds as follows: in Section 2 we provide a brief summary of some recent literature in this area; in Section 3 we describe the data that we use; in Section 4 we analyse the relationship between non-cognitive skills at age 7 and a range of later outcomes – including educational attainment, employment status, wages, smoking, truancy, involvement in crime and health status – both for the sample as a whole and for subgroups defined according to father's socio-economic

[2] We describe the non-cognitive and cognitive skills measures used in more detail in Section 3 and Appendix A respectively.

status; in Section 5 we study the determinants of non-cognitive skills at ages 7, 11 and 16; Section 6 concludes.

2. Literature Review

The number of studies documenting the importance of social skills for a range of outcomes has grown substantially in recent years. Here, we provide a short summary of some of the most recent papers on this topic.[3] As expected, social skills are found to be very important. They are strong determinants of employment status, work experience and wages; they are also important predictors of schooling outcomes. Furthermore, they are shown to be strongly correlated with engagement in a variety of risky behaviours, such as smoking, teenage pregnancy and crime.

One of the most striking examples of the importance of non-cognitive skills is provided by Heckman, Hsee & Rubinstein's (2000) study of the General Educational Development (GED) programme in the US. High-school dropouts in the US (individuals who stop attending high school before they have enough credits for a high-school diploma) have the opportunity of achieving high-school certification by taking the GED exam. However, it was observed by Cameron & Heckman (1993) that GED recipients earned much lower wages than regular high-school graduates, even though their degrees were supposed to be equivalent and – as shown by Heckman, Hsee & Rubinstein (2000) – they demonstrated similar cognitive ability. In fact, controlling for cognitive skill, job training, and years of schooling, GED recipients have lower wages than high-school dropouts *without* a GED degree!

Heckman, Hsee & Rubinstein (2000) go on to investigate why this might be the case. They find that GED recipients are much more likely to exhibit delinquent behaviours in adolescence (such as skipping school, getting into fights, or engaging in

[3] Note that this is not meant to be an exhaustive survey of the literature, but one that provides a sample of representative work in this area.

crime) than either high-school graduates or high-school dropouts (without a GED degree). They are also less likely to be able to hold a job as adults. This indicates that GED recipients are relatively qualified and intelligent individuals, but that they lack skills such as discipline, patience, or motivation, and as a result are penalised in the labour market.

In another paper, Heckman, Stixrud & Urzua (2006) provide direct evidence of the importance of non-cognitive skills by modelling labour market outcomes as a function of measures of self-esteem and locus of control. They show that these variables strongly affect employment status, work experience, occupational choice, and wages. In their paper, if one moves an individual from the 25th to the 75th percentile of the non-cognitive skill distribution, wages improve by about 10 per cent for males and 40 per cent for females. As a comparison, a similar movement in the cognitive skill distribution leads to a wage increase of about 20 per cent for males and 30 per cent for females. Once they condition on schooling, the authors generally find that wages exhibit a stronger gradient with non-cognitive skills than with cognitive skills. In terms of employment probabilities, moving a male up in the non-cognitive skill distribution as described above increases the probability of employment at age 30 by 15 per cent in their paper. Effects on work experience are equally important.

Another interesting paper, Kuhn & Weinberger (2005), finds that males who occupied leadership positions in high school earn between 4 and 33 per cent higher wages as adults; Duncan & Dunifon (1998) show that several measures of motivational traits are good predictors of wages, while Osborne-Groves (2005) shows that personality measures predict labour market outcomes. Bowles, Gintis & Osborne (2001) provide a comprehensive survey of the literature, discussing several studies that find large effects of what they call ‘psychological’ variables on earnings.

In terms of findings for the UK, Feinstein (2000) uses the British Cohort Study (BCS) to document the economic importance of behavioural and psychological attributes of children measured by age 10. In his paper, going from the 20th to the 80th percentile of the distribution of anti-social disorder increases the probability that one experiences an episode of unemployment that lasts for longer than 4 months by 6 per cent for boys. Similarly, an increase from the 20th to the 80th percentile of the self-esteem distribution is associated with an increase in earnings of 5.6 per cent for boys. For girls, the self-esteem variable is not significantly important in predicting wages, but locus of control and other behavioural scores have strong effects: moving up the distribution of these skills as described above leads to increases in wages of 6.3 per cent and 5 per cent respectively.

Blanden, Gregg & Macmillan (2007) argue that non-cognitive variables are important determinants of the degree of intergenerational transmission of income, but that much of this effect can be attributed to the effect of non-cognitive skills on schooling, rather than to their direct effect on earnings.

Given the findings in these papers, it is natural to discuss the role of social skills in promoting educational attainment: Duckworth & Seligman (2005) and Duckworth, Peterson, Matthews & Kelly (2007) are two fascinating examples. The first paper uses two different samples of data to show that self-discipline (on several measures) outdoes IQ as a predictor of the academic performance of adolescents: the authors find that self-discipline measured in the autumn accounts for twice as much variance as IQ in explaining final grades.

The second of these studies examines the relationship between perseverance and long-term goals, again using more than one data-set. The main results show that perseverance accounts, on average, for 4 per cent of the variance in outcomes such as

educational attainment among adults, university marks among students in elite universities, performance in military school and performance in spelling bees. Surprisingly, the authors find that perseverance is not related to IQ.[4]

The paper by Duncan et al. (2007) focuses on school readiness measured at school entry and later educational achievement. This paper is remarkable in examining in a uniform way six different longitudinal studies of children that cover the UK, the US, and Canada. The paper reports that, across the six studies, the best predictors of educational achievement at school entry are maths and reading scores, and attention skills. Other measures of socio-emotional behaviours at school entry had limited power in explaining educational success.

Heckman, Stixrud & Urzua (2006) also examine this issue, and find that non-cognitive skills have a very strong impact on educational attainment. For example, an increase in the non-cognitive score from the 25th to the 75th percentile of its distribution is associated with a 30 per cent increase in the probability of graduating from a four-year college.

We end this short and selective review of the literature by focusing on risky behaviours (such as teenage pregnancy, substance use, and crime) of adolescents and adults. Risky behaviours are of interest for several reasons. First, they are often undesirable in their own right, because they generate large costs to society. Second, they are likely to influence the life of the individuals engaged in such behaviours, preventing them from performing in school or in work, increasing the probability that they spend time in prison or suffer from poor health (for several reasons), or even influencing their chances of forming stable families.

[4] Heckman, Stixrud & Urzua (2006) report a similar result. In their sample, you cannot reject that the correlation between cognitive and non-cognitive skills is equal to zero.

Heckman, Stixrud & Urzua (2006) show that both cognitive and non-cognitive skills influence smoking by age 18, imprisonment, participation in illegal activities, pregnancy by age 18, and marital status. It is both interesting and important that, for many of these behaviours, non-cognitive skills are much more important than cognitive skills.

In this paper, we are able to build on the literature discussed above in several important dimensions. First, most economics studies rely on measures of non-cognitive skills in adolescence and adulthood to explain the relevance of such skills for contemporaneous outcomes. In contrast, the essays in Tremblay, Hartup & Archer (2005) show how the origins of aggression in adolescence and adulthood lie very early in the life cycle, underlining the importance of studying this relationship in a life-cycle setting.[5] Because our data follow individuals through childhood, into adolescence and adulthood, we can analyse the relationship between early non-cognitive skills and later outcomes, thus overcoming potential endogeneity problems.

Second, since we have detailed information on each individual, we can consider a wide range of outcomes beyond schooling and labour market variables. In particular, as in Heckman, Stixrud & Urzua (2006), we can analyse the relationship between early social skills and engagement in risky behaviours – such as teenage motherhood and criminal activity, plus smoking and truancy – at different ages.

Third, our measures of non-cognitive skills during childhood come from teacher assessments, while the early measures of non-cognitive skills used in studies such as Carneiro & Heckman (2003) and Carneiro, Heckman & Masterov (2005)

[5] Carneiro & Heckman (2003) and Carneiro, Heckman & Masterov (2005) also document how gaps in non-cognitive skills emerge early in the life cycle and persist (although they do not analyse the relationship between early measures of non-cognitive skill and later outcomes).

come from maternal assessments.[6] This may be an advantage if one believes that teachers provide more objective measures of social skills than parents.

Fourth, we estimate the impact of cognitive and non-cognitive skills separately for individuals from high and low socio-economic backgrounds, which – to our knowledge – few papers have previously considered.

3. Data

The National Child Development Study (NCDS) comprises detailed longitudinal records for all children born in Great Britain in a single week in March 1958. There have been eight sweeps, the first of which was carried out at birth, with follow-ups at ages 7, 11, 16, 23, 33, 42, and 46. We make use of background characteristics for both the child and their family at birth and age 7, of social and cognitive test results at ages 7, 11 and 16[7], and of various schooling, behavioural, and labour market outcomes at ages 16 and 42.

In this section, we provide further details of the measure of non-cognitive (social) skills that we use. Details of our measure of cognitive skills, the outcome variables under consideration and other background characteristics for which we control can be found in Appendix A.

3.1 Social skills at age 7

The Bristol Social Adjustment Guide (BSAG) is used to measure social *mal*adjustment at ages 7 and 11 in the NCDS.[8] Teachers are given a series of phrases describing particular aspects of behaviour (often ranked according to severity) and are asked to underline those that apply to the child. The phrases are grouped into 12

[6] Currie & Thomas (2001) and Fronstin, Greenberg & Robins (2005) both use the same teacher assessment measures to study the relationship between early test scores and future schooling and labour market outcomes in the NCDS; however, they do not consider adolescent or adult social outcomes.
[7] Note that we use measures of social and cognitive skills at ages 11 and 16 only in assessing the development of such skills over time (see Section 6).
[8] Teacher ratings of social skills at age 16 are based on the Rutter Behavioural Scale (Rutter, 1967).

domains: anxiety for acceptance by children, hostility towards children, hostility towards adults, 'writing off' adults and adult standards, withdrawal, unforthcomingness, depression, anxiety for acceptance by adults, restlessness, inconsequential behaviour, miscellaneous symptoms, and miscellaneous nervous symptoms. Each domain contains a different number of phrases, with one point allocated to each sentence that the teacher underlines.[9]

The BSAG has been used extensively in previous research and has been externally validated in two key ways: first, the results have been checked against other teacher assessments of social maladjustment (plus assessments from professional observers, parents, and peers) and have been found to be significantly positively correlated with these measures (see Achenbach, McConaughy & Howell (1987) for a summary of this literature). Second, greater maladjustment (a higher number of sentences underlined) is frequently associated with more negative social outcomes: for example, individuals who re-offended whilst on probation tended to be more maladjusted than those who did not (Stott, 1960), and of those who had been caught truanting, first-time offenders were found to be less maladjusted than repeat offenders (Stott, 1966).

To generate our primary measure of social skills, the number of sentences underlined in each of the 12 domains were added together to give a total 'social maladjustment' score; we reversed the sign of this score and normalised it to have mean 0 and variance 1.[10]

[9] The distribution of sentences underlined at age 7 can be found in Appendix A (Figure A.1).
[10] The reason for the reversal of sign on the social adjustment measure is to ensure that the likely impacts of social and cognitive skills on particular outcomes go in the same direction – for ease of interpretation.

3.2 Our sample

Table 3.1 provides mean outcomes for individuals who have above- or below-median social adjustment at age 7.[11] This table pre-empts the results discussed in the remainder of this paper, to the extent that there is often a significant difference between the mean outcomes for these two groups. For example, 86.7 per cent of individuals with above-median social skills at age 7 have achieved O-levels or above by age 42 compared with only 71.2 per cent of those with below-median social skills at age 7: this is a difference of 15.5 percentage points (which is significant at the 1 per cent level). On the other hand, 55.7 per cent of individuals with below-median social skills at age 7 have played truant by age 16 compared with 47.1 per cent of those with above-median social skills at the same age.

Table 3.1 Mean outcomes for our sample

Outcome	Above-median social skills at age 7	Below-median social skills at age 7	Difference
Education and labour market outcomes			
O-levels or above highest qualification	0.867	0.712	0.155**
HE highest qualification	0.4	0.25	0.149**
Employment status	0.869	0.82	0.048**
Log hourly wages (£)	2.147	2.057	0.091**
Adolescent social outcomes			
Smoking	0.113	0.151	-0.037**
Truancy	0.471	0.557	-0.086**
Exclusion	0.008	0.02	-0.012**
Crime	0.059	0.149	-0.090**
Teenage motherhood (proportion of females)	0.092	0.172	-0.080**
Adult social outcomes			
Crime	0.225	0.283	-0.057**
Poor or fair health	0.146	0.221	-0.075**
Depression	0.109	0.157	-0.047**
Mental health problems	0.13	0.16	-0.029**

Notes to Table 3.1:

1) The median value of standardised social adjustment at age 7 is 0.317. Note that we only summarise the outcomes of individuals for whom we observe both social and cognitive skills at age 7.
2) With the exception of log hourly wages (reported in pounds), all outcomes are dummy variables, so the values in the table represent the proportion of individuals in our sample who take value 1 for the outcome of interest.
3) ** indicates that differences are significant at the 1 per cent level, * at the 5 per cent level.

[11] Note that the median value of standardised social adjustment at age 7 is 0.317. It is greater than the mean (0 by construction) because the distribution is skewed to the right (i.e. towards individuals showing no signs of maladjustment).

4. Impact of Skills at Age 7 on Later Outcomes

In this section, we consider the impact of social and cognitive skills (measured at age 7) on education and labour market outcomes (Section 4.1), adolescent social outcomes (Section 4.2), and adult social outcomes (Section 4.3). Within each subsection, we consider both the overall impact (on all individuals on our sample), and whether the impact varies by father's socio-economic status (SES).[12]

The basic regression has the following format:[13]

$$D_i = 1 \quad \text{if } \alpha + \beta C_i + \gamma S_i + \phi C_i \times S_i + X_i \varphi + \varepsilon_i > 0$$

where D is a dummy variable indicating whether the individual displays the outcome of interest (for example, whether they have attained a particular qualification or demonstrated a particular social behaviour), C is cognitive skill, S is social skill, $C \times S$ is the interaction between C and S, X is a vector of other controls (including gender, ethnicity, early health/development, family structure, the home learning environment, parental characteristics – including socio-economic status and years of schooling – and local area variables[14]), and ε is a residual which is assumed to have a standard normal distribution. We estimate probit regressions (ordinary least squares (OLS) regressions for log hourly wages) and report marginal effects (evaluated at the mean value of the covariates).

4.1 Education and labour market outcomes

Table 4.1 reports estimates of the impact of our measures of social and cognitive skills (plus a host of other variables – see Appendix A for details) on two indicators of educational attainment – whether the cohort member has O-levels (or equivalent) or

[12] Cohort members are assigned to the 'low father's SES' subgroup if their father worked in a manual occupation (or lower) at the time of their birth and to the 'high father's SES' subgroup otherwise.
[13] The only outcome for which this model is not relevant is log hourly wages (Section 4.1), for which we use ordinary least squares (OLS) regression; C, S, $C \times S$, X, and ε are defined in the same way.
[14] See Section A.3 of Appendix A for the full list of background characteristics for which we control.

above, and whether they have a degree from a higher eduation institution, by age 42 – and two labour market outcomes – employment status and log hourly wages (in pounds) at age 42.

Table 4.1 Impact of a standardised social adjustment score (and other variables) on selected education and labour market outcomes

	Highest qualification O-levels or above	Highest qualification HE degree or above	Employment status		Log hourly wage (£)	
			Without education	With education	Without education	With education
Mean outcome in population	0.797	0.33	0.845		2.11	
Social skills at age 7	0.028 [0.004]**	0.036 [0.006]**	0.021 [0.008]**	0.01 [0.009]	0.025 [0.007]**	0.016 [0.021]
Cognitive skills at age 7	0.136 [0.006]**	0.153 [0.008]**	0.029 [0.011]**	0.034 [0.014]*	0.157 [0.010]**	0.057 [0.031]
Cognitive× Social skills at age 7	0.005 [0.005]	-0.005 [0.009]	-0.012 [0.006]**	-0.008 [0.005]	0.003 [0.009]	-0.007 [0.010]
Female	-0.084 [0.007]**	-0.06 [0.010]**	-0.124 [0.042]**	-0.117 [0.007]**	-0.41 [0.012]**	-0.375 [0.011]**
Father's years of education	0.017 [0.004]**	0.017 [0.004]**	-0.001 [0.003]	-0.002 [0.003]	0.021 [0.004]**	0.015 [0.004]**
Mother's years of education	0.026 [0.005]**	0.028 [0.004]**	0.001 [0.003]	-0.001 [0.003]	0.02 [0.005]**	0.008 [0.005]
High father's SES[15]	0.078 [0.014]**	0.149 [0.018]**	0.002 [0.012]	-0.01 [0.012]	0.109 [0.021]**	0.058 [0.020]**
Medium father's SES[16]	0.034 [0.008]**	0.065 [0.013]**	0.009 [0.009]	0.002 [0.009]	0.056 [0.015]**	0.037 [0.014]**
Any serious difficulties in the family (age 7)	-0.015 [0.010]	-0.022 [0.016]	-0.046 [0.019]**	-0.044 [0.010]**	-0.018 [0.019]	-0.01 [0.018]
Low birth weight or premature	-0.017 [0.014]	-0.056 [0.018]**	-0.005 [0.013]	-0.001 [0.013]	-0.03 [0.023]	-0.013 [0.022]
Mother heavy smoker (during pregnancy)	-0.02 [0.009]*	-0.019 [0.013]	-0.006 [0.009]	-0.004 [0.009]	-0.017 [0.015]	-0.007 [0.014]
Highest qualification Level 1 (age 42)				0.069 [0.011]**		0.033 [0.033]
Highest qualification Level 2 (age 42)				0.08 [0.012]**		0.14 [0.029]**
Highest qualification Level 3 (age 42)				0.082 [0.011]**		0.227 [0.031]**
Highest qualification Level 4 (age 42)				0.113 [0.011]**		0.427 [0.030]**
Highest qualification Level 5 (age 42)				0.1 [0.012]**		0.563 [0.043]**
Observations	10,123	10,123	10,111		7,079	
R-squared					0.264	0.334

Notes to Table 4.1:

1) Models considering highest educational qualification and those using the 'without education' specification control for gender, ethnicity, early health/development, family structure, the home learning environment, parental characteristics (including socio-economic status and years of schooling), and local area variables (see Appendix A for more details). Models using the 'with education' specification additionally control for a series of dummy variables indicating the cohort

[15] High SES (socio-economic status) is defined here as working in a professional occupation.
[16] Medium SES is defined as working in a non-manual (non-professional) occupation.

member's highest qualification at age 42 (the missing dummy is having no qualifications); each of these education variables is also interacted with our measures of social and cognitive skills at age 11.

2) We report the coefficients (and associated standard errors) from the OLS models and the marginal effects (and associated standard errors) from the probit models; however, the significance levels for the probits are based on the coefficients (and associated standard errors). Standard errors are shown in square brackets: * denotes significance at the 5 per cent level and ** at the 1 per cent level.

For the labour market outcomes, two specifications are considered: one with controls for educational attainment and one without. This allows us to assess whether the effect of social and cognitive skills works solely through their impact on educational attainment, or whether there is an additional effect over and above that on qualifications.

Table 4.1 shows that – while not quite as important as cognitive skills – social skills at age 7 matter for educational attainment at age 42: an increase of one standard deviation in terms of social adjustment at age 7 is associated with a 2.8 percentage point (3.8 per cent) increase in the likelihood of having O-levels or above as your highest qualification at age 42, and a 3.6 percentage point (10.9 per cent) rise in the probability that your highest qualification at that age is a higher-education degree. These effects are of similar magnitude to a one-year increase in the number of years of mother's education.

Looking first at the 'without education' specification for labour market outcomes, it is clear that age 7 social skills are significantly correlated with both employment status and log hourly wages at age 42: a one standard deviation increase in social adjustment at age 7 is associated with a 2.1 percentage point (2.5 per cent) increase in the probability of being in work at age 42, and a 2.5 per cent increase in hourly wages at the same age. Once we control for educational attainment (the 'with education' specification), however, these effects become insignificant, suggesting that social skills only affect employment and wages indirectly via educational attainment.

Table 4.2 provides estimates of the impact of social and cognitive skills at age 7 on selected education and labour market outcomes by father's socio-economic status. As one would expect, there are large differences in the mean educational outcomes achieved: individuals from the low father's SES subgroup are 14.9 (= 100×[0.83-0.681]) percentage points less likely to have obtained O-levels or above by age 42 than cohort members from the high father's SES group, and 17.6 percentage points less likely to have obtained a higher-education degree. Differences in labour market outcomes are somewhat smaller, being only 4 percentage points for the probability of being in work at age 42 and 18 pence for hourly wages.

Table 4.2 Impact of a standardised social adjustment score (and other variables) on education and labour market outcomes, by father's SES

	Highest qualification O-levels or above	Highest qualification HE degree or above	Employment status	Log hourly wage (£)
Low father's SES				
Mean outcome in population	0.681	0.191	0.815	1.97
Social skills at age 7	0.054 [0.013]**	0.034 [0.010]**	0.033 [0.010]**	0.023 [0.016]
Cognitive skills at age 7	0.201 [0.018]**	0.099 [0.013]**	0.019 [0.013]	0.149 [0.020]**
Cognitive×Social skills at age 7	0.025 [0.015]	-0.016 [0.014]	-0.022 [0.011]*	-0.015 [0.018]
Observations	2,163	2,160	2,131	1,503
R-squared				0.262
High father's SES				
Mean outcome in population	0.83	0.367	0.855	2.15
Social skills at age 7	0.023 [0.004]**	0.034 [0.007]**	0.017 [0.009]**	0.027 [0.008]**
Cognitive skills at age 7	0.116 [0.006]**	0.167 [0.010]**	0.029 [0.015]**	0.159 [0.011]**
Cognitive×Social skills at age 7	0.002 [0.005]	0.004 [0.010]	-0.008 [0.007]	0.01 [0.011]
Observations	7,855	7,855	7,850	5,512
R-squared				0.26
Difference (low father's SES-high father's SES)				
Social skills at age 7	0.032*	0.000	0.017	-0.003
Cognitive skills at age 7	0.085**	-0.067**	-0.010	-0.010
Cognitive×Social skills at age 7	0.023	-0.020	-0.014	-0.026

Notes to Table 4.2:

1) All models contain controls for gender, ethnicity, early health/development, family structure, the home learning environment, parental characteristics (including years of schooling, but excluding socio-economic status), and local area variables (see Appendix A for more details). Note that we do *not* include controls for highest qualification in these models.
2) We report the coefficients (and associated standard errors) from the OLS models and the marginal effects (and associated standard errors) from the probit models; however, the significance levels for

the probits are based on the coefficients (and associated standard errors). Standard errors are shown in square brackets: * denotes significance at the 5 per cent level and ** at the 1 per cent level.

Table 4.2 shows that while social skills have a positive and significant effect on educational attainment for both subgroups and at both qualification levels, their impact on the probability of obtaining at least O-levels by age 42 is significantly greater for cohort members from the low father's SES group than it is for cohort members from the high father's SES group. This is illustrated by the fact that a one standard deviation increase in social adjustment at age 7 is associated with a 5.4 percentage point (7.9 per cent) increase in the likelihood of obtaining O-levels or above by age 42 for those amongst the low SES subgroup, but only a 2.3 percentage point (2.8 per cent) increase for those amongst the high SES subgroup.

It is interesting to note that while the impact of cognitive skills at age 7 on the likelihood of obtaining O-levels or above by age 42 is significantly *higher* (by 8.5 percentage points) for cohort members from the low father's SES subgroup than for cohort members from the high father's SES subgroup, the impact of age 7 cognitive skills on the probability of having a higher-education degree by age 42 is significantly *lower* amongst cohort members from the low SES group (by 6.7 percentage points).

These differences may arise for one of two reasons: first, the technology of cognitive skill formation from age 7 onwards may differ according to socio-economic status, such that individuals with similar cognitive abilities at age 7 end up with different cognitive abilities by age 42. Second, individuals from different social backgrounds may have similar cognitive abilities at later ages, but may differ in terms of their propensity to go obtain a degree. Recent work by Chowdry et al (2008) suggests that the former explanation may be the more plausible.

In terms of employment status at age 42, social skills at age 7 seem to matter more (although not significantly so) for individuals from low SES backgrounds than

they do for individuals from high SES backgrounds. Furthermore, social skills matter more (in terms of employment outcomes) than cognitive skills for individuals from low SES families: a one standard deviation increase in social adjustment at age 7 is associated with a 3.3 percentage point (4 per cent) increase in the likelihood of being in work at age 42 (compared with a 1.7 percentage point (2 per cent) increase for those from high SES families), while a one standard deviation increase in cognitive skills at age 7 is only associated with a 1.9 percentage point (2.3 per cent) insignificant rise in the probability of being employed for cohort members from low SES families.

For wages, on the other hand, coefficients are of similar sign and magnitude for individuals from low and high SES backgrounds. Moreover, the impact of cognitive skills on hourly wages is considerably larger (by a factor of about six) than the impact of social skills for both groups.

4.2 Adolescent social outcomes

Table 4.3 considers the impact of social and cognitive skills at age 7 (plus a range of other factors, detailed in Appendix A) on whether the individual was a heavy smoker at age 16, whether they ever played truant from school, whether they were ever excluded from school, whether they had been in trouble with the police or a court by age 16, and (for girls) whether they had their first child as a teenager. As these outcomes can be thought of as negative social outcomes, it is important (but perhaps somewhat unsurprising) that good social skills at age 7 have a negative (and significant) impact on all but the probability of being a teenage mother. For example, a one standard deviation increase in social adjustment at age 7 is associated with a 1.6 percentage point (15.7 per cent) reduction in the likelihood of having been in trouble with the police or a court (crime) by age 16.

Table 4.3 Impact of a standardised social adjustment score (and other variables) on adolescent social outcomes

	Smoking	Truancy	Exclusion	Crime	Teen mum
Mean outcome in population	0.13	0.51	0.014	0.102	0.125
Social skills at age 7	-0.013 [0.004]**	-0.022 [0.006]**	-0.002 [0.020]**	-0.016 [0.012]**	-0.01 [0.006]
Cognitive skills at age 7	0.011 [0.005]*	0.001 [0.008]	0.001 [0.008]	-0.013 [0.011]**	-0.033 [0.012]**
Cognitive×Social skills at age 7	-0.013 [0.004]**	-0.023 [0.006]**	0.001 [0.005]	-0.002 [0.003]	-0.011 [0.006]
Female	-0.068 [0.006]**	-0.006 [0.009]	-0.005 [0.048]**	-0.092 [0.066]**	
Father's years of education	-0.002 [0.003]	-0.004 [0.004]	0.001 [0.008]	-0.005 [0.004]*	-0.006 [0.005]
Mother's years of education	-0.001 [0.003]	-0.018 [0.004]**	0 [0.004]	-0.003 [0.003]	-0.008 [0.005]
High father's SES[17]	-0.03 [0.012]*	-0.113 [0.017]**	-0.005 [0.051]*	-0.036 [0.028]**	-0.054 [0.023]**
Medium father's SES[18]	-0.014 [0.008]	-0.024 [0.012]*	-0.001 [0.007]	-0.011 [0.009]*	-0.009 [0.009]
Any serious difficulties in the family (age 7)	0.029 [0.009]**	0.032 [0.014]*	0.002 [0.018]	0.024 [0.019]**	0.024 [0.013]*
Low birth weight or premature	0.011 [0.013]	-0.036 [0.018]*	0.001 [0.014]	0.008 [0.011]	-0.016 [0.014]
Mother a heavy smoker (during pregnancy)	0.019 [0.008]*	0.053 [0.012]**	0.002 [0.023]	0.02 [0.015]**	0.022 [0.011]*
Observations	10,533	12,511	9,737	12,096	5,585

Notes to Table 4.3:

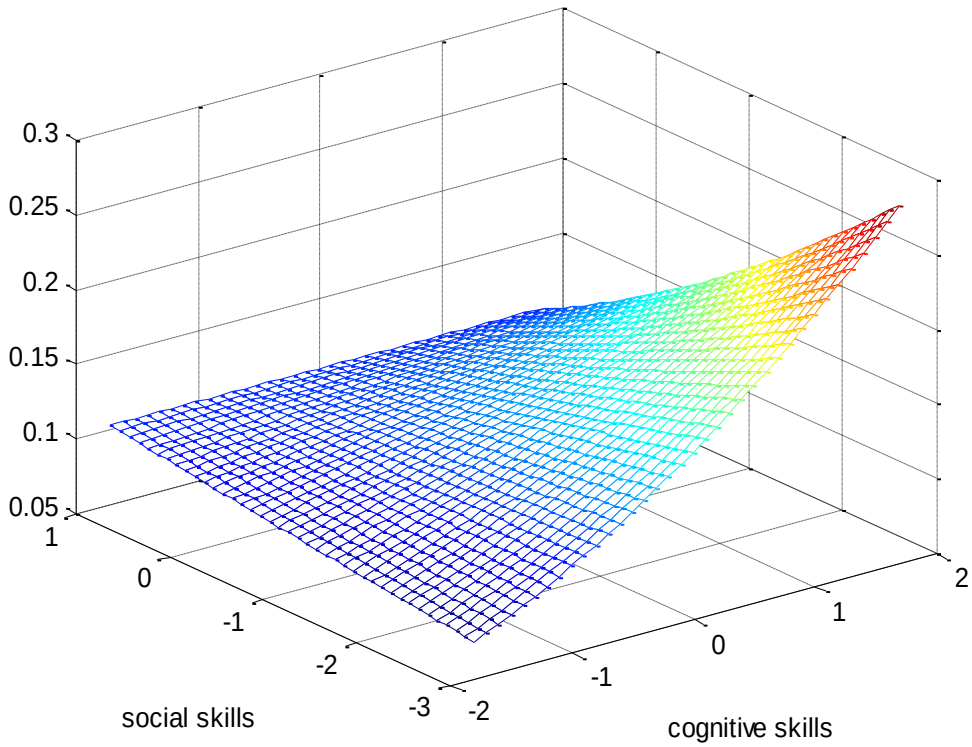
1) All models contain controls for gender, ethnicity, early health/development, family structure, the home learning environment, parental characteristics (including socio-economic status and years of schooling), and local area variables (the only exception being that the teenage motherhood equation does not – for obvious reasons – include a female dummy). Details can be found in Appendix A.
2) We report the marginal effects (and associated standard errors) from the probit models; however, the significance levels are based on the coefficients (and associated standard errors). Standard errors are shown in square brackets: * denotes significance at the 5 per cent level and ** at the 1 per cent level.

The results for smoking are particularly interesting and are shown graphically in Figure 4.1 below. This Figure shows that when social skills are fixed at a low level, the probability that an individual smokes more than 40 cigarettes per week (at age 16) is increasing in cognitive skills. Furthermore, when cognitive skills are fixed at a *high* level, the likelihood of being a heavy smoker is *decreasing* in social skills. Taken together, these results suggest that it is individuals with good cognitive skills and poor social skills who are most likely to be heavy smokers at age 16. This may seem an unlikely combination, but would be consistent with a story in which children from

[17] High SES (socio-economic status) is defined here as working in a professional occupation.
[18] Medium SES is defined as working in a non-manual (non-professional) occupation.

high-income families rebel and take up smoking: these individuals probably exhibit relatively high cognitive skills and are more likely to have access to the resources to buy at least two packets of cigarettes per week than children from less affluent backgrounds.

Figure 4.1 Whether the individual was a heavy smoker (at age 16) as a function of social and cognitive skills at age 7



Notes to Figure 4.1:

1) Figure 4.1 presents the predicted probability that an individual is a heavy smoker (defined as smoking more than 40 cigarettes per week) at age 16 for different values of cognitive and social skills, fixing all other control variables at their mean values in the sample (see Table A.1 in Appendix A for some mean values of key variables).
2) The control variables include gender, ethnicity, early health/development, family structure, the home learning environment, parental characteristics (including socio-economic status and years of schooling), and local area variables. Details can be found in Appendix A.

Table 4.4 presents estimates of the impact of social and cognitive skills (and their interaction) on adolescent social outcomes separately for individuals from low and high socio-economic backgrounds. This table makes clear that there are differences across subgroups in terms of the likelihood of exhibiting these risky behaviours: for example, cohort members from high SES backgrounds are 11.9

percentage points less likely to have played truant than cohort members from low SES backgrounds.

Table 4.4 Impact of a standardised social adjustment score (and other variables) on adolescent social outcomes, by father's SES

	Smoking	Truancy	Exclusion	Crime	Teen mum
Low father's SES					
Mean outcome in population	0.165	0.604	0.02	0.154	0.187
Social skills at age 7	-0.017	-0.03	-0.001	-0.025	-0.037
	[0.009]	[0.012]*	[0.001]	[0.007]**	[0.014]**
Cognitive skills at age 7	0.016	0.002	0.001	-0.022	-0.03
	[0.012]	[0.015]	[0.001]	[0.009]*	[0.017]
Cognitive×Social skills at age 7	-0.017	-0.037	0	-0.001	-0.029
	[0.010]	[0.012]**	[0.001]	[0.007]	[0.014]*
Observations	2,309	2,826	1,606	2,720	1,204
High father's SES					
Mean outcome in population	0.122	0.485	0.012	0.086	0.105
Social skills at age 7	-0.011	-0.02	-0.001	-0.014	-0.004
	[0.004]**	[0.006]**	[0.000]*	[0.056]**	[0.005]
Cognitive skills at age 7	0.009	-0.006	0	-0.011	-0.033
	[0.006]	[0.009]	[0.001]	[0.047]**	[0.006]**
Cognitive×Social skills at age 7	-0.01	-0.02	0	-0.003	-0.009
	[0.005]*	[0.008]**	[0.000]	[0.012]	[0.006]
Observations	8,087	9,535	7,391	9,235	4,309
Difference (low father's SES-high father's SES)					
Social skills at age 7	-0.005	-0.010	0.000	-0.012	-0.033*
Cognitive skills at age 7	0.008	0.008	0.001	-0.011	0.003
Cognitive×Social skills at age 7	-0.007	-0.016	0.000	0.001	-0.020

Notes to Table 4.4:

1) All models contain controls for gender, ethnicity, early health/development, family structure, the home learning environment, parental characteristics (including years of schooling, but excluding socio-economic status), and local area variables (see Appendix A for more details).
2) We report the marginal effects (and associated standard errors) from the probit models; however, the significance levels are based on the coefficients (and associated standard errors). Standard errors are shown in square brackets: * denotes significance at the 5 per cent level and ** at the 1 per cent level.

Table 4.4 provides some evidence to suggest that – in terms of adolescent social outcomes – individuals from low SES backgrounds may benefit more from policies designed to improve social skills in childhood than individuals from high SES backgrounds.[19] This is particularly true in the case of teenage motherhood. In this case, the overall insignificant estimate (shown in Table 4.3) concealed variation across subgroups according to father's socio-economic status: while a one standard deviation increase in social adjustment at age 7 would reduce the likelihood of giving

[19] While many of the coefficients are insignificant for the low SES group, the point estimates are often larger than those for the high SES group, suggesting that this insignificance may be due to relatively smaller sample sizes amongst the low SES group.

birth as a teenager by 3.7 percentage points (19.8 per cent) for girls from low SES backgrounds, it would only reduce the probability of teenage motherhood by an insignificant 0.4 percentage points (3.8 per cent) for girls from high SES backgrounds.

4.3 Adult social outcomes

Table 4.5 provides estimates of the impact of social and cognitive skills (plus a range of other variables – see Appendix A for details) on the probabilities that individuals have had dealings with the police or a court between ages 33 and 42, that self-reported health status is fair or poor (rather than good or excellent) at age 42, and that responses to two separate medical questionnaires indicate that individuals are suffering from depression or other mental health problems (assessed at age 42).

This Table confirms that social skills at age 7 exert a negative and significant influence on each of these adult social outcomes, with estimates ranging from 1.2 percentage points (crime) to 1.9 percentage points (health status and depression). This means, for example, that a one standard deviation increase in social adjustment at age 7 is associated with a 1.9 percentage point (14.3 per cent) reduction in the probability that the cohort member is deemed to be suffering from depression at age 42 (holding all else constant).

Interestingly, whether the mother was a heavy smoker during pregnancy has a large and significant impact on self-reported health status at age 42 – this variable is associated with a 4.2 percentage point (23.1 per cent) increase in the probability that the individual reports poor or fair health (rather than good or excellent health) at age 42 – while low birth weight does not appear to be important.[20]

[20] This may be, for example, because of the U-shaped relationship between birth weight and adult health status, as found for this cohort in Case, Fertig & Paxson (2003).

Table 4.5 Impact of a standardised social adjustment score (and other variables) on adult social outcomes

	Crime	Poor or fair health	Depression	Mental health problems
Mean outcome in population	0.253	0.182	0.133	0.143
Social skills at age 7	-0.012 [0.005]*	-0.019 [0.009]**	-0.019 [0.004]**	-0.016 [0.007]**
Cognitive skills at age 7	-0.007 [0.007]	-0.042 [0.018]**	-0.026 [0.005]**	-0.001 [0.006]
Cognitive×Social skills at age 7	0.003 [0.006]	-0.005 [0.006]	-0.001 [0.005]	-0.007 [0.005]
Female	-0.242 [0.009]**	0.01 [0.009]	0.063 [0.007]**	0.054 [0.020]**
Father's years of education	-0.002 [0.003]	0.003 [0.003]	-0.003 [0.003]	0.004 [0.003]
Mother's years of education	0.004 [0.004]	-0.009 [0.005]*	0.004 [0.003]	0.001 [0.003]
High father's SES[21]	-0.01 [0.016]	-0.037 [0.020]**	-0.024 [0.012]*	-0.004 [0.013]
Medium father's SES[22]	-0.01 [0.011]	-0.025 [0.014]**	-0.016 [0.008]*	-0.007 [0.009]
Any serious difficulties in the family (age 7)	0.024 [0.014]	0.035 [0.018]**	0.039 [0.010]**	0.03 [0.015]**
Low birth weight or premature	0.009 [0.017]	0.021 [0.017]	0.016 [0.013]	0.012 [0.015]
Mother a heavy smoker (during pregnancy)	0.045 [0.011]**	0.042 [0.019]**	0.015 [0.008]	0.015 [0.010]
Observations	10,015	10,123	10,005	10,013

Notes to Table 4.5:

1) All models contain controls for gender, ethnicity, early health/development, family structure, the home learning environment, parental characteristics (including socio-economic status and years of schooling), and local area variables. Details can be found in Appendix A.
2) We report the marginal effects (and associated standard errors) from the probit models; however, the significance levels are based on the coefficients (and associated standard errors). Standard errors are shown in square brackets: * denotes significance at the 5 per cent level and ** at the 1 per cent level.

Table 4.6 documents the impact of social and cognitive skills (and their interaction) at age 7 on adult social outcomes for individuals from low and high socio-economic backgrounds. This Table shows that individuals from the low father's SES subgroup are 7.1 percentage points less likely to report poor or fair health (rather than good or excellent health) at age 42 than individuals from the high father's SES subgroup, and are 5 percentage points more likely to be reported as suffering from depression at the same age.

[21] High SES (socio-economic status) is defined here as working in a professional occupation.
[22] Medium SES is defined as working in a non-manual (non-professional) occupation.

Table 4.6 Impact of a standardised social adjustment score (and other variables) on adult social outcomes, by father's SES

	Crime	Poor or fair health	Depression	Mental health problems
Low father's SES				
Mean outcome in population	0.264	0.235	0.171	0.153
Social skills at age 7	-0.013 [0.012]	-0.051 [0.011]**	-0.034 [0.010]**	-0.032 [0.009]**
Cognitive skills at age 7	-0.02 [0.016]	-0.05 [0.015]**	-0.023 [0.013]	0.006 [0.013]
Cognitive×Social skills at age 7	-0.006 [0.014]	-0.03 [0.012]*	-0.013 [0.011]	-0.02 [0.011]
Observations	2,125	2,155	2,125	2,119
High father's SES				
Mean outcome in population	0.248	0.164	0.121	0.139
Social skills at age 7	-0.013 [0.006]*	-0.011 [0.007]*	-0.014 [0.004]**	-0.012 [0.007]**
Cognitive skills at age 7	-0.003 [0.008]	-0.042 [0.020]**	-0.026 [0.006]**	-0.003 [0.007]
Cognitive×Social skills at age 7	0.007 [0.007]	-0.003 [0.006]	0.000 [0.005]	-0.005 [0.006]
Observations	7,784	7,855	7,767	7,773
Difference (low father's SES-high father's SES)				
Social skills at age 7	0.000	-0.039**	-0.020	-0.020
Cognitive skills at age 7	-0.018	-0.008	0.004	0.009
Cognitive×Social skills at age 7	-0.014	-0.027*	-0.014	-0.015

Notes to Table 4.6:

1) All models contain controls for gender, ethnicity, early health/development, family structure, the home learning environment, parental characteristics (including years of schooling, but excluding socio-economic status), and local area variables (see Appendix A for more details).
2) We report the marginal effects (and associated standard errors) from the probit models; however, the significance levels are based on the coefficients (and associated standard errors). Standard errors are shown in square brackets: * denotes significance at the 5 per cent level and ** at the 1 per cent level.

The impact of social skills at age 7 on health status at age 42 also differs according to socio-economic background: a one standard deviation increase in social adjustment at age 7 is associated with a 5.1 percentage point (21.7 per cent) reduction in the likelihood of reporting poor or fair health for individuals from low SES backgrounds, but only a 1.1 percentage point (6.7 per cent) reduction for individuals from high SES backgrounds. This suggests that policies designed to develop social adjustment at age 7 may improve health outcomes more for individuals from low SES backgrounds than for individuals from high SES backgrounds.

4.4 Summary

The results presented in this section have demonstrated the importance of social skills for a range of outcomes – in particular, educational attainment and adolescent and adult social outcomes. Where there are significant differences across subgroups (defined according to socio-economic status), it is always the case that cohort members from low father's SES backgrounds benefit relatively more from good social skills than cohort members from high father's SES backgrounds. This suggests that policies designed to improve social adjustment in childhood may reduce inequality across a range of later outcomes.

5. The Home Learning Environment and Skill Formation

In Section 4, we saw the importance of social and cognitive skills for a range of outcomes. In this section, we explore the development of these skills from birth to age 16. Table 5.1 presents results from a simple ordinary least squares (OLS) model, in which we regress our standardised measures of social and cognitive skills at ages 7, 11 and 16 on a host of background characteristics. From these results, it is clear that family background, the home learning environment and (to some extent) school quality are all extremely important for skill development in childhood.

By age 7, gaps in social and cognitive abilities have already emerged according to socio-economic status, with children from both professional and non-manual family backgrounds exhibiting significantly greater cognitive and social skills than children from manual backgrounds (holding all else constant). Interestingly, in contrast to the findings for socio-economic status, years of mother's and father's education do not appear to affect social skills at ages 7, 11 or 16 (although years of parental education does exert a positive and significant effect on cognitive skills at these ages).

Whilst the number of years of formal education of the parents does not appear to matter for social skill development, other aspects of the home learning environment – such as whether the parents show an interest in their child's education – are extremely important. We can see from Table 5.1 that if mothers who currently show little interest in their child's education were to change their behaviour in this respect, the additional attention would be associated with an increase of nearly half a standard deviation in social skills at age 7 (and smaller – but still significant – increases at ages 11 and 16).

The home environment more generally also plays a valuable role in early skill development: serious difficulties in the family – alcoholism, mental health issues, divorce, and so on – observed by the health visitor at age 7 are associated with lower social and cognitive skills at 7, 11 and 16; birth order is also important over time, with those with many younger siblings faring worse than those with only older siblings.

The child's own early developmental outcomes – including whether or not they could walk alone by age 1½ years, whether they could speak by age 2, and whether they still wet themselves by day beyond age 3 (described together as 'slow early development' in Table 5.1), plus poor health or disability at birth and/or during early childhood – are also extremely important in explaining social and cognitive skills at age 7, but only have a direct impact on cognitive skills at age 11 (and on neither at age 16).

Table 5.1 Impact of family background, the home learning environment and school quality on social and cognitive skills at ages 7, 11 and 16

	Age 7		Age 11		Age 16	
	Social skills	Cognitive skills	Social skills	Cognitive skills	Social skills	Cognitive skills
Female	0.274	0.026	0.211	-0.05	0.062	-0.158
	[0.015]**	[0.011]*	[0.016]**	[0.009]**	[0.019]**	[0.010]**
Father's years of education	0.006	0.019	-0.001	0.021	0.001	0.013
	[0.006]	[0.004]**	[0.006]	[0.004]**	[0.007]	[0.004]**
Mother's years of education	0.001	0.032	0.011	0.033	0.003	0.015
	[0.007]	[0.005]**	[0.007]	[0.004]**	[0.008]	[0.004]**
Father's social class – professional	0.096	0.196	0.081	0.188	0.102	0.1
	[0.028]**	[0.020]**	[0.029]**	[0.017]**	[0.034]**	[0.018]**
Father's social class – non-manual	0.047	0.095	0.054	0.05	0.058	0.031
	[0.019]*	[0.014]**	[0.020]**	[0.012]**	[0.023]*	[0.012]*
Mother shows little interest in child's education	-0.442	-0.259	-0.091	-0.041	-0.14	-0.047
	[0.030]**	[0.021]**	[0.031]**	[0.018]*	[0.037]**	[0.020]*
Father shows little interest in child's education	-0.31	-0.21	-0.037	-0.089	-0.069	-0.047
	[0.031]**	[0.022]**	[0.032]	[0.019]**	[0.038]	[0.020]*
Mother reads news most days and books most weeks	-0.011	0.064	-0.012	0.066	0.005	0.011
	[0.019]	[0.013]**	[0.019]	[0.011]**	[0.022]	[0.012]
Father reads news most days and books most weeks	0.077	0.09	-0.013	0.039	-0.009	0.036
	[0.018]**	[0.013]**	[0.018]	[0.011]**	[0.021]	[0.011]**
Low birth weight or premature	-0.089	-0.159	-0.025	-0.065	0.067	-0.045
	[0.030]**	[0.021]**	[0.031]	[0.018]**	[0.036]	[0.019]*
Early illness or handicap	-0.31	-0.356	0.003	-0.07	0.015	-0.017
	[0.027]**	[0.019]**	[0.028]	[0.016]**	[0.033]	[0.017]
Slow early development	-0.228	-0.264	-0.033	-0.079	-0.035	0.013
	[0.024]**	[0.017]**	[0.025]	[0.015]**	[0.029]	[0.015]
Mother a heavy smoker (during pregnancy)	-0.06	-0.017	-0.066	-0.011	-0.092	0.011
	[0.020]**	[0.014]	[0.021]**	[0.012]	[0.024]**	[0.013]
Ever in care (by age 7)	-0.363	-0.129	-0.05	-0.011	-0.187	-0.028
	[0.058]**	[0.041]**	[0.059]	[0.035]	[0.072]**	[0.038]
Only child (by age 7)	-0.083	-0.015	-0.064	-0.052	-0.042	0
	[0.035]*	[0.025]	[0.036]	[0.021]*	[0.042]	[0.022]
Number of younger siblings at age 7	-0.032	-0.042	-0.037	-0.02	-0.053	-0.017
	[0.009]**	[0.007]**	[0.009]**	[0.006]**	[0.011]**	[0.006]**
Any serious difficulties in the family at age 7	-0.152	-0.146	-0.087	-0.04	-0.114	0.004
	[0.023]**	[0.016]**	[0.024]**	[0.014]**	[0.029]**	[0.015]
Social skills at age 7			0.268	0.078	0.068	0.022
			[0.009]**	[0.006]**	[0.012]**	[0.006]**
Cognitive ability at age 7			0.228	0.646	-0.015	0.119
			[0.013]**	[0.008]**	[0.019]	[0.010]**
Cognitive×Social skills at age 7			-0.022	0.022	-0.022	-0.02
			[0.011]*	[0.006]**	[0.014]	[0.007]**
Pupil-teacher ratio at age 11			0	0	0	0
			[0.001]	[0.001]	[0.001]	[0.001]
Social skills at age 11					0.227	0.069
					[0.012]**	[0.006]**
Cognitive ability at age 11					0.178	0.744
					[0.018]**	[0.010]**
Cognitive×Social skills at age 11					-0.051	0.029
					[0.012]**	[0.007]**
Pupil-teacher ratio at age 16					-0.006	-0.006
					[0.004]	[0.002]**
Observations	14,932	15,038	12,765	12,756	9,080	9,416
R-squared	0.153	0.22	0.236	0.591	0.266	0.741

Notes to Table 5.1:

1) All models contain controls for gender, ethnicity, early health/development, family structure, the home learning environment, parental characteristics (including socio-economic status and years of schooling), and local area variables. Details can be found in Appendix A.
2) Standard errors are shown in square brackets: * denotes significance at the 5 per cent level and ** at the 1 per cent level.

The results in Table 5.1 also confirm the notion that 'skills beget skills': cognitive and social skills (and their interaction) at age 7 (age 11) are important factors in explaining social and cognitive performance at age 11 (age 16). Furthermore, the magnitudes of these coefficients provide some suggestive evidence that – on average, at least – social skills may be more malleable than cognitive skills between the ages of 7 and 16. This is because the regressions reveal a stronger correlation (conditional on other background factors) between cognitive skills over time than between social skills over time. For example, the coefficient on the age 7 cognitive test score in the age 11 cognitive test regression is 0.646, compared with a coefficient of 0.268 on the age 7 social adjustment score in the age 11 social adjustment regression. Similarly, the coefficient on the age 11 cognitive test score in the age 16 cognitive test regression is 0.744, compared with a coefficient of 0.227 on the age 7 social adjustment score in the age 16 social adjustment regression.

The intuition that social skills exhibit greater mobility than cognitive skills is also confirmed in Tables 5.2 to 5.5, which show transition matrices for social adjustment and cognitive test scores between the ages of 7 and 11, and 11 and 16. To produce these, we divide the population into quartiles[23] at each age, and calculate the probabilities of moving between quartiles over time. These probabilities can provide useful information about the potential malleability of social versus cognitive skills.

[23] As a result of the rather skewed nature of the distribution of social adjustment scores, our social adjustment quartiles do not contain exactly 25 per cent of the NCDS population (see Notes to Tables 5.2 and 5.4 for more information).

For example, from Table 5.2 below, we see that 47 per cent of children in the most socially maladjusted quartile of the population at age 7 were still in the most socially maladjusted quartile at age 11, while for cognitive test scores (Table 5.3), the proportion was 65 per cent.

Table 5.2 Transition matrix for social adjustment scores between ages 7 and 11

Age 7 ↓ Age 11 →	Most maladjusted	2nd	3rd	Least maladjusted
Most maladjusted	0.47	0.30	0.13	0.09
2nd	0.25	0.33	0.24	0.18
3rd	0.16	0.28	0.25	0.31
Least maladjusted	0.09	0.24	0.27	0.40
Immobility index for social adjustment scores: 3.09				

Notes to Table 5.2:

1) Individuals are only counted in this transition matrix if they have both age 7 and age 11 social adjustment scores recorded. This is to ensure that the transition probabilities are not biased by differential composition of the age 7 and age 11 populations.
2) Because of the distribution of social adjustment scores, each 'quartile' contains approximately, rather than exactly, one quarter of the population. Transition probabilities are therefore presented for transitions from age 7 to age 11, i.e. the row probabilities sum to 1. The immobility index based on column rather than row probabilities shows a very similar picture, with an index of 3.11 for social adjustment.

Table 5.3 Transition matrix for cognitive test scores between ages 7 and 11

Age 7 ↓ Age 11 →	Lowest cognitive ability	2nd	3rd	Highest cognitive ability
Lowest cognitive ability	0.65	0.26	0.08	0.02
2nd	0.25	0.37	0.26	0.11
3rd	0.07	0.27	0.37	0.28
Highest cognitive ability	0.03	0.10	0.28	0.59
Immobility index for cognitive test scores: 3.59				

Note to Table 5.3:

1) Individuals are only counted in this transition matrix if they have both age 7 and age 11 cognitive test scores recorded. This is to ensure that the transition probabilities are not biased by differential composition of the age 7 and age 11 populations.

These differences are even more pronounced when we consider transitions between the ages of 11 and 16. For example, from Table 5.4, we see that only 39 per cent of children in the most maladjusted quartile at age 11 are still there at age 16. For cognitive test scores (Table 5.5), on the other hand, 72 per cent of children in the lowest quartile of the population in terms of cognitive ability are still in that position at age 16.

Table 5.4 Transition matrix for social adjustment scores between ages 11 and 16

Age 7 ↓ Age 11 →	Most maladjusted	2nd	3rd	Least maladjusted
Most maladjusted	0.39	0.30	0.17	0.14
2nd	0.20	0.28	0.27	0.25
3rd	0.12	0.25	0.28	0.35
Least maladjusted	0.07	0.20	0.28	0.45
Immobility index for social adjustment scores: 3.05				

Notes to Table 5.4:

1) Individuals are only counted in this transition matrix if they have both age 11 and age 16 social adjustment scores recorded. This is to ensure that the transition probabilities are not biased by differential composition of the age 11 and age 16 populations.
2) Because of the distribution of social adjustment scores, each 'quartile' contains approximately, rather than exactly, one quarter of the population. Transition probabilities are therefore presented for transitions from age 11 to age 16, i.e. the row probabilities sum to 1. The immobility index based on column rather than row probabilities shows a very similar picture, with an index of 3.11 for social adjustment.

Table 5.5 Transition matrix for cognitive test scores between ages 11 and 16

Age 7 ↓ Age 11 →	Lowest cognitive ability	2nd	3rd	Highest cognitive ability
Lowest cognitive ability	0.72	0.25	0.03	0.00
2nd	0.24	0.47	0.25	0.04
3rd	0.04	0.24	0.47	0.26
Highest cognitive ability	0.01	0.04	0.25	0.71
Immobility index for cognitive test scores: 3.85				

Note to Table 5.5:

1) Individuals are only counted in this transition matrix if they have both age 11 and age 16 cognitive test scores recorded. This is to ensure that the transition probabilities are not biased by differential composition of the age 11 and age 16 populations.

Taken together, these matrices suggest considerably more mobility in social skills than cognitive skills. To summarise the degree of mobility across all quartiles, we calculate immobility indices for social adjustment and cognitive test scores between ages 7 and 11, and 11 and 16.[24] The immobility index is higher for cognitive test scores (3.59 between ages 7 and 11, and 3.85 between ages 11 and 16) than for measures of social maladjustment (3.09 between ages 7 and 11, and 3.05 between ages 11 and 16), which may imply that social skills are more malleable than cognitive skills.

It should be noted, however, that apparent differences in the degree of mobility between cognitive and social skills shown in these transition matrices – and

[24] We calculate the immobility indices by summing proportions on the leading diagonal and all adjacent squares, so for social maladjustment between ages 7 and 11, the immobility index is calculated as 0.47+0.33+0.25+0.40+0.30+0.24+0.31+0.25+0.28+0.27 = 3.09.

in the regression coefficients in Table 5.1 – could also arise from differences in the extent to which measurement error is a problem for these scores. In particular, if there were greater measurement error in the social adjustment scores (which is plausible, given that these measures are likely to be assessed by different teachers at ages 7, 11 and 16, whilst cognitive tests may be scored more objectively), then this could be recorded as greater mobility in social skills compared with cognitive skills: for this reason, our findings should be taken as suggestive.[25]

6. Conclusion

In this paper, we have made clear that a vision of the world in which skill is a one-dimensional object is extremely inadequate. While we only grouped skill into two categories (cognitive and non-cognitive), it is quite likely that a much larger variety of skills is important (see, for example, Carneiro, Crawford & Goodman (2007), Duncan et al. (2007) and Feinstein (2000)). There is substantial evidence that non-cognitive skills are important determinants of schooling and labour market outcomes (largely indirectly through their effect on educational attainment), as well as engagement in risky behaviours – for example, involvement in crime or exclusion from school – which impose costs not only for the individual but also for society as a whole. Moreover, it seems clear that social skills are more important predictors of many of these outcomes for individuals from low socio-economic backgrounds than they are for individuals from high socio-economic backgrounds.

Furthermore, as suggested by a large literature (see, for example, Carneiro & Heckman (2003)), both cognitive and non-cognitive skills are malleable. We have shown in this paper that they are strongly dependent on family background and other characteristics of the home learning environment, and that this is likely to be for both

[25] Note that in future work we plan to calculate how much greater the measurement error in social skills would have to be for these apparent differences in malleability to be undermined.

genetic and environmental reasons. More importantly, our work has suggested that social skills may be *more* malleable than cognitive skills (see also Carneiro & Heckman (2003)). If this is true, then there may be greater scope for education policy to affect social skills rather than cognitive skills; moreover, such a policy may reduce inequality as a result of the greater impact of social skills amongst individuals from poorer backgrounds.

Bibliography

Achenbach, T., S. McConaughy & C. Howell (1987), *Child/adolescent behavioural and emotional problems: implications of cross-informant correlations for situational specificity*, Psychological Bulletin, Vol. 101, No. 2, pg 213-232

Blanden, J., P. Gregg & L. Macmillan (2007), *Accounting for intergenerational income persistence: noncognitive skills, ability and education*, Economic Journal, Vol. 117, No. 519, pg C43-C60

Bowles, S., H. Gintis & M. Osborne (2001), *The determinants of earnings: a behavioral approach*, Journal of Economic Literature, Vol. 39, No. 4, pg 1137-1176

Cameron, S. & J. Heckman (1993), *The non-equivalence of high school equivalents*, Journal of Labor Economics, Vol. 11, No. 1, pg 1-47

Carneiro, P., C. Crawford & A. Goodman (2007), *The impact of early cognitive and non-cognitive skills on later outcomes*, CEE Discussion Paper No. 92

Carneiro, P. & J. Heckman (2003), *Human capital policy*, NBER Working Paper No. 9495

Carneiro, P., J. Heckman & D. Masterov (2005), *Labor market discrimination and racial differences in pre-market factors*, Journal of Law and Economics, Vol. 48, No. 1, pg 1-39

Case, A., A. Fertig & C. Paxson (2003), *From cradle to grave? The lasting impact of childhood health and circumstance*, NBER Working Paper No. 9788

Chowdry, H., C. Crawford, L. Dearden, A. Goodman & A. Vignoles (2008), *Understanding the determinants of participation in higher education and the quality of insitute attended: analysis using administrative data*, mimeo

Currie, J. & D. Thomas (2001), *Early test scores, school quality and SES: long-run effects on wage and employment outcomes*, Worker Wellbeing in a Changing Labor Market, Vol. 20, pg 103-132

Duckworth, A., C. Peterson, M. Matthews & D. Kelly (2007), *Grit: perseverance and passion for long-term goals*, Journal of Personality & Social Psychology, Vol. 92, No. 6, pg 1087-1101

Duckworth, A. & M. Seligman (2005), *Self-discipline outdoes IQ in predicting academic performance of adolescents*, Psychological Science, Vol. 16, No. 12, pg 939-944

Duncan, R. & G. Dunifon (1998), *Long-run effects of motivation on labor market success*, Social Psychology Quarterly, Vol. 61, No. 1, pg 33-48

Duncan, G., C, Dowsett, A. Claessens, K. Magnuson, A. Huston, P. Klebanov, L. Pagani, L. Feinstein, M. Engel, J. Brooks-Gunn, H. Sexton, K. Duckworth & C. Japel (2007), *School readiness and later achievement*, Developmental Psychology, Vol. 43, No. 6, pp. 1428-1446

Feinstein, L. (2000), *The relative economic importance of academic, psychological and behavioural attributes developed in childhood*, CEP Discussion Paper No. 443

Fronstin, P., D. Greenberg & P. Robins (2005), *The labor market consequences of childhood maladjustment*, Social Science Quarterly, Supplement to Vol. 86, pg 1170-1195

Heckman, J., J. Hsee & Y. Rubinstein (2000), *The GED is a mixed signal: the effect of cognitive and non-cognitive skills on human capital and labour market outcomes*, University of Chicago Working Paper

Heckman, J., J. Stixrud & S. Urzua (2006), *The effects of cognitive and noncognitive abilities on labour market outcomes and social behaviour*, Journal of Labor Economics, Vol. 24, pg 411-482

Kuhn, P. & C. Weinberger (2005), *Leadership skills and wages*, Journal of Labor Economics, Vol. 23, pg 395-436

McDermott, P. (1980), *Prevalence and constituency of behavioral disturbance taxonomies in the regular school population*, Journal of Abnormal Child Psychology, Vol. 8, No. 4, pg 523-536

Osborne-Groves, M. (2005), *Personality and the intergenerational transmission of earnings*, in S. Bowles, H. Gintis & M. Osborne-Groves, *Unequal Chances: Family Background and Economic Success*, Princeton University Press

Rutter, M. (1967), *A Children's Behaviour Questionnaire for Completion by Teachers: Preliminary Findings*, Journal of Child Psychology and Psychiatry, Vol. 8, No. 1, pp. 1-11

Stott, D. (1960), *Delinquency, maladjustment and unfavourable ecology*, British Journal of Psychology, Vol. 51, pg 157-210

Stott, D. (1966), *Studies of Troublesome Children*, Tavistock Publications, London

Stott, D. (1974), *Bristol Social Adjustment Guides Manual* (5th edition), Hodder & Stoughton, London

Tremblay, R., W. Hartup & J. Archer (2005), *Developmental Origins of Aggression*, Guilford Press, New York

Appendix A: Data

A.1 Outcomes

We make use of the following outcomes in our analysis:

Education outcomes

- Highest qualification O-levels or above: dummy variable indicating whether the individual's highest qualification (at age 42) was O-levels (or equivalent) or above (including A-levels and ordinary or higher degree).[26]
- HE highest qualification: dummy variable indicating whether the individual held a higher-education degree as their highest qualification (at age 42).

Labour market outcomes

- Employment status: dummy variable indicating whether the cohort member is employed (as reported by the individual at age 42).
- Log hourly wages (calculated using gross hourly pay and usual hours per week, as reported by the individual at age 42).

Adolescent social outcomes

- Smoking: dummy variable indicating whether the cohort member smoked more than 40 cigarettes per week at the age of 16 (as reported by the individual at age 16).
- Truancy: dummy variable indicating whether the cohort member had ever played truant (recorded at age 16 – takes value 1 if the individual or the parent or the teacher reported that they had).

[26] All variables indicating the cohort member's highest qualification were derived by comparing qualification levels reported in Waves 4 (age 23), 5 (age 33), and 6 (age 42), plus details that were provided via the exam boards in 1978.

- Exclusion: dummy variable indicating whether the cohort member was ever excluded (suspended) from school (as reported by the individual at age 42).
- Crime: dummy variable indicating whether the cohort member had ever been in trouble with the police (as reported by the school at age 16) or if they had ever been to court (as reported by the parent at age 16).
- Teenage mother: dummy variable indicating whether the cohort member gave birth as a teenager (as reported by the individual at age 23).

Adult social outcomes

- Crime: dummy variable indicating whether the cohort member had dealings with the police or a court between ages 33 and 42 (as reported by the individual at age 42).
- Poor or fair health: dummy variable indicating whether the cohort member's health was poor or fair (rather than good or excellent) (as reported by the cohort member at age 42).
- Depression: dummy variable indicating whether the cohort member showed signs of depression – defined as having a malaise index score greater than 7 (as reported by the individual at age 42).[27]
- Mental health problems: dummy variable indicating whether the cohort member showed signs of psychological distress – defined as having a General

[27] The malaise index is one element of the Cornell Medical Index questionnaire, and uses questions defined on a relative scale. For example, 'Have you recently been losing confidence in yourself?'; answer: not at all, no more than usual, rather more than usual, or much more than usual. This questionnaire was also used to identify depression in NCDS4, with a dummy variable indicating malaise derived by the NCDS team; we follow their methodology in defining our dummy variable.

Health Questionnaire[28] score greater than 15 (as reported by the individual at age 42).[29]

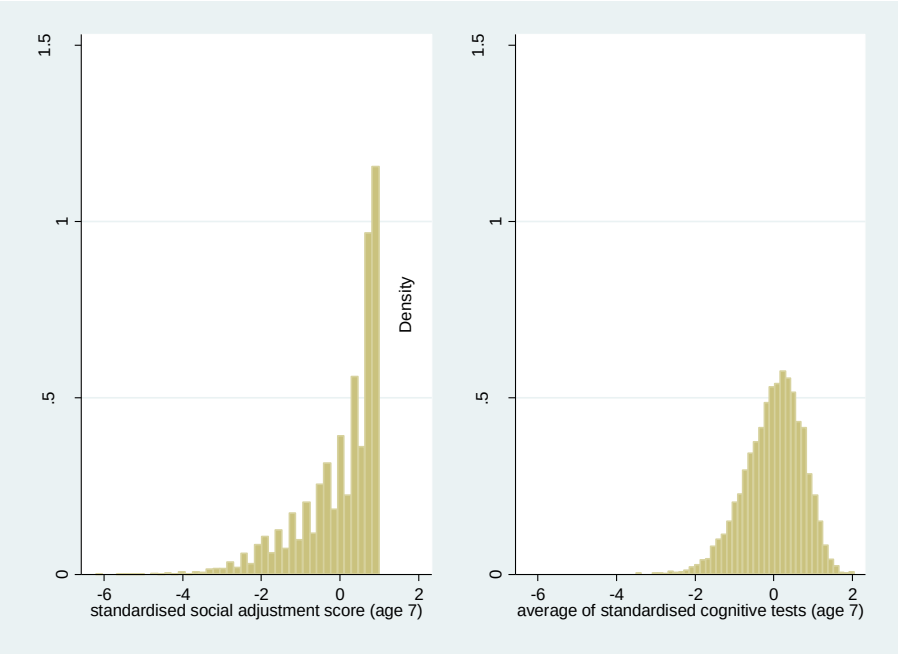
A.2 Cognitive skills at age 7

We use an average of standardised test results in maths, reading, copying, and drawing as our measure of cognitive skills at age 7.[30]

- The Southgate Group reading test was used. In this test, the child was given a choice of five words. On 16 (of 30) occasions, the child was given a picture of an object and had to ring the word describing that object. On the other 14 occasions, the teacher read out a word and the child had to circle the correct one. One mark was awarded for each correct answer, giving a score between 0 and 30.
- The arithmetic test comprised 10 questions, which the teacher could read to the child. One mark was awarded for each correct answer, giving a score between 0 and 10.
- In the copying test, the child was given six shapes and asked to copy each of them twice. One mark was awarded for each correct attempt, giving an overall score between 0 and 12.
- For the drawing test, the child was asked to draw a picture of a man, which was then awarded a mark out of 100 according to the features that were included.

[28] For more details on the General Health Questionnaire, see www.workhealth.org/UCLA%20OHP%20class%202004/GHQ%20and%20scoring.pdf.
[29] This index relies more heavily on physiological symptoms of mental health difficulties than the malaise index (described above): for example, 'Is your appetite poor?' or 'Does your heart often race like mad?'. Furthermore, the questions have 'yes/no' answers (rather than being defined relative to how the individual usually feels, as in the malaise index).
[30] Our measure of cognitive skills at age 11 consists of standardised test scores in maths, reading, copying and general ability (see Carneiro, Crawford & Goodman (2007) for more information). Our measure of cognitive skills at age 11 consists of standardised test scores in reading and maths.

Figure A.1 Distribution of standardised social adjustment and cognitive test scores at age 7



A.3 Background characteristics used

All models contain controls for child characteristics, parental characteristics, and local area characteristics (except where otherwise specified in the text).

A.3.1 Child characteristics

The following child characteristics are controlled for: gender; ethnicity; whether the cohort member had low birth weight or was born prematurely; illness and/or handicap at birth; twin status; whether the cohort member was an only child (by age 7); birth order; number of older brothers; number of older sisters; whether next oldest sibling was born within 2 years of the cohort member; number of younger siblings (by age 7); number of household members; whether the cohort member was breastfed; whether they were walking alone before the age of 1½ years; whether they were speaking by age 2 years; whether they were wetting by day after age 3 years; whether the cohort member attended a welfare clinic as a baby.

*A.3.2 **Parental characteristics** (at child's birth unless otherwise stated)*

The following parental characteristics are controlled for: father's age; mother's age; education of both parents; high father's SES and medium father's SES;[31] marital status of the mother; whether the mother was a heavy smoker, and whether she stopped, during pregnancy; previous complications in pregnancy; interval between marriage and birth; whether the mother was obese; whether the mother worked during pregnancy, and number of hours; whether English is the mother's usual language with the child; whether or not each parent reads books and newspapers regularly; whether each parent shows interest in the cohort member's education (age 7); whether the cohort member has ever lived in care (measured at age 7); health visitor reports of serious family difficulties (including disability, mental illness, divorce, alcoholism) (age 7).

Table A.1 Mean values of selected child and parental characteristics

Variable	Mean value
Child characteristics	
Female	0.487
White	0.976
Low birth weight or premature	0.073
Early illness or handicap	0.095
Slow early development	0.122
Breastfed	0.433
Only child (by age 7)	0.076
Number of younger siblings (by age 7)	0.967
Parental characteristics	
Father's age (at time of child's birth)	30.579
Mother's age (at time of child's birth)	27.488
Father's years of education	9.959
Mother's years of education	9.972
Father's social class – professional	0.175
Father's social class – non-manual	0.599
Father shows little interest in child's education	0.245
Mother shows little interest in child's education	0.16
Father reads a lot	0.347
Mother reads a lot	0.486
Ever in care (by age 7)	0.022
Family difficulties (by age 7)	0.156
Mother a heavy smoker (during pregnancy)	0.192

Note to Table A.1:

1) Variables are only summarised for individuals for whom both social and cognitive skills measures are recorded at age 7.

[31] High SES (socio-economic status) is defined here as working in a professional occupation; medium SES is defined as working in a non-manual (non-professional) occupation.

A.3.3 Local characteristics

The following local characteristics are controlled for: broad region (North West, North, East & West Riding, North Midlands, East, London & South East, South, South West, Midlands, Wales, Scotland); urban vs. rural; percentage semi-skilled and unskilled males as a proportion of economically active males in local authority (in 1961); percentage economically active females/economically active males in local authority (in 1961).