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Parents' basic skills and their children's test scores[*]

Results from the BCS70, 2004 parents and children assessments

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SUMMARY

The aim of this report is to assess the impact of parents' basic skills in literacy and numeracy on their children's cognitive outcomes. The relevance of the issue is justified on two counts: the severe problems of low numeracy and literacy levels for a large proportion of the UK adult population (see the Moser Report, DfEE, 1999) on the one hand, and the significant gap in the cognitive skills achieved by children from lower and higher socioeconomic groups (Cunha and Heckman, 2007; Feinstein, 2003). The first issue calls for policies aimed at improving the supply of basic skills. To this end, we want to understand whether and to what extent these basic skills may be transferred intergenerationally. If there is extensive intergenerational transmission of skills, this will also highlight the importance of a family-based approach to reducing the inequality in the cognitive skills of children coming from different family backgrounds.

We address this issue empirically using data from the British Cohort Survey (BCS), a longitudinal study on 18,000 individuals born on a particular week in 1970 and regularly interviewed since then. In 2004 the interviews included basic skills assessments for the parents (aged 34) and cognitive skill assessments for their children. In particular, we use the NRDC-funded numeracy and literacy tests of parents at age 34 and relate them to two batteries of cognitive tests administered to their children, one for pre-school children (aged 3 to 6) and one for school-aged children (aged 6 to17)[1]. Drawing on these various tests, we examine the relationship between parental basic skills and child cognitive development.

The analysis is performed mainly using Ordinary Least Square (OLS) regressions where the dependent (explained) variable is the synthetic index of the children's cognitive outcomes and the main explanatory variable is an index of parents' basic skills. We are also able to allow for a vast array of family and individual characteristics that also influence child achievement, including information on the parents' childhoods and schooling, as well as their socio-economic background. We can also allow for the child's own characteristics in our analysis (age, gender and whether first born), as well as family structure (number of siblings, single parenthood), parenting style, household income, parent's education, occupation and 'innate ability' as measured by test scores at age 5. The richness of our data makes us confident that we are identifying a genuine causal relationship between parental basic skills and their children's cognitive development.

We find a positive and significant relationship between parents' skills in literacy and numeracy and their children's cognitive development, for both younger and older children. This relationship holds even when we allow for the myriad of other factors that also influence child development, particularly parental qualification levels and parental ability measures (i.e. parental cognitive ability as measured at age 10). This means that parents' basic skills have a positive impact on their children's cognitive skills, regardless of the education of the parent and indeed the early ability of the parent, which is arguably an indicator of parental IQ. In terms of the size of the observed impact, our estimates reveal that one standard deviation of

[1] The tests have been conducted using the British Ability Scale Second Edition (BAS II) which is a battery of individually administered tests of cognitive abilities.

parents' basic skills index (1.3) would lead to an increase in their young children's cognitive skill index by 10 per cent of a standard deviation. For older children the effect is slightly lower (9.7 per cent of a standard deviation).

When splitting the sample of parents into two groups according to the highest level of education attained by parents, we find that the positive relationship between the parents' basic skills and their children's cognitive skills is always significant for parents with low levels of qualifications. This lends further support for skill enhancing policies targeted at adults with low levels of qualifications. For parents with high levels of qualifications, having higher basic skills is associated with higher test scores for school-aged children only (aged from 6 to 17 years).

We then proceed to a gender specific investigation of the intergenerational transfer. Our results show that there are no significant differences between the transfer of skills from mothers and fathers to children. However, when we run separate regressions for daughters and sons, we find some evidence of a gender specific transfer: mothers' basic skills are more significant for daughters than for sons whilst for fathers the opposite is observed. The relationship between fathers' basic skills and sons is particularly strong for school-aged children.

We also try to separate the effect of literacy from that of numeracy and thus investigate in more detail the channels by which basic skills affect children's cognitive performance. It is of course difficult to measure literacy and numeracy as separate concepts since a lot of the skills measured in the two tests are highly related (e.g. the ability to read the test). For policy purposes, however, it is interesting to investigate whether it is possible to observe separate effects of parents' literacy and numeracy on their children's test scores. Our results suggest a stronger relationship between parental literacy and child cognitive development. Focusing on the younger children in particular, the results suggest that children in families with parents at Level 1 or 2 in literacy assessment perform significantly better than children of parents at the very lowest literacy level (below Entry level 2). The impact of parental numeracy appears to be at Entry level 3 and higher levels. It seems that having reached the literacy and numeracy levels set as the minimum target by the Government (Level 1 and Entry level 3 respectively) significantly affects the cognitive performance of young children. For older children, the picture is rather different in that the impact of literacy seems to be more continuous. Each level of literacy above the lowest one leads to better cognitive performance of children, whilst numeracy has a lesser impact.

Overall, our results have revealed that the higher the parents' literacy and numeracy scores, the better is the cognitive performance of their children. From a theoretical point of view, we might expect parents' basic skills to have a positive impact on child cognitive outcomes only. Better basic skills might enable parents to read to their children and help them with their homework, etc. However, it is not clear that the basic skills of parents would necessarily impact on other outcomes, such as child behaviour. In fact, if we find similar effects from parental basic skills on the non-cognitive outcomes of children, we might suspect that our apparent impact from parental basic skills is actually picking up other aspects of parents' behaviour, such as attitude or aspirations. To explore this issue further, we model the factors which influence child cognitive and non-cognitive outcomes simultaneously. Non-cognitive outcomes are measured using the child *Strength and Difficulties Questionnaire* (SDQ, or Goodman) included in the *Parent and Child Questionnaire* section of the 2004 sweep of BSC70 (see Appendix A). The four sub-scales of the SDQ constitute an index of general 'emotional behavioural problems'. We find that parents' basic skills have indeed a direct impact only on children's cognitive outcomes, once the effects of other aspect of family background are netted out. This also reassures us on the validity of our results. It seems that we are in fact identifying the specific effects of parents' literacy and numeracy, without capturing other aspects of parents' behaviour, such as attitude or aspirations.

The main policy conclusion that can be drawn from these results is that policy aimed at increasing parents' basic skills may have potentially large intergenerational effects on the cognitive performance of children. There is particular scope for policies targeted at low-qualified adults and young parents, for which our results show the intergenerational transfer is especially strong.

1. Introduction

The problems of low numeracy and literacy levels for a large proportion of the UK adult population have been documented at key points in recent decades (e.g. the 1999 Moser Report (DfEE, 1999); the 2003 *Skills for Life Survey* (Williams et al., 2003) and the 2006 Leitch Review of Skills). In 1999, it was documented that approximately 20 per cent of adults in England had severe literacy difficulties, whilst around 40 per cent had some numeracy problems. Having poor literacy and/or numeracy is harmful both to low-skilled individuals, who face a higher probability of unemployment, unstable jobs and fewer prospects for career advancement, and to the economy at large, which increasingly needs a more highly qualified workforce. The current Skills for Life strategy was introduced in 2001 to provide numeracy and literacy skills to those who did not acquire them during their compulsory schooling.

This report addresses the important question of how parents' basic skills relate to the cognitive and non-cognitive performance of their children. The report cannot directly address the question of whether the Skills for Life policy in itself has had intergenerational outcomes, i.e. whether parents who improved their numeracy and literacy skills through Skills for Life have had children who performed better in the early years tests scores. We can, however, investigate the more general question of how parents' numeracy and literacy levels affect the performance of their children on early tests of cognitive ability. This question is particularly relevant since it has been proved that early cognitive ability is an important determinant of schooling, wages, and success in many aspect of social and economic life (Heckman, 1995; Murnane et al., 1995; Feinstein and Duckworth, 2006). It seems that there are significant ability gaps across children from various socio-economic groups and that these gaps open up at early ages before children enter school (Cunha and Heckman, 2007). Moreover, it seems that these early-ability differences by family background persist and increase as children age (Carneiro and Heckman, 2004; Feinstein, 2003). Thus, understanding the intergenerational transmission of skills constitutes an important potential issue for any policy that aims at increasing the basic skills of adults. Indeed the finding that parents' basic skills impacted fully into increased performance of their children would constitute a major support for Skills for Life. This report therefore investigates a potential wider outcome of a policy that was originally targeted at adults (whether parents or not).

The report uses the British Cohort Study data set, where incredibly rich information on parents is combined with early test scores for their children. We use the NRDC funded numeracy and literacy tests of parents at age 34 and relate them to two batteries of cognitive tests of their children, one for pre-school children aged 3 to 6 and one for school-aged children aged 6 to17. We are also able to control for a vast array of family and individual characteristics, including information on parents' early years (parents have been surveyed seven times since their birth in 1970) and their socio-economic background.

The report is organised as follows:

- Section 2 – recent literature is surveyed.
- Section 3 – provides a discussion of the empirical challenge encountered in conducting a robust investigation into which parents' skills are transferred to their children.
- Section 4 – describes our data and presents the relevant descriptive statistics.
- Section 5 – presents our main results.
- Section 6 – proposes some conclusions and discusses the policy implications of our results.

2. Literature review

Our research can be situated in different theoretical frameworks and bridges at least four strands of literature. First, there is the growing body of literature assessing the impact of adults' basic skills on various economic and non-economic outcomes. As discussed below, while the bulk of this research has studied the impact of adults' literacy and numeracy on the labour market, there are almost no empirical works focusing on the impact of literacy and numeracy specifically on children's cognitive outcomes. In this sense, our analysis adds to this literature, focusing as it does on a new potential outcome from adult basic skills.

Second, our research could be also situated in the stream of literature analysing intergenerational mobility and, more broadly, the links between parents and their children's outcomes. Most of the empirical works in this field have focused on the intergenerational transmission of income and of human capital (usually meaning education).

There is little published evidence on the mechanisms by which adult basic skills are transferred to the next generation and this analysis fills this gap.

Finally, our research is also influenced by the literature on early cognitive development and on the effect of family environment on early child performance and we draw on their findings.

The aim of this section is to briefly mention these different theoretical frameworks and to present some of the previous empirical evidence in each field.

Various empirical researchers in the UK have revealed the value of adult basic skills in the labour market. McIntosh and Vignoles (2001), using data from the 1958 National Child Development Study (NCDS) and International Adult Literacy Survey (IALS), show that better numeracy is associated with higher employment rates, even after controlling for a person's education level. The impact of literacy is less robust and once all controls are inserted in the model, it appears to be positive and significant only when using IALS data. Other results by Dearden et al. (2002) confirm the importance of numeracy skills on individuals' labour market outcomes. In particular, using NCDS data they find a large positive effect of numeracy levels on both employment rates and earnings. De Coulon et al. (2008) study the link between basic skills and earnings based on the British Cohort Study (BCS) cohort in the 2004 labour market and estimate the wage return to literacy and numeracy. Their results, robust to different specifications, suggest that both literacy and numeracy are significantly associated with higher earnings. Bynner et al. (2001) include estimates of the impact of basic skills on earnings and employment using data on a 10 per cent sub-sample of the BCS surveyed in 1991. In a recent DfES report, Grinyer (2005), using the Skills for Life Survey 2003, finds a positive earnings effect for higher levels of numeracy and literacy. He also finds some indications of a positive earnings effect for individuals who took a literacy and numeracy course. He also provides a careful review of the existing evidence. These works confirm the main findings above, namely that those with better basic skills earn more and are more likely to be employed.

In the US also, some studies have attempted to determine the effect of basic skills on labour market outcomes. Boissiere et al. (1985) investigate the effect of post-school numeracy and literacy levels and find that its effect on wages is larger than the number of school years. Ishikawa and Ryan (2002) attempt to differentiate the measured skills into the portion obtained through school and the portion obtained elsewhere (e.g. parental background, books at home, etc.). They find skills learned at school to have a stronger wage effect. More recently Tyler (2004) provides an excellent brief review of the literature in this area. Restricting his sample to dropouts (i.e. early school leavers), he found substantial positive wage effects for those with higher maths test scores at age 16 over their following first three years in the labour market. These wage effects appears to persist over time. Zax and Rees (2002) show that tests scores at age 17 are associated with higher earnings at age 35 and 53. Murnane et al. (1995) find that the wage return to maths tests scores increased over time between 1978 and 1986 (see also Murnane et al., 2000).

Bynner et al. (2001) extend this type of analysis and also evaluate the impact of basic skills on non-economic outcomes. In particular, they find that individuals with higher basic skills tend to suffer less from poor physical and mental health, are more likely to be active citizens, as shown by voting vote and expressing interest in politics, and are more liberal and less discriminatory in their attitudes. Interestingly, they also show that people with better numeracy and literacy skills are less likely to have children who experience difficulty at school. They use a probit model to estimate the effect of literacy and numeracy on the probability of the respondents themselves having a child with literacy or numeracy difficulties of some kind. The evidence suggests that individuals with better numeracy skills (at or above Level 1) have a 3–5 percentage point lower probability of having a child who has literacy or numeracy difficulties, although the result in the full model specification is not statistically significant.

Williams et al. (2003) argues that having good literacy and numeracy skills may enable parents to help children with reading, writing and with maths homework. In the case of reading it is shown that there are no significant differences between parents at Entry level 3 or above, as 95 per cent of these parents do help their children. It appears that only parents with lower levels of literacy do not provide any help in reading. The same applies to help with writing. Also in the case of maths, the likelihood of a parent giving help with maths increases with numeracy ability. These findings only describe the help provided by parents without investigating whether this help is efficient. The possible links between parents' basic skills and their children's outcomes are also briefly investigated in Bynner and Parsons (2006). They look at the relationship between the children's cognitive performance and that of their parents' literacy and numeracy using BCS data in 2004. They find that the correlation in performance is strongest between cohort members' literacy scores and their children's outcomes in 'Word Reading' test. Other correlations are weaker than expected. Interestingly, their analysis reveals a cut-off between parents with very low levels of literacy and numeracy (Entry level 2 and Entry level 3) and those with higher levels. In particular, the children of parents in the bottom part of the basic skills distribution seem to experience substantial difficulties and to perform significantly worse in their reading and maths development with respect to children with parents at higher levels of literacy and numeracy. However, the authors explicitly argue that their analysis is very preliminary and point out the need for further research in this field, which indeed is the purpose of this report. Apart from this contribution, there are no empirical works that have focused on the intergenerational transfer of basics skills in numeracy and literacy.

Many empirical and theoretical works have studied the intergenerational mechanisms of transmission of education and income. Even if these works do not deal directly with basic skills, they are important to our aim since they model and discuss the impact of family background on children's outcomes.

The literature agrees that economic status and education are positively correlated across generations; it repeatedly shows as well that parents with higher educational levels have children with higher educational levels. In general, children growing up in more highly educated families tend to have better educational and labour market outcomes as adults than children who grow up in less educated families. However, it is not clear whether this observed intergenerational correlation comes from a selection mechanism or reflects a causal link. In the first case, the transmission mechanism works through genetic or environmental factors: more educated parents may have some unobserved characteristics that are transferred to their children who in turn will have higher education and earnings as well. This mechanism is completely different from a causal one which would imply that attaining more education bestows parents with skills that make them better parents, thus leading to their children having higher educational outcomes. In the empirical literature three main approaches and identification strategies have been used to identify a causal effect of education and distinguish it from mere correlation: identical twins, adoptees and Instrumental Variables (IV).

Behrman and Rosenzweig (2002), using data drawn from the Minnesota Twins Register, examine educational choice of children of twin pairings to eliminate the genetic/nature effect of one of the parents. Their results suggest that an increase in the schooling of women does not have beneficial effects in terms of the schooling of children. However, the effect of fathers' education seems to be strong. Oreopoulos et al. (2003) criticise this work arguing that it is based on a small and non-representative sample.

An alternative strategy to account for genetic effects and endogeneity problems is to compare adopted and natural children. Using this strategy, Plug (2003) finds weak effects of adoptive mothers' schooling on children's schooling but large effects for fathers' schooling.

Sacerdote (2002 and 2007) using a data set of Korean-American adoptees who were randomly assigned to families in the US, finds that being assigned to a high education family has important effects on educational outcomes for these adoptees. In particular, he finds that adoptees are 9 per cent more likely to have four years of college if their mothers do and calculates that each additional year of a mother's educational attainment raises the adoptee's educational attainment by 0.07 years. However, the effects for adoptees are modest when compared to corresponding effects for non-adoptees, indicating that the transmission of education for adoptees is much less strong than for non-adoptees. This suggests that initial endowments, the genetic factor, also play a role.

This approach is appealing because it allows the separation of the effect of environmental and genetic factors and it is hence impossible to ascribe the intergenerational link to a genetic inheritance; but, as noted in Carneiro et al., 2007, these studies do not inform directly about the causal effect of parental schooling on child outcomes.

The third identification strategy to identify a causation link between parental education and children's outcomes relies on the use of instrumental variables (IV). The aim is to find an instrument that is correlated with parents' education but unrelated to their children's attainments. Chevalier (2004), Black et al. (2005), and Oreopoulos et al. (2003) use the IV method based on the natural experiments of changes in compulsory schooling laws in the UK, Norway and the US respectively. These policy changes create a discontinuity in the years of education attained by the parental generation and therefore this method should ensure that an extra year of schooling for the treated (compared with the control) group is not correlated with the individual, family, and social characteristics of the children. Although using similar methodologies, the results of these three papers are rather different. Chevalier (2004) finds that parental education has a significant effect on children's educational attainment: in the IV estimates the effects of a parent's education on the child of the same gender increased substantially (with respect to OLS estimates) for a sample of natural parents. This finding highlights the occurrence of substantial social returns to education that significantly affect educational attainment of the next generation. Also the paper by Oreopoulos et al. (2003) does find a causal effect of parents' education on children's outcomes. Their results in fact indicate that a one-year increase in the education of either parent significantly reduces the probability that a child repeats a grade. Indeed, it seems that education policies may have important social returns and potentially are able to reduce part of the intergenerational transmission of inequality. Conversely, in Black et al. (2005) the IV estimates were consistently lower than the OLS estimates, with the only statistically significant effect being a positive relationship between a mother's education and a son's education. They interpret this evidence by arguing that the high correlations between parents' and children's education are due primarily to family characteristics and inherited ability and not to education spillovers.

Carneiro et al. (2007) use different instruments to study the effects of maternal education on children's outcomes – outcomes including cognitive development, behavioural problems, grade repetition, and health outcomes. They use as instruments the costs of schooling, exploiting the differential changes in the direct and opportunity costs of schooling across counties and cohorts of mothers. Their results point out that the mother's education increases the child's performance in both maths and reading at ages 7–8, but not at ages 12–14. They also find that maternal education reduces the incidence of behavioural problems and reduces grade repetition, but has no impact on obesity.

Overall, these works point out a strong and significant role of parental education on different child outcomes, highlighting the potential for educational policy to reduce inequality in child opportunities and performances. However, they fail to identify the channels through which parents' higher levels of education lead to better outcomes for their children.

Indeed another strand of the literature has directly focused on the determinants of children's attainments, analysing the role of different factors, including parenting style and investments. For example, Michael (2004, 2005) shows that besides families' resources (income, education and ability), the actual willingness of spending these resources on behalf of children is highly correlated with children's cognitive outcomes (here measured as reading and maths test scores). In other words, he suggests that parent's 'caring' for the child is an important mechanism affecting children performance. He exploits the rich information provided by the NCDS data to proxy such 'family caring', using several variables indicating parents' behaviours during pregnancy and during the child's early years. His results indicate that caring for children has a substantial correlation with children's measured skills in reading and maths and that this relationship is separate from and additional to the advantages of family resources.

The general framework for research on children's attainment has principally focused on the processes by which family inputs can affect children's educational development and outcomes (*production function approach*). The process of child attainment is viewed as an aspect of the theory of family behaviour (see Haveman and Wolfe, 1995 for a detailed review). The family is modelled as a production unit, which employs inputs to generate utilities for its members. The amount of family resources allocated to children, the nature of these resources, parents' choices regarding family structure, type of neighbourhood, type of school, etc., influence the attainments of children in the family. Cunha and Heckman (2007) have extended this approach and have built a model of skill formation with multiple stages of childhood, where inputs at different stages are complements and where there is self-productivity of investment. Two features of the model are therefore: *dynamic complementarity* which means that stock of skill acquired in period *t-1* makes investment in period *t* more productive; and *self-productivity* which implies that higher stocks of skill in one period create higher stocks of skill in the next period. While this model is theoretically appealing, it is difficult to use it in empirical research since it requires longitudinal data and repeated information on children skills.

3. The empirical approach

In this report, we use a well-developed framework for research on child attainment, which is referred to as the 'production function' approach. By that expression, we mean the processes by which family inputs can affect children's educational development and outcomes. Most of the analysis is performed using regression analysis where the dependent (explained) variable is the child outcomes: i.e. children's early (3 to 6) and later (6 to 16) tests scores. The dependent variable is explained by (regressed on) a series of explanatory variables that the literature has shown to matter for children's scores. The main focus of our analysis is, however, on the link between parents' basic skills and their children's performance in tests scores, so we will treat all other explanatory variables other than parents' basic skills as control variables only. We mean by that term that we will not give them any causal interpretation. More formally our estimating equation is the following:

$$S_c = \beta_0 + \beta_1 S_p + \beta_2 X_c + \beta_3 F + \beta_4 O_p + \beta_5 E_p + \beta_6 Y_p + \beta_7 A_p + \varepsilon$$

Where the subscript *c* = child; subscript *p* = parents; and *S* = skills; *X* is the set of child characteristics (sex, age, whether first-born); *F* is family structure (lone parents; number of siblings); *O* is occupation; *E* is education; *Y* is income (log household income in 2000 and 2004 and whether a recipient of state benefits); and finally *A* stands for parents' ability (as measured by parents' test score at age 5). All along, we adjust the standard errors of the coefficients for the fact that some children come from the same households.

As our main interest is the link between parents' basic skills and children's tests scores, we will focus on the estimates for the coefficient β_1.

As already mentioned in the introduction, the BCS70 data constitutes an incredibly rich source of information. The first attempt at uncovering a causal link between parents' numeracy and literacy skills and their children's early tests scores is operationalised by running simple Ordinary Least Squares (OLS) regression. When regressing the children's tests scores on the basic skills measures for their parents, we allow for a very large array of child and parent characteristics in the regressions (see Section 4). Some of these variables would be 'unobserved' variables in more conventional data sets. By doing so we tend to reduce the probability that 'omitted variables' might indeed bias our main coefficient of interest β_1. This would happen if a main variable that we do not have in our data sets is both intensively related with parent and child test scores.

Such average estimates from our OLS regressions above may hide differences in the effects of parental skills on child outcomes across different sub-groups of the population. In further attempt to uncover a causal relationship, we separate the regressions by gender and qualification level of the parents to identify the specificities of the transmission mechanisms. We are particularly interested in the effects of parental skills at the bottom end of the parents' basic skills distribution, as Skills for Life is targeted at individuals with low basic skills. We also considered the separate contribution of parents' literacy and numeracy on their children's test results. In doing so, we first used continuous measures, and then also introduced the levels of numeracy and literacy according to the Skills for Life standard.

Of course OLS estimates may still be biased if there remain unobserved factors that determine both the parental skills level and the cognitive skill of their children. For example, perhaps more emotionally warm parents have better skills and, due to their parenting, tend to also have children with higher levels of skill. If we do not include any measure of parental environment in our model then we may spuriously believe that parental basic skills cause better child outcomes, whereas in fact it is parental environment that is determining the better child outcomes. We therefore use an instrumental variables (IV) approach to attempt to overcome this potential problem. The IV method was originally introduced to reduce the problem of biases arising from measurement errors (Friedman, 1957), but it is now widely used to uncover causal relationships (Angrist and Krueger, 1999). The IV method in essence is an attempt at approximating a randomised experiment. One needs to find an instrument, i.e. a factor that can predict differences in parental basic skills level but that has no direct effect on their children's outcomes. For the approach to yield unbiased coefficients one needs: few instruments, a relatively large sample, and a strong correlation between the variable of interest (parents' skills) and the instruments. Finding the necessary instruments has proved problematic so results presented here should be interpreted with caution.

We also use quantile regressions to explore the differential impact of basic skills along the distribution of child outcomes. It is interesting to check whether the observed relationship is constant in the distribution of children tests scores.

Given that finding an instrument proved problematic, we also explored other ways to check whether we had uncovered a genuinely causal relationship between parental skills and child outcomes. In particular, we use Seemingly Unrelated Regression Estimation (SURE) regressions to jointly estimate two equations for cognitive and non-cognitive outcomes. Indeed we want to check whether parents' skills are able to explain the performance of their children as well as some measure of their emotional state. By doing so, we want to check whether parents' basic skills truly translate into the performance of their children or whether there is some other mechanism that could drive this relationship. In particular, returning to the example mentioned above, we want to check whether parents with higher basic skills are actually providing their children with more emotional stability, which in turn is the key factor that then translates into higher performance in cognitive test scores.

4. Data description

The empirical analysis relies on different sweeps of the British Cohort Study. Since our aim is to study the impact of parents' basic skills on their children's cognitive outcomes, we restrict the sample to the cohort members included in the 'Parent and Child' section of the 2004 survey.

Of the 9,665 cohort members in the core dataset, 4,792 had been randomly selected into the 'Parent and Child' elements of the survey. Of these, 2,824 (59 per cent) has at least one child. In total, we have information on 5,207 own or adopted children of cohort members who are aged between 0 and 16 years and11 months. Table 1 shows the distribution of children by age group and sex.

Table 1: Number of children, by age group and sex

Age groups	Male	Female	Total
0–2	700	626	1,326
3–6	665	694	1,359
6–16	1,290	1,232	2,522
Total	2,655	2,552	5,207

Of the 5,207 children, only those aged between 3 and 16 are eligible for the cognitive assessment. Therefore the total number of observations in our sample is reduced to 3,881. Of these 1,359 (about 65 per cent) are aged between 3 and 5 years and 11 months and 2,522 (about 65 per cent) are aged between 6 and 16 years and 11 months.

Children have been tested using the British Ability Scale Second Edition (BAS II) which is a battery of individually administered tests of cognitive abilities and educational achievements[2]. Tests are organised into two age-specific batteries. The Early Year (EY) battery is given to children of more than 3 and less than 6 years and it composed entirely of cognitive scales. The School Years (SY) battery is designed for children of more than 6 and less than 17 years and comprises both cognitive and achievement scales.

Table 2 lists the different tests and gives some descriptive statistics. In particular, it displays mean, standard deviation, minimum and maximum value of ability scores[3] for each test.

Table 2: Children test scores (ability scores)

Children aged	Variable	No. of observations	Mean	Std. Dev.	Min.	Max.
3 yrs to 5 yrs 11 mths	Early Number Concepts	1,226	124.39	26.47	10	185
	Naming Vocabulary	1,238	99.69	19.38	10	170
6 yrs to 15 yrs 11 mths	Word Reading Scale	2,248	133.30	37.86	10	222
	Spelling	2,248	59.91	21.91	0	100
	Number Skills	2,240	107.36	31.59	10	208

Drawing on the results of these tests, we use a principal component analysis (PCA) to construct an index of 'cognitive ability' (*ICA* hereafter), using the first principal component

[2] For further details on children assessment, see Bynner and Parsons (2006).

[3] Ability scores are estimates of children ability measured by an individual scale. The ability score reflects both the raw score and the difficulty of the item administered (see Bynner and Parsons, 2006, p. 81).

extracted[4]. This procedure is very common in the psychometric literature in order to build an index of general ability or intelligence (see Cawley et al., 1996). In our case, we do not interpret this index as a measure of general intelligence or ability – which would be too ambitious for our aims – but only as an index that allow us to rank each child in terms of ability (see also Galindo-Rueda and Vignoles, 2005).

Table 3 provides some information on the process of extracting our index for the two groups of children differentiated by age. The second and the third columns indicate the principal component order and the cumulative proportion of the overall variance explained by each principal component. It can be noticed that the first principal component explains about 80 per cent of the variance in the case of early test scores and about 77 per cent for school-year test scores. This reassures us on the validity of the choice of extracting the first component only. Columns 4 and 5 specify the correlation between each test score and the first principal component, which can be considered as an indicator of each score to the constructed *g* score.

Table 3: PCA and Cognitive Ability Index (*ICA*)

	Principal component rank	**Cumulative variance explained**	**Name of original test**	**Correlation (*g* score)**
Early years battery	1 (i.e. *ICA*)	0.836	Early Number Concepts	0.9143
	2	1.000	Naming Vocabulary	0.9143
School years battery	1 (i.e. *ICA*)	0.7735	Word Reading	0.9476
	2	0.9462	Spelling	0.8206
	3	1.000	Number Skills	0.8655

The next two figures show the distribution of the constructed *g* scores by different age groups. Obviously, as a child's age increases, the performance in the tests gets better. In the econometric analysis we control for this by including the child's age in the regressions.

[4] More formally, the '*index of cognitive ability*' is measured by the product of the test score vector and the eigenvector associated with the largest eigenvalue of the matrix of correlations among standardised BAS II test scores.

Figure 1: Distribution of index of cognitive ability by age groups (3–6 years old)

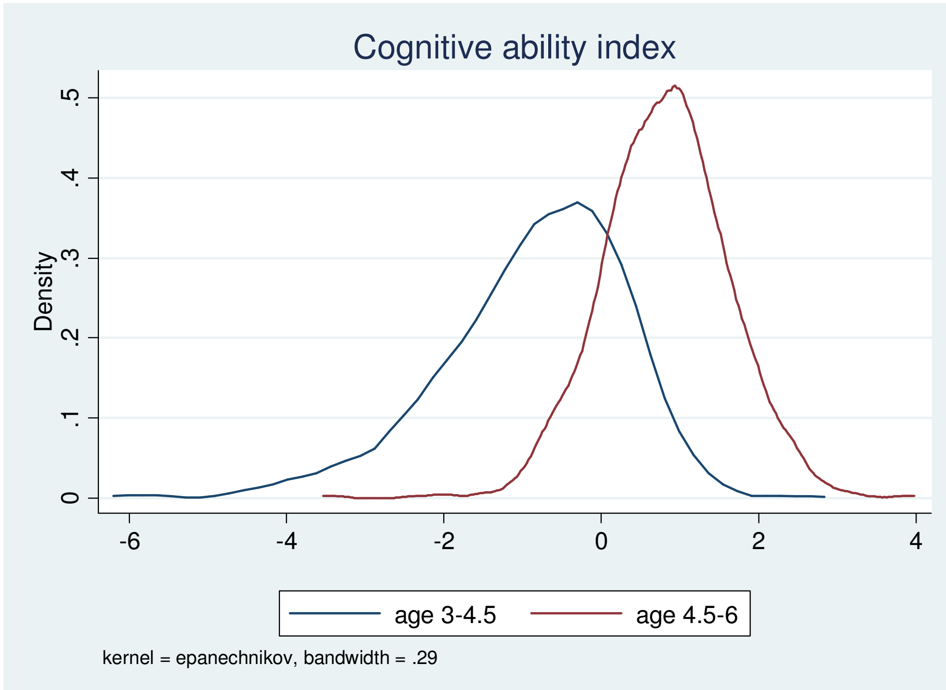
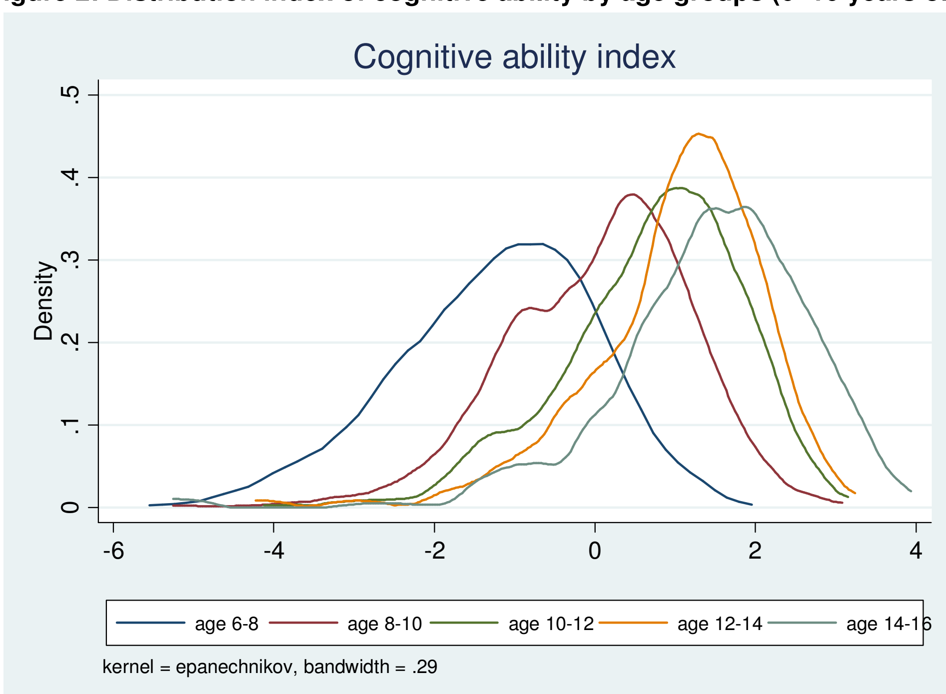


Figure 2: Distribution index of cognitive ability by age groups (6–16 years old)



In order to assess parents' literacy and numeracy, two tests have been performed at age 34. The items are set at five levels of difficulty: Entry level 1, Entry level 2, Entry level 3, Level 1 and Level 2, the most difficult. The literacy test is made up of 20 multiple-choice questions taken from the *Skills for Life Survey* (2003). Ten initial questions were introduced to screen individuals: when individuals score lower that 6, they were asked 10 easier Entry level 2 questions while those who scored between 6 and 10, were given harder questions: (five Level 1 and then five Level 2). The numeracy test is made up of 17 multiple-choice questions, asked to all individuals: five at Entry level 2, four at Entry level 3, five at Level 1 and three at Level 2 (for a detailed explanation of the test's design see Parsons and Bynner, 2005).

Table 4 shows the distribution of parents' literacy and numeracy levels in 2004. It highlights the literacy and numeracy problems faced by a large part of our sample. In literacy, almost 9 per cent of individuals have skills below the minimum target of Level 1, whilst in numeracy more than 16 per cent of the sample is below the national minimum target of Entry level 3.

Table 4: Distribution of parents' literacy and numeracy

	Literacy (% of sample*)	Numeracy (% of sample*)
Below entry level 2	1.8	6.3
Entry level 2	2.3	10.4
Entry level 3 (*minimum target for numeracy*)	4.6	26.2
Level 1 (*minimum target for literacy*)	31.6	31.8
Level 2	59.6	25.3

*the sample only includes parents with children aged over 2 yrs11 mths (N = 2844)

It is interesting to observe the distribution of literacy and numeracy also within each educational group. As shown in Table 5, numeracy and literacy achievements do vary also within education group. Obviously, the more educated people also have on average better basic skills. The last column shows that among those with a higher degree only 0.6 per cent are below the national target for literacy and only 1.3 per cent for numeracy. More interestingly, among people with no or low levels of education, there is a significant variation in the basic skills assessments. This suggests that education and basic skills, although related and sometime overlapping concepts, are in fact capturing different aspects of a person's human capital. In this sense, it is important to evaluate the impact of adults' basic skills conditional on education levels.

Table 5: Distribution of numeracy and literacy by highest qualifications

	No qualifications	Level 1	Level 2	Level 3	Level 4	Level 5
Literacy						
Below Entry level 2	8.6	1.8	2.0	0.9	0.3	0.0
Entry level 2	7.7	3.4	2.0	0.9	1.0	0.0
Entry level 3	8.2	6.8	6.4	3.5	1.0	0.6
Level 1	43.2	38.6	31.7	32.2	23.7	15.1
Level 2	32.3	49.4	57.9	62.6	74.0	84.4
Numeracy						
Below Entry level 2	20.5	7.8	5.3	6.7	2.1	0.6
Entry level 2	19.6	15.2	12.0	7.3	4.3	1.7
Entry level 3	38.2	34.4	28.5	20.9	17.4	11.2
Level 1	15.0	30.1	30.6	36.5	37.4	33.0
Level 2	6.8	12.6	23.7	28.7	38.8	53.6

In order to preliminarily explore the potential impact of having low literacy and numeracy skills on cohort members' children's outcomes, the next two tables show the average ability scores of children, by the literacy (Table 6) and numeracy (Table 7) levels of their parents. As expected, the children's scores in the different tests increase as parents' literacy and numeracy increase.

Table 6: Children ability scores (mean) by parents' literacy level

Parents' literacy assessment	Early Years Battery (aged 3 yrs to 5yrs 11 mths)		School Years Battery (aged 6 yrs to 15 yrs 11 mths)		
	Naming Vocabulary	Early Number Concepts	Word Reading Scale	Spelling	Number Skills
Below entry Level 2	84.39	117.47	117.02	46.18	94.95
Entry level 2	88.59	111.62	124.89	52.17	104.52
Entry level 3	91.09	113.86	125.90	54.17	106.50
Level 1	98.77	124.14	133.20	59.39	107.06
Level 2	101.54	125.87	135.58	62.11	108.36

Table 7: Children ability scores (mean) by parents' numeracy level

Parents' numeracy assessment	Early Years Battery (aged 3 yrs to 5 yrs 11 mths)		School Years Battery (aged 6 yrs to 15 yrs 11 mths)		
	Naming Vocabulary	Early Number Concepts	Word Reading Scale	Spelling	Number Skills
Below Entry level 2	90.26	117.05	125.33	52.45	102.14
Entry level 2	96.60	116.61	132.15	58.02	107.15
Entry level 3	99.26	124.68	133.06	59.36	107.86
Level 1	100.51	125.71	134.12	60.87	107.36
Level 2	102.48	127.19	136.48	63.60	108.64

Even if the levels of literacy and numeracy presented above are instructive and have been widely used to measure adults' basic skills (see, for example, the Moser Report (DfEE, 1999) and Leitch, 2006), we prefer to use a continuous measure of the individual's basic skills, so as not to lose insightful variations. Indeed, we use PCA to create a unique index of cohort members' basic skills. As we will see below, in some regression we will also use separate measure of literacy and numeracy based on standardised test scores.

As mentioned above, we shall also include in the regressions a vast array of control variables in order to reduce the omitted-variable bias and to account for family background and characteristics. In particular, we insert child characteristics; family structure; parents' education, occupations and income; some measures of parenting style; and finally parents' test scores at age 5.

First of all we control for the child's age – which obviously affects the performance in the test scores – gender and whether she/he is a first-born. For family characteristics, we include the number of siblings and a dummy variable describing whether the cohort member is a lone parent. Cognitive outcomes of the children may be also affected by parents' socio-economic conditions. We describe socio-economic conditions by looking at family income, at poverty status and at occupation categories. The family income variable is built as the log of the average weekly household income in 2000 and 2004. In each year, household income has been calculated as the average (mean) of net weekly earnings of the cohort member and net weekly earnings of the partner (if any). In order to control for outliers and to reduce the measurement error we have dropped the values below the lower tail (0.5 percentile) and above the upper tail (99.5 percentile). To control for the effect of poverty status in 2004 we also include a dummy variable equal to 1 if the family receive any state benefits. Parents' social class is described using the NS-SEC[5] occupationally based classification. Table 8 shows the distribution of cohort members by occupation and indicates that almost 44 per cent of the sample is employed in routine or semi-routine occupations, which roughly correspond to Unskilled Occupations in the SOC2000 classification[6]. Only 8.3 per cent of individuals are employed in the most skilled occupations.

[5] National Statistics Socio-Economic Classification.
[6] Further details on the classification of social classes and occupations can be found at: http://www.statistics.gov.uk/methods_quality/ns_sec

Table 8: Occupational distribution

NC-SEC classification, 2004	Frequency	%	Cumulative
Higher managerial and professional occupations	187	8.31	8.31
Lower managerial and professional occupations	329	14.63	22.94
Intermediate occupations	239	10.63	33.57
Small employers and own account workers	229	10.18	43.75
Lower supervisory and technical occupations	293	13.03	56.78
Semi-routine occupations	667	29.66	86.44
Routine occupations	305	13.56	100
Total	2,249	100	

In the regressions we use *intermediate occupation* as the base category (the omitted one) and inserted dummies for all other occupations. Indeed the coefficients of the different dummies should be interpreted in comparison with *intermediate occupations.* Apart from socio-economic status, we control for parents' education. If we were to exclude this variable from the analysis, then our indicators of basic skills may simply pick-up the effect of education. Instead, we want of evaluate the impact of basic skills netting out that of education so that our specification measures the marginal impact of having better basic skills conditional on a given level of education achieved. This is therefore an extremely stringent test: we are asking whether within a given level of parental education whether having better skills improves their children's outcomes. We include a variable indicating the cohort member's highest level of education attained in 2004 (academic and vocational one). The distribution of this variable is described in Table 9.

Table 9: Highest educational level, 2004

Highest qualification, 2004	Frequency	%	Cumulative
No qualification	227	7.98	7.98
Level 1 (e.g. CSE, low GCSEs, etc.)	802	28.2	36.18
Level 2 (e.g. good GCSEs, NVQ2, etc.)	614	21.59	57.77
Level 3 (e.g. A-levels, etc.)	348	12.24	70.01
Level 4 (e.g. Degree, etc.)	674	23.7	93.71
Level 5 (e.g. MSc, PhD, etc.)	179	6.29	100
Total	2,844	100	

As emphasised by Michael (2005) and Feinstein et al. (2004) among others, child development and cognitive outcomes are heavily affected by home environment, parents' behaviours and parent–child interactions. Analysing the impact of these variables capturing the 'parenting style' is out of the scope of this work. However, we need to include some proxies of these variables, which may be related both to children's cognitive outcomes and to parents' basic skills. In order to capture parenting style, we insert in the model measures of *warmth* and of *conflict* in the parent and child relationship.

There is also extensive literature documenting the importance of parental warmth for the development of children's cognitive and behavioural competence (see for example, Masten and Coatsworth, 1998 and Feinstein et al., 2004). A large number of studies – cited in Feinstein et al. (2004, p. 25) – have found correlations between the warmth of parent–child interactions and later cognitive outcomes. The importance of parental warmth may be due to its effects on the child's sense of attachment and the resulting capability to develop understanding and confront uncertainty or puzzling tasks (Feinstein et al., 2004). Another relevant variable affecting child development is acknowledged to be the conflict nature of the parent–child relationship. This variable can be seen as an aspect of discipline and can be either constructive in the sense that it involves high levels of negotiation, justification and resolution or destructive if it does not involve these positive strategies and if it is only an indicator of dysfunction in the relationship. We created the *warmth* and *conflict* variables by extracting the first and second principal component respectively from the *Child–Parent Relationship Scale* (Pianta: Short Form[7]), which is included in the *Parent and Child Questionnaire* in BCS 2004. Appendix A gives the full list of questions included in the Pianta scale.

We also control for the 'home learning environment', by including a variable indicating how often the parents read to the children. Several studies have shown that the frequency with which parents read to their children is associated with higher scores in cognitive assessments (see Feinstein *et al*. 2004). We have taken this variable from the *Parent and Child Questionnaire* in the 2004 sweep of BCS. The variable is available for all children aged less than 10.

Finally, our dataset also allow us to control for parents' 'innate' ability which we proxy using their tests scores at age 5 (Tyler, 2004). The inclusion of this variable is an attempt to control for the genetic factor in the intergenerational transmission of skills. However, the age 5 tests used in the British Cohort Study were not IQ-based tests per se so some caution is needed here, in that clearly we may not have controlled for all genetic factors that influence child outcomes. Innate ability may be in fact highly correlated with parents' basic skills and can be inherited by their children. In other words, children may have inherited some of their parents' innate abilities, which can be translated later into cognitive attainments. Therefore if we do not control for this factor our results may be biased.

The next table summarises all the variables used in the analysis and give some descriptive statistics.

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[7] See Parsons (2006) for further details.

Table 10: Variables in the analysis

Variable description	Obs.	Mean	Std. dev.	Min	Max
*ICA** for younger children	1,226	0.00	1.29	-5.91	3.98
ICA for older children	2,240	0.00	1.52	-5.25	3.94
Child age	5,207	5.86	4.16	0	16
Whether child is female	5,207	0.49	0.50	0	1
Whether CM** is female	5,207	0.63	0.48	0	1
CM literacy scores	5,142	8.83	1.64	0	10
CM numeracy scores	5,141	12.79	3.54	0	17
Principal component on CM literacy and numeracy scores	5,141	-0.09	1.31	-6.67	1.30
Whether child is first born	5,207	0.55	0.50	0	1
CM's age at first birth	5,207	25.69	4.31	16.25	34.67
Whether CM is lone parent	5,207	0.10	0.30	0	1
Social class; NS-SEC classification	3,913	3.60	1.93	1	7
Whether CM receives state benefits	5,207	0.09	0.29	0	1
Highest qualification in 2004	5,197	2.58	1.09	1	5
Average value of household income in 2000 and 2004	3,759	439	229	18	2331
Principal component on parents cognitive test scores at age 5 (1975)	3,367	0.00	1.26	-3.89	3.57
Parents' life satisfaction scale at age 34 (0 to 10)	5,170	7.59	1.80	0	10
First principal component on 'warmth' variables (form Pianta scale). Young child	1,245	0.00	1.34	-12.11	3.40
First principal component on 'conflict' variables (from Pianta scale). Young child	1,245	0.00	1.90	-2.65	7.16
First principal component on 'warmth' variables (form Pianta scale). School age child	2,249	0.00	1.48	-9.95	4.42
First principal component on 'conflict' variables (from Pianta scale). School age child	2,249	0.00	2.19	-2.68	11.70
Frequency of which parents read to the child. Young child	1,256	4.43	0.79	1	5
Frequency of which parents read to the child. School age child	1,308	3.92	0.97	1	5
Standardised scores on 'Strengths and Difficulties' scale (Goodman). Young children	1,259	0.00	1.00	-7.03	5.17
Standardised scores on 'Strengths and Difficulties' scale (Goodman). School age children	1,259	0.00	1.00	-7.03	5.17

**ICA* refers to the Index of Cognitive Ability

** CM means cohort member

5. Results

Throughout the empirical analysis, we use as dependent variables the children index of cognitive ability. As explained in the Data Description Section, for younger children, the principal components are extracted from two tests (Early Number Concepts and Naming Vocabulary) and for older children three tests (Word Reading Scale, Spelling, and Number Skills).

As the main explanatory variable, we use the combined index of parents' basic skills (aged 34) in literacy and numeracy. In most of the tables, we follow an approach where in the first few columns from the left, only parsimonious regressions are performed where few variables of control are introduced. As we move to the right of the tables, more variables of control are introduced, each of which have been shown to affect children tests scores in previous research (quoted in the literature review). We will comment only briefly on these coefficients (when they first appear), and will not put strong emphasis on their value as their main role is to control for factors that may otherwise confound the relationship between parents' basic skills and their children's tests scores.

5.1 Results for young and school-aged children (whole samples)

This section provides two sets of OLS regressions for young children aged 3 to 5 and 11 months (Table 11) and older children of age 6 to 16 and 11 months (Table 12). In column 1 of Table 11, we first regress young children's indices of cognitive ability on their parents' basic skills. The coefficient is positive and highly significant. This coefficient provides essentially the raw correlation between parental skills and child cognitive skill, controlling only for child age and gender. As one might expect, this coefficient is positive and highly significant. The child's age is positive and highly significant. The gender variable is not significant, meaning test scores do no vary according to gender at this early age. This first regression therefore suggests that parents with better basic skills have children who also have higher levels of cognitive skill. However, a number of other factors may explain this relationship, not least parental socio-economic background. In columns 2 to 11, we therefore progressively introduce more variables of control, starting with some family demographic features. The number of siblings is only significant in column 3 and its significance disappears once more variables are introduced (columns 4 to 10). First-born children tend to perform better and the effect is significantly positive and strong in all specifications where it is introduced. We then introduce parents' characteristics. As mentioned above, we are particularly fortunate in this respect as the BCS provides invaluable information on the early and later lives of parents. One question of importance is to determine whether being a lone parent may impact on the transfer of skills. The coefficient for whether the parent is a lone parent is however never significant, suggesting this factor is not in and of itself an important determinant of child cognitive development. Also the effect of parents' income and whether they receive state benefits is never significant. On the other hand, parental occupation does influence child cognitive skill, namely if the parent performs semi-skilled work, the child has lower cognitive skills. The coefficient is always significant and strongly negative. The highest education level of parents is also introduced but it never turns out to be significant. On the other hand, the coefficients on the variables measuring parents' own ability at age 5 are highly significant. Those early tests scores are supposed to proxy IQ (Tyler, 2004). Those tests should capture that part of the children's performance that comes from their parents' higher IQ. Indeed when they are introduced, the coefficient for parents' literacy and numeracy decrease substantially.

Finally three measures of family environment are introduced. They have been shown to affect children's early performance (as discussed in Sections 2 and 4). The coefficients for whether the family environment is warm or conflictual are never significant. They do, however, reduce substantially the number of observations on which the regressions are run. The same applies when we introduce variables measuring whether the children are being read to by parents. As these variables are insignificant, we consider column 8 as our preferred specification and will not include these variables in the sections that follow. The main result to take from this first table (Table 11) is that the coefficient for the literacy and numeracy is high and remains high and significant when we introduce our large array of control variables. In particular, the effect is robust to the inclusion of the parental qualification levels and parental ability measures. This means that parents' basic skills have a positive impact within each educational group, and are conditional on parental IQ (as best we can measure it).

Table 11: Young children

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Literacy/ Numeracy (pc)	0.189***	0.183***	0.179***	0.148***	0.147***	0.144***	0.119***	0.0998**	0.0812*	0.0843*
	(0.024)	(0.024)	(0.023)	(0.027)	(0.027)	(0.030)	(0.031)	(0.044)	(0.045)	(0.044)
Child's age	1.059***	1.056***	1.063***	1.044***	1.047***	1.064***	1.062***	1.076***	1.063***	1.067***
	(0.032)	(0.032)	(0.032)	(0.035)	(0.036)	(0.040)	(0.040)	(0.050)	(0.051)	(0.051)
Child is female	0.0780	0.0786	0.0796	0.0551	0.0541	0.0554	0.0575	0.00552	0.0107	0.00283
	(0.051)	(0.051)	(0.051)	(0.056)	(0.056)	(0.063)	(0.062)	(0.084)	(0.086)	(0.087)
Whether first-born		0.270***	0.206***	0.198***	0.198***	0.202***	0.200***	0.212**	0.247***	0.232**
		(0.052)	(0.059)	(0.067)	(0.067)	(0.074)	(0.073)	(0.095)	(0.095)	(0.095)
Number of siblings			-0.0699*	-0.0396	-0.0452	-0.0480	-0.0457	-0.0550	-0.00640	-0.00047
			(0.037)	(0.050)	(0.051)	(0.059)	(0.058)	(0.073)	(0.066)	(0.067)
Whether lone parent			-0.0602	-0.135	-0.171	-0.272*	-0.243	-0.316	-0.302	-0.288
			(0.11)	(0.12)	(0.12)	(0.16)	(0.16)	(0.20)	(0.21)	(0.21)
Higher managerial and professional occupations				-0.0363	-0.0410	-0.0132	-0.0870	0.0612	0.0668	0.125
				(0.13)	(0.13)	(0.14)	(0.14)	(0.19)	(0.20)	(0.20)
Lower managerial and professional occupations				0.122	0.119	0.143	0.0901	0.0746	0.0858	0.129
				(0.10)	(0.11)	(0.11)	(0.11)	(0.15)	(0.15)	(0.15)
Lower supervisory and technical occupations				-0.0918	-0.0974	-0.0782	-0.0529	-0.147	-0.135	-0.0555
				(0.13)	(0.13)	(0.14)	(0.14)	(0.18)	(0.18)	(0.18)
Small employers and own account workers				-0.0828	-0.0898	-0.0399	-0.0606	-0.149	-0.0678	-0.0250
				(0.11)	(0.11)	(0.16)	(0.16)	(0.19)	(0.18)	(0.19)
Semi-routine occupations				0.0766	0.0723	0.0760	0.0992	0.121	0.136	0.140

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
				(0.13)	(0.13)	(0.14)	(0.14)	(0.17)	(0.18)	(0.18)
Routine occupations				-0.382**	-0.405***	-0.408**	-0.360**	-0.441**	-0.454**	-0.391*
				(0.15)	(0.15)	(0.16)	(0.17)	(0.21)	(0.22)	(0.22)
In receipt of state benefits					0.314*	0.394*	0.469**	0.169	0.128	0.186
					(0.17)	(0.20)	(0.22)	(0.28)	(0.30)	(0.28)
Mean log household income (2000-2004)						0.0963	0.0839	-0.0772	-0.0605	-0.0586
						(0.079)	(0.078)	(0.094)	(0.097)	(0.095)
Level 1							0.0124	-0.267	-0.218	-0.290
							(0.17)	(0.20)	(0.20)	(0.20)
Level 2							0.231	-0.0344	0.00646	-0.0786
							(0.18)	(0.20)	(0.21)	(0.21)
Level 3							0.123	-0.178	-0.122	-0.248
							(0.19)	(0.22)	(0.23)	(0.23)
Level 4							0.267	-0.0316	-0.0162	-0.135
							(0.18)	(0.22)	(0.23)	(0.22)
Level 5							0.310	-0.00805	0.00081	-0.148
							(0.21)	(0.26)	(0.27)	(0.27)
Parents' ability at age 5								0.119***	0.123***	0.125***
								(0.041)	(0.040)	(0.040)
Conflicts									-0.00212	0.00051
									(0.026)	(0.026)
Warmth									0.0611*	0.0531
									(0.037)	(0.037)
Whether child is read to										0.138**
										(0.059)
Observations	1219	1219	1219	934	934	758	758	481	468	466
R-squared	0.50	0.51	0.51	0.51	0.51	0.52	0.53	0.53	0.52	0.53

Note: dependent variable: young children (aged 3–6) overall *Index of Cognitive Ability –ICA* (pc on standardised ability scores)
Standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 12: School-age children

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Literacy/ Numeracy (pc)	0.219***	0.210***	0.207***	0.162***	0.162***	0.164***	0.144***	0.113***	0.120***	0.148***
	(0.023)	(0.023)	(0.022)	(0.028)	(0.028)	(0.034)	(0.034)	(0.040)	(0.043)	(0.049)
Child's age	0.358***	0.350***	0.354***	0.355***	0.355***	0.354***	0.358***	0.361***	0.365***	0.599***
	(0.0099)	(0.010)	(0.011)	(0.013)	(0.013)	(0.015)	(0.015)	(0.017)	(0.018)	(0.045)
Child is female	0.185***	0.191***	0.191***	0.192***	0.192***	0.256***	0.263***	0.208***	0.183**	0.180*
	(0.050)	(0.050)	(0.050)	(0.058)	(0.058)	(0.065)	(0.065)	(0.074)	(0.078)	(0.095)
Whether first-born		0.220***	0.188***	0.176***	0.176***	0.206***	0.196***	0.198**	0.217**	0.265**
		(0.054)	(0.057)	(0.066)	(0.066)	(0.075)	(0.076)	(0.093)	(0.098)	(0.12)
Number of siblings			-0.0406	-0.0169	-0.0171	-0.0129	-0.0157	-0.0171	-0.00545	0.00747
			(0.035)	(0.043)	(0.043)	(0.049)	(0.051)	(0.061)	(0.063)	(0.088)
Whether lone parent			-0.133	-0.126	-0.128	-0.159	-0.193	-0.157	-0.101	-0.244
			(0.083)	(0.11)	(0.11)	(0.14)	(0.14)	(0.15)	(0.15)	(0.18)
Higher managerial and professional occupations				0.0120	0.0122	-0.0176	-0.0434	-0.0709	-0.134	-0.335
				(0.13)	(0.14)	(0.14)	(0.15)	(0.19)	(0.20)	(0.26)
Lower managerial and professional occupations				-0.0421	-0.0421	-0.0202	-0.0311	0.00517	0.0156	-0.0277
				(0.089)	(0.089)	(0.096)	(0.098)	(0.11)	(0.12)	(0.14)

Lower supervisory and technical occupations				-0.125	-0.125	-0.155	-0.148	-0.0902	-0.103	-0.198
				(0.12)	(0.12)	(0.13)	(0.13)	(0.14)	(0.15)	(0.18)
Small employers and own account workers				-0.158	-0.158	-0.134	-0.137	-0.217	-0.184	-0.293
				(0.12)	(0.11)	(0.17)	(0.17)	(0.19)	(0.21)	(0.26)
Semi-routine occupations				-0.176*	-0.177*	-0.145	-0.130	-0.162	-0.142	-0.156
				(0.099)	(0.099)	(0.11)	(0.11)	(0.12)	(0.12)	(0.14)
Routine occupations				-0.261**	-0.262**	-0.285**	-0.290**	-0.257	-0.266	-0.0651
				(0.12)	(0.12)	(0.13)	(0.14)	(0.17)	(0.18)	(0.18)
Receipt State benefits					0.0123	-0.0672	-0.0460	0.0902	0.0592	0.222
					(0.20)	(0.20)	(0.20)	(0.21)	(0.23)	(0.41)
Mean log household income (2000–2004)						0.0743	0.0548	0.109	0.111	0.123
						(0.076)	(0.078)	(0.094)	(0.098)	(0.13)
Level 1							0.303**	0.179	0.166	-0.0862
							(0.14)	(0.14)	(0.15)	(0.19)
Level 2							0.229	0.0126	0.0258	-0.173
							(0.15)	(0.16)	(0.16)	(0.20)
Level 3							0.274*	0.0830	0.0991	-0.270
							(0.17)	(0.17)	(0.18)	(0.23)
Level 4							0.240	0.0280	0.0300	-0.143
							(0.16)	(0.17)	(0.18)	(0.23)
Level 5							0.664***	0.576**	0.547**	0.448
							(0.22)	(0.26)	(0.27)	(0.30)
Parents' ability at age 5								0.0438	0.0461	0.0202
								(0.033)	(0.034)	(0.044)
Conflicts									-0.0461**	-0.0645**
									(0.019)	(0.029)
Warmth									0.0275	0.0324
									(0.029)	(0.040)
Whether is read to										-0.179***
										(0.054)
Observations	2228	2228	2228	1649	1649	1310	1309	881	832	499
R-squared	0.42	0.42	0.43	0.43	0.43	0.42	0.42	0.46	0.46	0.38

Note: dependent variable: school age children (aged 6–16) overall *Index of Cognitive Ability –ICA* (pc on standardised ability scores). Standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In Table 12, similar regressions are performed for children aged 6 to 16 and 11 months. Results are very similar to those for younger children. In particular the age variable is highly significant and positive, and the same applies for first-born children. One noticeable difference is that child gender is now significant. Girls are performing better, so it is when children are older and in the school environment that this advantage appears. But again, the main result to take from this second table is that the coefficient for parents' basic skills in numeracy and literacy remains positive and highly significant despite our best efforts to find confounding variables.

For the interpretation of the size effect, we use the value of the coefficients for our preferred specification (column 8 in Table 11 and Table 12). An increase in one standard deviation (1.3) of parents' basic skills index would lead to an increase in their young children's cognitive skill index by 10 per cent of a standard deviation. Otherwise expressed, the parents whose basic skills situated them at the 25th percentile have children who perform 10.1 per cent better than those parents situated at the 10th percentile (the difference between the 25th and the 10th percentiles is within one standard deviation). For older children, the same gaps in parents' basic skills explains a 9.7 per cent difference in their children's cognitive skill.

Overall, these results suggest a great impact from adults' basic skills on child cognitive development, conditional on a large set of other control variables. This result holds even after inclusion of parents' education and ability. The coefficient of parents' basic skills – although decreasing in magnitude as we add more controls – remains always strongly significant. The decreasing value of our coefficient of interest is due to the fact that we are adding more controls that mediate the impact of parents' literacy and numeracy and not to the different sample size of each regression (Appendix B reports the previous tables using the same sample size for all the regressions).

The following section will test whether the impact of basic skills is higher for those with low qualifications or high qualifications.

5.2 Results for young and school-aged children, differentiated by qualification level

The main aim of Skills for Life is to address the lack of basic skills of large proportions of the UK adult population, i.e. to help people who did not gain sufficient basic skills during their school years. It is therefore of great interest to check whether the results obtained here on the role of parental basic skills still apply with samples restricted to low educated parents. It is also interesting to check with a sample restricted to high-qualified individuals for comparison purposes. Therefore, we split the sample into two groups: parents with less than Level 3 (A-level equivalent) and parents with higher qualifications (Level 3, 4, and 5). We do this decomposition first for young children (

Table 13 and Table 14) and then for older children (Table 15 and Table 16). In these tables, we focus on the relationship of main interest, namely the association between parental basic skills and child outcomes, and therefore only indicate which variables of control are introduced without providing their coefficients.

5.2.1 Young children (aged 3 to 5 and 11 months)

In Table 13 results for low-educated parents are presented. As can be seen from the first row, the link between parents' basic skills and their children's early test scores remain strong and significant across the full range of regressions (columns 1 to 5). The coefficient on parental basic skills in the full specification allowing for the widest range of control variables is 0.13, which is very similar to the corresponding one for the full sample in Table 11 (0.11). The range of variation from a parsimonious to a fully controlled regression is reduced, the coefficients moved down from 0.17 to 0.13 (from columns 1 to 5).

Table 13: young children – low educated parents

	(1)	(2)	(3)	(4)	(5)
Parents' skills	0.168*** (0.028)	0.162*** (0.027)	0.139*** (0.032)	0.137*** (0.035)	0.128** (0.053)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√
Socio-economic occupation			√	√	√
Household (log) income and poverty status				√	√
Parents' ability at age 5					√
Observations	691	691	501	394	252
R-squared	0.52	0.53	0.54	0.55	0.54

Note: dependent variable: young children (aged 3–6) overall *ICA* (pc on standardised ability scores)
Robust standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

These results contrast sharply when compared to results for the sample restricted to the children of parents with at least an A-level (e.g. with qualifications of Level 3 to 5). For the high-educated sample, the intergenerational link is not robust to the inclusion of more control variables. Interestingly, this is not caused only by increasing standard errors which lead to non-significant coefficients in the fully controlled regression (column 5). It is rather caused by the sharp decrease in the magnitude of the basic skills coefficient, dropping from 0.14 to 0.05 when one adds more control variables. This is an important result, as we would have expected a sharper increase in the standard errors due to the reduced size of the sample in the column to the right of the table. The decrease in the value of the coefficient is large when the household income and poverty status are introduced (in column 4) and then even greater when parents' early ability tests scores at 5 are introduced (in column 5).

Table 14: young children – medium and high educated parents

	(1)	(2)	(3)	(4)	(5)
Parents' skills	0.142*** (0.053)	0.142*** (0.052)	0.129** (0.058)	0.0975 (0.062)	0.0465 (0.083)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√
Socio-economic occupation			√	√	√
Household (log) income and poverty status				√	√
Parents' ability at age 5					√
Observations	528	528	433	364	229
R-squared	0.49	0.49	0.50	0.51	0.52

Note: dependent variable: young children (aged 3–6) overall *ICA* (pc on standardised ability scores)
Robust standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Overall, these results indicate rather clearly that for younger children, the impact of parents' basic skills is higher for those at the bottom of the educational distribution. This result does not imply that parents with higher levels of qualifications do not transfer any skills to their young children. Rather that at higher levels of basic skills (due to selecting a sample with higher levels of education), the role of parental basic skills does not appear so important in determining child cognitive outcomes. In fact, we rather think that this result may be due to the design of the parents' basic skills tests. Indeed, the main aim of the basic skills tests is to discriminate skills level at the bottom of the distribution. This will lead to a distribution where a large proportion of parents with higher qualifications will get the maximum score. There is consequently low variation in the dependent variable for parents of younger children when one introduces more variables in the regressions. These results seem to suggest that the types of skills measured by our parental basic skills tests (low levels of numeracy and literacy) do not affect significantly the cognitive tests score of the children of parents with qualification higher than A-level. For parents with low qualification levels, the opposite conclusion can be drawn. The type of skills measured by our tests makes a great deal of difference to children of parents with low qualification. This provides some support for policy that aims at increasing the basic skills of parents at the bottom of the qualification distribution only.

We now turn to the results for older children aged 6 to 16 and 11 months.

5.2.2 School age children (aged 6 to 16 and 11 months)

Results for older children differ compared to those for young children. The transfer of basic skills to the children is highly significant both for low and highly qualified parents. The coefficients in column 5 of both Table 15 and Table 16 are strongly significant and positive. The sample of parents with older children differs substantially from the sample of parents with young children, not least in the sense that the former had their children 'early', indeed below the age of 28 years for cohort members[8]. In general parents who have their children younger are less educated and skilled and many become qualified as they raise their children. We think this could explain why the impact of parental basic skills on child cognitive development appears to be significant for both more and less qualified early parents. In other words, parents who have their children early may have poorer skills during the early years of their children's childhood, even if they go on to achieve higher levels of skills and education later on. If it is the early years (0–5) that matter most in terms of a child's cognitive development, as suggested by a number of influential academics (Heckman, 2007), it may be that we need to measure actual parental skills during these formative years rather than much later when the children have passed through this formative phase. One policy conclusion to draw from this, could be that the transfer of basic skills is important for early parents whether qualified (or rather in the process of become qualified) or not qualified.

[8] See Appendix C for a table reporting the average education and basic skills level for parents of younger and older children separately. The table highlights that among higher educated parents those with older children have on average lower basic skills (and higher variance) than those with younger children. Moreover even in the 'high qualified' category, they are concentrated in the lower levels of qualification if compared with parents of younger children.

Table 15: School age children – low educated parents

	(1)	(2)	(3)	(4)	(5)
Parents' skills	0.187***	0.184***	0.137***	0.138***	0.100**
	(0.026)	(0.026)	(0.032)	(0.039)	(0.044)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√
Socio-economic occupation			√	√	√
Household (log) income and poverty status				√	√
Parents' ability at age 5					√
Observations	1575	1575	1119	872	609
R-squared	0.41	0.41	0.40	0.40	0.43

Notes: dependent variable: school age children (aged 6–16) overall *ICA* (pc on standardised ability scores).
Robust standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 16: School age children – medium and highly educated parents

	(1)	(2)	(3)	(4)	(5)
Parents' skills	0.267***	0.264***	0.263***	0.245***	0.251***
	(0.048)	(0.048)	(0.055)	(0.072)	(0.087)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√
Socio-economic occupation			√	√	√
Household (log) income and poverty status				√	√
Parents' ability at age 5					√
Observations	653	653	530	438	272
R-squared	0.47	0.48	0.51	0.50	0.55

Notes: dependent variable: school age children (aged 6–16) overall *ICA* (pc on standardised ability scores).
Robust standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

This latter analysis suggests that the transfer of basic skills from parents to children is not constant for parents of different ages. So now, the obvious next step in our analysis is to investigate whether the transfer of skills does vary across parents' and children's genders. We proceed to this analysis in the section that follows.

5.3 Disaggregation by parents' and children's gender

The majority of parents interviewed and tested in the BCS70 at age 34 were women (63 per cent). This is explained by differences in the lifecycle across gender where the first birth for men tends to appear at later age than for women. It is interesting to conduct a gender-specific investigation of the inter-generational link between parents and children in terms of skills. It is important to keep in mind that throughout the gender-specific analysis, the sample of mothers and fathers do differ[9].

We retain our distinction between younger and older children, and start with the analysis of younger children (Table 17 to Table 22), then proceed to the analysis of older children (Table 23 to Table 28).

5.3.1 Young children (aged 3 to 5 and 11 months)

For young children, we first compare the link between mothers and fathers in Table 17 and Table 18 without differentiating the gender of the children. We then proceed to the children gender-specific regressions in Table 19 to Table 22.

Mothers/fathers and their children

The coefficients in column 6 of both Table 17 and 18 stand only on the margin of statistical significance (at the 10 per cent level). In other words, when we examine the transmission of basic skills from mothers to their children (Table 17) and from fathers to their children (Table 18) we get only marginally significant results. The sample size appears to play a role here by increasing the standard errors (this is particularly the case for Table 17). The coefficients of parents' basic skills for both mothers and fathers are highly significant across all the specifications. Their significance slightly decreases when parental ability is included in the model (column 6), but their magnitude do not change substantially. One could therefore consider that the association between parents' basic skills and children's cognitive outcomes is significant for both genders of parent. However, the coefficients are not statistically different for mothers and fathers, suggesting we would be better to use the combined mother and father sample to maximise sample size.

[9] Women constitute 60.58 per cent of our sample, while the men are only 39.42 per cent. Men tend to be slightly more educated (their average educational level is 2.4 against 2.3 for women) and more skilled in literacy and numeracy (their average score is 0.89 (std = 1.88), whilst that of women is – 0.98 (std = 1.29). Moreover, men's partners are usually younger than women's partner (32.9 against 36.7).

Table 17: Young children, mothers only

	(1)	(2)	(3)	(4)	(5)	(6)
Parents' skills	0.194***	0.187***	0.156***	0.126***	0.132***	0.122*
	(0.031)	(0.030)	(0.043)	(0.045)	(0.050)	(0.065)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√	√
Socio-economic occupation			√	√	√	√
Education				√	√	√
Household (log) income and poverty status					√	√
Parents' ability at age 5						√
Observations	745	745	480	480	409	277
R-squared	0.53	0.53	0.54	0.55	0.55	0.55

Note: dependent variable: young children (aged 3–6) overall *ICA* (pc on standardised ability scores)
Robust standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 18: Young children, fathers only

	(1)	(2)	(3)	(4)	(5)	(6)
Parents' skills	0.184***	0.183***	0.148***	0.144***	0.124***	0.116*
	(0.038)	(0.037)	(0.035)	(0.038)	(0.040)	(0.060)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√	√
Socio-economic occupation			√	√	√	√
Education				√	√	√
Household (log) income and poverty status					√	√
Parents' ability at age 5						√
Observations	474	474	454	454	349	204
R-squared	0.49	0.49	0.49	0.50	0.52	0.54

Note: dependent variable: young children (aged 3–6) overall *ICA* (pc on standardised ability scores)
Robust standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

We then further disaggregate Table 17 and study separately the relationship between mothers' basic skills and their daughters' cognitive skills (Table 19) and mothers' basic skills and their son's test scores (Table 20). It appears that the skills link between mothers and daughters remain strong across most specifications (only at 10 per cent level in the fully controlled specification in column 6 of Table 19). The link between mothers and sons is less robust. In particular after we control for the highest education level, the link is not statistically significant.

Table 19: Young children, mothers–daughters

	(1)	(2)	(3)	(4)	(5)	(6)
Parents' skills	0.204***	0.191***	0.184***	0.171***	0.174***	0.133*
	(0.045)	(0.043)	(0.062)	(0.064)	(0.065)	(0.076)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√	√
Socio-economic occupation			√	√	√	√
Education				√	√	√
Household (log) income and poverty status					√	√
Parents' ability at age 5						√
Observations	389	389	243	243	208	140
R-squared	0.54	0.55	0.56	0.57	0.60	0.63

Note: dependent variable: young children (aged 3–6) overall *ICA* (pc on standardised ability scores)
Robust standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 20: Young children, mothers–sons

	(1)	(2)	(3)	(4)	(5)	(6)
Parents' skills	0.184***	0.183***	0.123**	0.0754	0.0580	0.0480
	(0.041)	(0.041)	(0.055)	(0.055)	(0.067)	(0.12)
Child characteristics (age, gender, whether first born)	√	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√	√
Socio-economic occupation			√	√	√	√
Education				√	√	√
Household (log) income and poverty status					√	√
Parents' ability at age 5						√
Observations	356	356	237	237	201	137
R-squared	0.51	0.51	0.54	0.55	0.54	0.52

Note: dependent variable: young children (aged 3–6) overall *ICA* (pc on standardised ability scores)
Robust standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

And the final decomposition in this section is to separate the link between fathers and their children (Table 18) into the relationship between fathers and daughters (Table 21) and fathers and sons (Table 22). The picture is less clear for the relationship between fathers and their daughters and sons. None of the coefficients in the fully controlled regressions are significant (column 6). However, it appears that the link is more often significant for fathers and sons (Table 22) than mothers and sons (Table 20). Sample sizes are undoubtedly becoming a problem however in this analysis, so the results should be viewed as indicative only.

Table 21: Young children, fathers–daughters

	(1)	(2)	(3)	(4)	(5)	(6)
Parents' skills	0.167*** (0.052)	0.162*** (0.051)	0.125*** (0.047)	0.152*** (0.053)	0.124** (0.051)	0.0955 (0.069)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√	√
Socio-economic occupation			√	√	√	√
Education				√	√	√
Household (log) income and poverty status					√	√
Parents' ability at age 5						√
Observations	238	238	226	226	174	100
R-squared	0.49	0.49	0.51	0.52	0.55	0.61

Note: dependent variable: young children (aged 3–6) overall *ICA* (pc on standardised ability scores)
Robust standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 22: Young children, fathers–sons

	(1)	(2)	(3)	(4)	(5)	(6)
Parents' skills	0.197*** (0.053)	0.199*** (0.054)	0.161*** (0.052)	0.123** (0.053)	0.0997* (0.060)	0.0754 (0.11)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√	√
Socio-economic occupation			√	√	√	√
Education				√	√	√
Household (log) income and poverty status					√	√
Parents' ability at age 5						√
Observations	236	236	228	228	175	104
R-squared	0.48	0.48	0.49	0.51	0.53	0.59

Note: dependent variable: young children (aged 3–6) overall *ICA* (pc on standardised ability scores)
Robust standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

5.3.2 School-age children (aged 6 to 16 and 11 months)

Mothers/fathers and their children

For school-aged children, the link between mothers' basic skills and their children's cognitive skills is not significant when one introduces the full set of controls available (Table 23, column 6). For fathers, the link remains very strong and highly significant in all regressions of Table 24. Dividing the link in Table 24 between sons and daughters shows that it is the relationship between fathers' basic skills and sons' cognitive skills that is particularly strong and significant (Table 28). For mothers, their basic skills level is always significantly and strongly associated with their sons' and daughters' tests scores in all regressions but only when parental ability is excluded from the model (i.e. column 1 to 4 of both Table 25 and Table 26). It is worth noting that introducing the parental ability measures in the regressions constitutes a very conservative test of the robustness of the link between parents' basic skills and their children's tests scores.

Table 23: School-age children, mothers only

	(1)	(2)	(3)	(4)	(5)	(6)
Parents' skills	0.210*** (0.028)	0.207*** (0.028)	0.138*** (0.037)	0.123*** (0.037)	0.134*** (0.047)	0.0622 (0.049)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√	√
Socio-economic occupation			√	√	√	√
Education				√	√	√
Household (log) income and poverty status					√	√
Parents' ability at age 5						√
Observations	1610	1610	1081	1081	859	603
R-squared	0.42	0.42	0.42	0.42	0.42	0.49

Notes: dependent variable: school age children (aged 6-16) overall *ICA* (pc on standardised ability scores).
Robust standard errors (clustered by family) in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 24: School-age children, fathers only

	(1)	(2)	(3)	(4)	(5)	(6)
Parents' skills	0.209*** (0.036)	0.213*** (0.037)	0.203*** (0.041)	0.163*** (0.041)	0.145*** (0.045)	0.191*** (0.066)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√	√
Socio-economic occupation			√	√	√	√
Education				√	√	√
Household (log) income and poverty status					√	√
Parents' ability at age 5						√
Observations	618	618	568	567	450	278
R-squared	0.43	0.44	0.45	0.46	0.46	0.44

Notes: dependent variable: school age children (aged 6-16) overall *ICA* (pc on standardised ability scores).
Robust standard errors (clustered by family) in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 25: School-age children, mothers–daughters

	(1)	(2)	(3)	(4)	(5)	(6)
Parents' skills	0.220*** (0.036)	0.214*** (0.035)	0.141*** (0.044)	0.121*** (0.045)	0.123** (0.060)	0.0185 (0.057)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√	√
Socio-economic occupation			√	√	√	√
Education				√	√	√
Household (log) income and poverty status					√	√
Parents' ability at age 5						√
Observations	811	811	539	539	430	302
R-squared	0.44	0.45	0.45	0.46	0.46	0.49

Notes: dependent variable: school age children (aged 6–16) overall *ICA* (pc on standardised ability scores).
Robust standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 26: School-age children, mothers–sons

	(1)	(2)	(3)	(4)	(5)	(6)
Parents' skills	0.200*** (0.038)	0.199*** (0.038)	0.135** (0.053)	0.127** (0.054)	0.146** (0.066)	0.115 (0.078)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√	√
Socio-economic occupation			√	√	√	√
Education				√	√	√
Household (log) income and poverty status					√	√
Parents' ability at age 5						√
Observations	799	799	542	542	429	301
R-squared	0.40	0.40	0.39	0.40	0.38	0.50

Notes: dependent variable: school age children (aged 6–16) overall *ICA* (pc on standardised ability scores).
Robust standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 27: School-age children, fathers–daughters

	(1)	(2)	(3)	(4)	(5)	(6)
Parents' skills	0.152***	0.155***	0.168***	0.143***	0.132**	0.130
	(0.042)	(0.043)	(0.051)	(0.053)	(0.052)	(0.10)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√	√
Socio-economic occupation			√	√	√	√
Education				√	√	√
Household (log) income and poverty status					√	√
Parents' ability at age 5						√
Observations	283	283	259	259	210	129
R-squared	0.51	0.52	0.54	0.56	0.58	0.57

Notes: dependent variable: school age children (aged 6–16) overall *ICA* (pc on standardised ability scores). Robust standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 28: School-age children, fathers–sons

	(1)	(2)	(3)	(4)	(5)	(6)
Parents' skills	0.270***	0.275***	0.246***	0.191***	0.187**	0.280***
	(0.058)	(0.058)	(0.064)	(0.065)	(0.081)	(0.10)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√	√
Socio-economic occupation			√	√	√	√
Education				√	√	√
Household (log) income and poverty status					√	√
Parents' ability at age 5						√
Observations	335	335	309	308	240	149
R-squared	0.37	0.38	0.38	0.41	0.40	0.38

Notes: dependent variable: school age children (aged 6–16) overall *ICA* (pc on standardised ability scores). Robust standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Results so far rely on Ordinary Least Squares (OLS) regressions with a rich set of control variables. They show that parents' basic skills are important determinants of the cognitive outcomes of their children. This result is robust to different specifications and to the inclusion of a large set of controls.

Even though we control for a multitude of observable factors, our results may still be biased by simultaneity (unobservable characteristics of children and /or their family that are correlated with both parents' skills and child outcomes) or by measurement error. We address these potential biases in the following section.

5.4 Impact of literacy and numeracy considered separately

Up until now, we have considered the common components of parents' basic skills measured from two different tests (i.e. a literacy and a numeracy test). Using a unique composite index derived from a principal components analysis relies on the assumption that a lot of the skills measured in the two tests are highly positively correlated[10]. The tests are designed to differentiate very low levels of basic skills, so that for example someone who cannot read properly will also score very low in the numeracy test. For policy purposes, however, it may be interesting to try to relax this assumption and investigate whether it is possible to observe separate effects of parents' literacy and numeracy on their children's tests scores.

In Table 29 we present such regressions. We show the results using only our preferred specification with all controls. We observe in columns 1 and 4 standardised tests scores for literacy when entered in isolation. Both coefficients are highly significant and positively hint at a strong effect of literacy on tests scores both for pre- and school-aged children. The effect of numeracy in isolation is only significant for school-aged children. So there is some support for a story where the effects observed previously comes mainly from parents' literacy skills. This is confirmed in column 3 where both tests are entered separately in the same regressions. Obviously the high correlation between numeracy and literacy takes away a bit of the significance of the literacy scores. Also numeracy is not significant in both the pre- and school-aged children. But we do not take the view that numeracy is not affecting children tests scores, rather we think that there is a combined effect of both literacy and numeracy. And we argue that the best way to measure this combined effect is to use the synthetic index we computed using principal components analysis.

Table 29: Impact of literacy and numeracy separately

	(1)	(2)	(3)	(4)	(5)	(6)
	Younger children			**Older children**		
Parents' literacy score	0.142**		0.136*	0.194***		0.174***
	(0.066)		(0.080)	(0.057)		(0.064)
Parents' numeracy score		0.0818	0.0127		0.114**	0.0343
		(0.058)	(0.069)		(0.050)	(0.057)
All controls	V	V	V	V	V	V
Observations	481	481	481	880	881	880
R-squared	0.53	0.52	0.53	0.46	0.46	0.46

Notes: dependent variable: young (3–6) and school-age (6–16) children overall *ICA* (pc on standardised ability scores). Robust standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

[10] Indeed, the correlation between the two tests is as high as 0.66 and highly significant.

While the previous table suggests that parents' literacy matters more than numeracy for children's cognitive outcomes, we still do not know whether this relationship is linear or not. In the following table, we use as a variable of interest the levels of literacy and numeracy achieved by parents (as defined in the new Skills for Life standards) instead of using a continuous measure. In this way we should be able to indentify possible discontinuities in the relationship between parents' basic skills and child performance. Indeed, Table 30 shows the estimated outcomes for both younger (columns 1 and 2) and older children (columns 3 and 4). As usual, the regressions are run using the full set of controls, even if they are not reported in the table.

Focusing on the younger children, the results reveal a significant cut-off between parents at Entry level 3 literacy and higher levels. Children in families with parents at Level 1 or 2 in literacy assessment perform significantly better than children of parents at the very lowest literacy level (below Entry level 2). In the case of numeracy the cut-off appears to be between parents at Entry level 3 and higher levels. It seems that having reached the literacy and numeracy levels set as a minimum target by the Government (Level 1 and Entry level 3 respectively) significantly affects the performance of young children.

For older children, the picture is rather different in that the impact of literacy seems to be more continuous. Each level of literacy above the lowest one leads to better performance of children. As shown previously, numeracy has a lower impact, and only children of parents with numeracy Level 2 are significantly advantaged with respect to the others.

Table 30: Impact of parents' literacy and numeracy levels

	(1)	(2)	(3)	(4)
	Younger children		**School-aged children**	
	Literacy levels	*Numeracy levels*	*Literacy levels*	*Numeracy levels*
Entry level 2	0.286	0.448	0.785***	0.0830
	(0.56)	(0.28)	(0.24)	(0.22)
Entry level 3 (*minimum target for numeracy*)	0.0664	0.470*	0.787***	0.161
	(0.48)	(0.24)	(0.20)	(0.20)
Level 1 (*minimum target for literacy*)	0.638**	0.565**	1.003***	0.139
	(0.32)	(0.24)	(0.18)	(0.21)
Level 2	0.732**	0.588**	1.048***	0.408*
	(0.32)	(0.23)	(0.18)	(0.21)
All controls	√	√	√	√
Observations	481	481	881	881
R-squared	0.53	0.53	0.46	0.46

Notes: dependent variable: young (3–6) and school-age (6–16) children overall *ICA* (pc on standardised ability scores). Robust standard errors (clustered by family) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

5.4 Instrumental Variables (IV) estimates for the intergenerational transfer of parents' basic skills

Ideally we would have needed a randomised experiment where a sample of parents with low basic skills is split in two samples of similar characteristics. Then if basic skills courses were given to one group and not the other, we could evaluate the underlying policy question, namely whether improvements in parental basic skills levels lead to improved child cognitive outcomes. In this random experiment, a simple comparison of the tests scores of the children in the two groups could provide solid inference on the intergenerational transfer that may be taking place. The IV approach is meant to approximate such an experiment. For this purpose, we need to find variables that are highly correlated with parents' skills but are non-correlated (exogenous) to the children's outcomes. We have experimented with the potential inclusion of the following instruments: age at which the grandmother left school, age at which grandfather left school, the cohort member's birth weight, the grandmother's age at cohort member's birth, whether the grandmother was smoking during pregnancy, whether the grandmother breastfed the cohort member, and whether the cohort member participated in a course to improve basic skills.

Table 31 presents the correlation matrix between the different potential instruments, parents' basic skills and child test scores. Correlations between parents' basic skills and different instruments are in the vertical square while correlations between instruments and child outcomes are in the horizontal square. In parentheses are *p*-values. It can be noticed that the correlations between parents' basic skills and our instrumental variables are always significant (which suggest these variables are potentially good instruments), while the correlation between child outcomes and instruments is not generally significant (which suggests our instruments could be exogenous to the children's tests scores). This table produces only one-to-one correlations, and we should not attach too much weight to them however.

Table 31: Correlation matrix between instruments and our variables of interest

	Parents' basic skills	Age grandfather left school	Age grandmother left school	Parents' birth weight	Age of grandparents at parents' birth	Whether grandparents smoked during pregnancy	Whether parents took basic skills course	Whether grandparents breastfed parents
Age grandfather left school	0.203							
	(0.000)							
Age grandmother left school	0.229	0.576						
	(0.000)	(0.000)						
Parents' birth weight	0.098	0.061	0.044					
	(0.000)	(0.000)	(0.003)					
Age of grandparents at parents' birth	0.017	0.010	0.025	0.071				
	(0.243)	(0.520)	(0.081)	(0.000)				
Whether grandparents smoked during pregnancy	-0.133	-0.146	-0.144	-0.188	-0.044			
	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)			
Whether parents took basic skills course	-0.040	0.030	0.012	-0.002	-0.013	0.023		
	(0.004)	(0.042)	(0.400)	(0.888)	(0.382)	(0.110)		
Whether grandparents breastfed parents	0.125	0.196	0.237	0.070	0.006	-0.135	0.003	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.721)	(0.000)	(0.853)	
Young children tests scores (3–6)	0.152	0.081	0.089	-0.030	-0.008	-0.033	0.058	0.001
	(0.000)	(0.008)	(0.003)	(0.310)	(0.782)	(0.268)	(0.041)	(0.975)
School-aged children tests scores (6–16)	0.100	-0.004	-0.015	-0.006	-0.020	0.017	-0.065	-0.011
	(0.000)	(0.872)	(0.506)	(0.802)	(0.368)	(0.450)	(0.002)	(0.654)

A potential problem with the IV method is that its validity depends crucially on the strength of the instrumental variables. If there is only a weak association between the instrumental variable and the explanatory variable of interest, then IV estimates may suffer from bias due to weak instruments as documented in Bound et al. (1995). It is therefore important to conduct a robustness check on the quality of the instruments by examining the partial R^2 (or the associated F statistic) on the excluded variables once the predetermined variables have been partialled out of the first-stage regression. In our case, the F test in the first stage was significant only when the 'age grandfather left school' and the 'age grandmother left school' were used as instruments. The other instruments were not strongly associated with parents' basic skills when the other variables of control were introduced.

Consequently, Table 32 only reports results of IV regressions using the 'age grandfather left school' and the 'age grandmother left school' as instruments. In this case, the argument for using these instruments is that the grandparents' education level will determine the parents' basic skills levels whilst not having a direct impact on the grandchild's own cognitive development. One could of course construct arguments to the contrary, as is often the case when applying instrumental variables of this type. One must therefore bear in mind that the IV results should be considered alongside the other OLS results as indicative of the effect of parental basic skills.

Table 32: IV regressions

	(1)	(2)	(3)
	Children early test scores (age 4–6)		
Parents' basic skills	0.678**	0.719*	0.674**
	(0.32)	(0.38)	(0.29)
Instruments	Age grandmother left school	Age grandfather left school	Age both grandmother/ grandfather left school
First stage F-test	15.05 (0.000)	8.49 (0.003)	8.17 (0.003)
Over-identifying test (Hanson)	.	.	0.017 (0.895)
N	693	678	677
	Children later tests scores (age 6–16)		
Parents' basic skills	-0.164	-1.052	-0.237
	(0.34)	(1.01)	(0.43)
Instruments	Age grandmother left school	Age grandfather left school	Age both grandmother/ grandfather left school
First stage F-test	7.15 (0.007)	2.48 (0.115)	2.78 (0.063)
Over-identifying test (Hanson)	.	.	1.704 (0.192)
N	1197	1155	1153

Note: The same variables as in Table 1 and 2, column 8 are introduced in the regressions but not presented. The dependent variables are overall *ICA* (pc on standardised ability scores).
Robust standard errors (clustered by family) in parentheses; *** p<0.01, ** p<0.05, * p<0.1

We present only the coefficients on the parental basic skills variable, but note that the control variables introduced in the previous sections were also included in these IV regressions. The table provides three regressions, firstly where the grandmother's and grandfather's age of leaving school are included as individual instruments (columns 1 and 2) and one with both variables as instruments (column 3). The advantage of the using both instruments jointly (as in column 3) is that it is possible to perform an over-identifying test of the exogeneity of the instruments. As can be seen from the top panel of Table 32, the coefficients on the parents' basic skills variable when instrumented by the age at which the grandparents left school are very high, stable (across columns 1 to 3), and precisely estimated. The IV evidence lends more supports to earlier results found using OLS regressions that parents' skills in numeracy and literacy transfer into the early test scores of their children. The sizeable increase in the coefficients suggests that earlier OLS estimations may be affected by measurement errors, which tend to attenuate coefficients. This is consistent with our earlier assertion that the tests of numeracy and literacy only imperfectly reflect the true levels of literacy and numeracy of parents. Critics of literacy and numeracy assessments generally stress that true levels of basic skills are under-reported, since individual contexts are not accounted for (Pryor and Schaffer, 1999).

The coefficients in the bottom panel of Table 32 apply to older i.e. school-aged children. The correlations between the instruments and parents' basic skills are much weaker than for the sample of younger children: the first stage F-tests barely reach common critical values used in the literature (see Bound et al., 1995) in column 1 and lie well below in columns 2 and 3. This translates into large standard errors and insignificant coefficients for all three IV regressions. This implies that we cannot reject the assumption that our instruments in the case of older children are weak. We can mention some potential causes for this weak correlation. First of all, parents of older children were much younger at the time of their first birth and less qualified (see Appendix B). The qualifications of grandparents are therefore lower and show less variation. This translates into poor association between age at which grandparents' left school and the parents' own basic skills. Another potential explanation for these non-significant coefficients may lie in the effect of schooling. As opposed to younger children, older children have had an exposure to the school environment. There is no information in our data sets on the performance of these children at school. This could potentially bias earlier OLS coefficients as the effect of schools was treated largely as an unobserved factor. In particular it could be that upward bias due to measurement error in the parental literacy and numeracy tests is more than offset by the downward bias coming from the levelling effect of schooling. This downward bias may happen if schools are successful in compensating for the lack of support at home when parents have low basic skills. This effect cannot happen before the start of school, hence the strong effect observed in the top panel for younger children.

5.5 Quantile regressions

OLS regressions measure the average relationship between different variables, i.e. the average association between parental basic skills and child cognitive skill. More formally, using OLS regressions, we are able to describe how the *mean* of y (children's cognitive skill outcomes) changes with the vector of covariates *X*. The OLS regression is in fact based on the mean of the conditional distribution of the regression's dependent variable. The underlying assumption of this model is that possible differences in terms of the impact of the exogenous variables along the conditional distribution are unimportant. Again more intuitively, this means we assume that the effect of parental basic skills is similar at the bottom end of the child cognitive skill distribution as at the top. This model can be inadequate if the effect of any exogenous variables, particularly parental basic skills, differs along the range of child outcomes (Koenker and Bassett, 1978). Imagine, for example, that parental basic skills levels have more impact on child cognitive skill levels at the bottom end of the distribution, where as at the top it is schooling factors or other variables that have a greater effect on child outcomes. OLS regressions cannot allow for this. Unlike OLS, quantile regression models allow for a full characterisation of the conditional distribution of the dependent variable by exploring the relationship between parental basic skills and child outcomes at different points of the distribution of cognitive outcomes. Notice that even for the extreme quantiles all the sample observations are actively in play in the process of quantile regression fitting (Koenker and Hallock, 2001).

In our case, quantile regressions allow us to assess how parents' skills affect differently their children's outcomes along the distribution of the cognitive outcomes. It may well be that the impact of parents' literacy and numeracy vary across the distribution of children test scores. In particular, we are more interested in exploring the determinants of lower achieving children's performance. In terms of policy it is probably useful to understand which factors may improve the performance of the least able children (those whose test scores are below the median).

The following graphs plot the estimated coefficients (and the confidence intervals) of parents' basic skills on child outcomes in different quantiles of the distribution (in x-axis) of child test scores. The regressions have been performed controlling for child characteristics, family structure, and parents' occupation, education and income.

Figure 3: Quantile regressions: young children

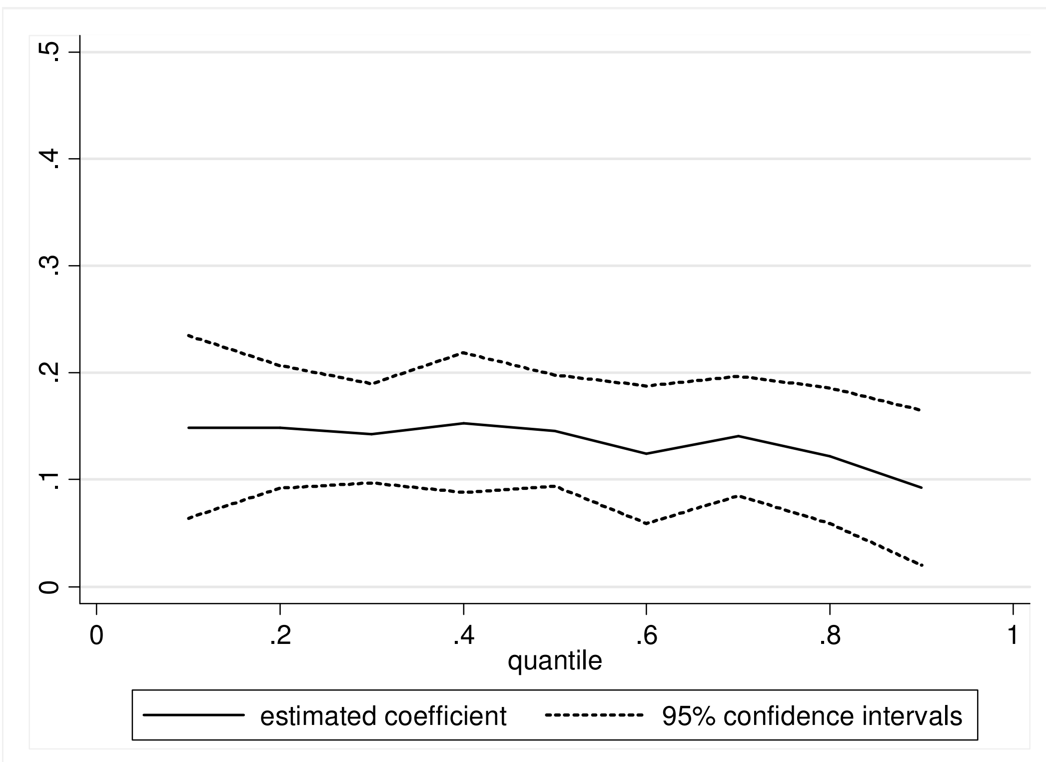
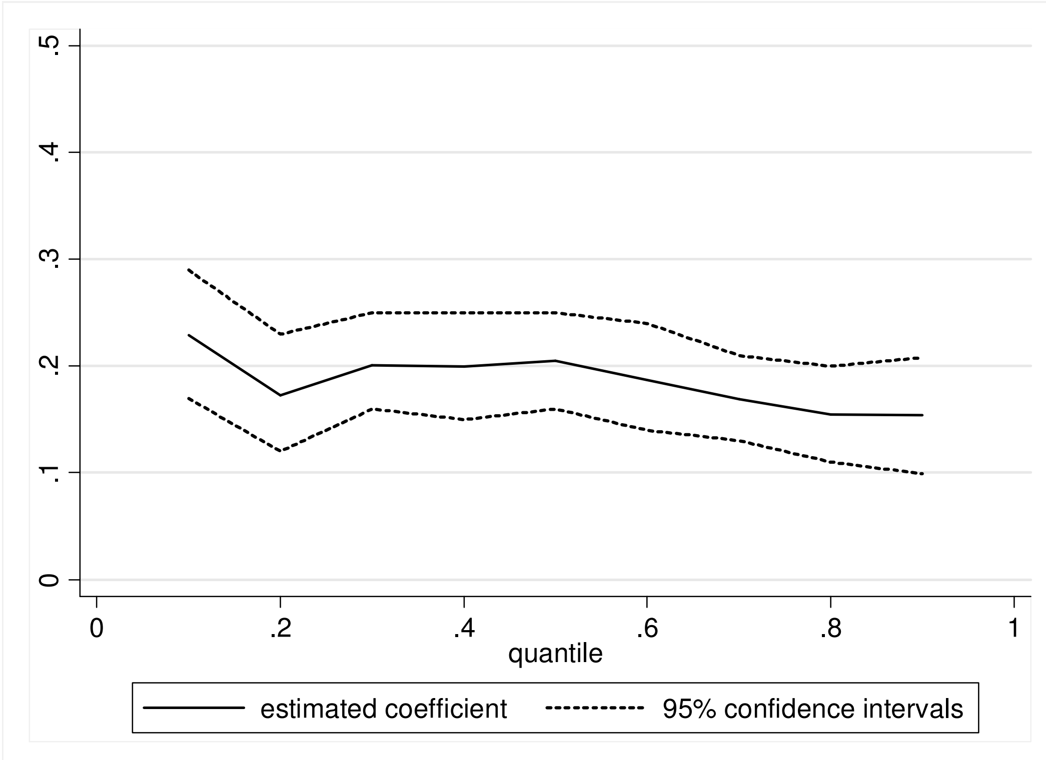


Figure 4: Quantile regressions: school-age children



Looking at the two figures, we can observe that the impact of parents' literacy and numeracy does in fact vary along the distribution of children's test scores. In particular, it seems that for both younger and school-age children, the impact of parents' basic skills is strongest for those at the bottom and around the median of the distribution. In the highest percentiles the magnitude of the coefficient decreases substantially. Indeed, it seems that the impact of parents' basic literacy and numeracy is higher for the lowest achieving children, as would seem intuitively correct.

5.6 Analysing cognitive and non-cognitive outcomes

Our results have revealed that the higher the parents' literacy and numeracy scores, the better is the cognitive performance of their children. From a theoretical point of view, we might expect parents' basic skills to have a positive impact on cognitive outcomes only. Better basic skills might enable parents to read to their children and help them with their homework, etc. However, it is not clear that the basic skills of parents would necessarily impact on other outcomes, such as behaviour. In fact if we find similar effects from parental basic skills (conditional on parental education and occupation) on non-cognitive outcomes of children, we might suspect that our apparent impact from parental basic skills is actually picking up other aspects of parents' behaviour, such as attitude or aspirations. To explore this issue further, we estimate a model where cognitive and non-cognitive outcomes are simultaneously determined.

The cognitive outcomes are described using the cognitive index extracted from different test scores as in previous regressions. In order to capture the non-cognitive outcomes we use the 'Strength and Difficulties scale' (SDQ or Goodman) included in the *Parent and Child Questionnaire*. The four sub-scales of the SDQ constitute an index of general 'emotional and behavioural problems'. Appendix A gives the full list of questions used to construct the index. The final scale is negative so that a low score indicates fewer emotional and behavioural problems.

We use a Seemingly Unrelated Regression (SUR; see Zellner, 1962) method jointly testing two equations: one for cognitive outcomes and one for non-cognitive ones.

Formally, the estimating equations are the following:

$$\begin{cases} S_c^C = \alpha^C + \beta_1^C S_p + \beta_2^C read + \beta_k^C \sum_k X_k + \varepsilon^C \\ S_c^{NC} = \alpha^{NC} + \beta_1^{NC} S_p + \beta_2^{NC} pwb + \beta_k^{NC} \sum_k X_k + \varepsilon^{NC} \end{cases} \qquad (2)$$

where the subscript *c* refers to children, the subscript *p* to parents; S^c and S^{nc} are children's cognitive and non-cognitive outcomes respectively. As explained before, cognitive outcomes are expressed using BAS tests scores, while non-cognitive outcome are proxied by the SDQ scale. S^p is the parents' combined literacy and numeracy scores, while X_k is the full set of control variables described in equation 1). As in the previous regressions, we shall control for child characteristics, family structure, parents' occupation, education, income and 'innate' ability. Because we have two equations, we need to find variables that predict one outcome but not the other. We therefore add a variable that is exclusive to the cognitive equation, namely the variable *read* which is a variable describing how often the parent reads to the child. The hypothesis is that reading to a child could be an important mechanism linking parents' basic skills and cognitive outcomes but should not have a direct impact on their children's non-cognitive outcomes. We also have a variable exclusive to the non-cognitive skill equation, namely a measure of parental well-being proxied by their assessment about their life satisfaction[11]. The hypothesis here is that parental well-being is likely to impact on children's emotional development but not necessarily their cognitive skills directly.

The estimates' outcomes are reported in the next two tables. Table 33 refers to pre-school children, while Table 34 to school-age children. Columns 1, 3, 5, 7, 9 and 11 in each table show the coefficients for cognitive outcomes, while the even columns refer to non-cognitive outcomes.

[11] The scale goes from 0 (the lowest level of life satisfaction) to 10 (the highest one).

Table 33: SUR approach on cognitive and non-cognitive outcomes – young children

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Cognitive	*Non-cognitive*	*Cognitive*	*Non-cognitive*	*Cognitive*	*Non-cognitive*	*Cognitive*	*Non-cognitive*	*Cognitive*	*Non-cognitive*	*Cognitive*	*Non-cognitive*
Parents' skills	0.170***	-0.278***	0.168***	-0.281***	0.133***	-0.182*	0.117***	-0.145	0.126***	-0.154	0.0863**	-0.101
	(0.023)	(0.080)	(0.024)	(0.080)	(0.029)	(0.10)	(0.030)	(0.10)	(0.032)	(0.11)	(0.042)	(0.14)
Reading to child	0.127***		0.124***		0.121***		0.114***		0.134***		0.140**	
	(0.033)		(0.034)		(0.036)		(0.037)		(0.042)		(0.054)	
Parents' life satisfaction		-0.205***		-0.210***		-0.144**		-0.142**		-0.110		-0.0521
		(0.054)		(0.055)		(0.066)		(0.066)		(0.071)		(0.089)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√	√	√	√	√	√	√	√
Family structure (no. of siblings, lone parent)			√	√	√	√	√	√	√	√	√	√
Socio-economic occupation					√	√	√	√	√	√	√	√
Education							√	√	√	√	√	√
Household (log) income and poverty status									√	√	√	√
Parents' ability at age 5											√	√
Observations	1166	1166	1166	1166	892	892	892	892	727	727	466	466
R-squared	0.51	0.04	0.51	0.04	0.51	0.04	0.52	0.04	0.52	0.05	0.52	0.08

Table 34: SUR approach on cognitive and non cognitive outcomes – older children

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Cognitive	*Non-cognitive*	*Cognitive*	*Non-cognitive*	*Cognitive*	*Non-cognitive*	*Cognitive*	*Non-cognitive*	*Cognitive*	*Non-cognitive*	*Cognitive*	*Non-cognitive*
Parents' skills	0.206***	-0.332***	0.203***	-0.329***	0.176***	-0.256**	0.152***	-0.198*	0.170***	-0.280**	0.140***	-0.216
	(0.026)	(0.091)	(0.026)	(0.091)	(0.033)	(0.11)	(0.034)	(0.12)	(0.039)	(0.13)	(0.050)	(0.18)
Reading to child	-0.0750**		-0.0745**		-0.101***		-0.113***		-0.114**		-0.151***	
	(0.035)		(0.035)		(0.039)		(0.040)		(0.045)		(0.051)	
Parents' life satisfaction		-0.537***		-0.522***		-0.535***		-0.532***		-0.575***		-0.505***
		(0.061)		(0.062)		(0.075)		(0.075)		(0.086)		(0.11)
Child characteristics (age, gender, whether first-born)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Family structure (no. of siblings, lone parent)			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Socio-economic occupation					✓	✓	✓	✓	✓	✓	✓	✓
Education							✓	✓	✓	✓	✓	✓
Household (log) income and poverty status									✓	✓	✓	✓
Parents' ability at age 5											✓	✓
Observations	1225	1225	1225	1225	930	930	929	929	757	757	502	502
R-squared	0.31	0.09	0.31	0.09	0.32	0.08	0.33	0.09	0.32	0.09	0.36	0.09

Consistent with our previous results, we can note that parents' basic skills have a strong, positive and significant impact on cognitive outcomes for both younger and older children. As far as non-cognitive outcomes are concerned, columns 2, 4 and 6 in Table 33 and Table 34 show a significant negative impact of parents' basic skills on children's behavioural problems (this means that the higher the literacy and numeracy of parents, the better the behavioural outcomes of children). However, when we control for occupation, education and ability, it turns out that parents' basic skills have a statistically positive significant impact only on cognitive outcomes, both for younger children and for school-age ones.

Looking at the other variables, the results show that as expected parents' well-being significantly affects children's behavioural and emotional problems (the negative sign means that the higher the parents' life satisfaction the less behavioural and emotional problems for their children). This effect is greater for older than for younger children, suggesting that the sensitivity of children to parents' mental state may increase with age. The identifying variable for the cognitive equation (how often do the parents read to the children) is positive and significant only for younger children. For older ones, it turns out to be negative. This finding could be surprising at the first sight, but can be easily interpreted if we consider the likely endogeneity of this variable for school-age children. For younger children being read to by a parent may be useful and may stimulate their curiosity, logical capacities and vocabulary abilities. For older children, however, the fact that they are still being read to by parents instead of doing that alone may be a signal of some cognitive problems. Therefore, in this case there may be a problem of reverse causality.

However, the main result we derived from these tables is that parents' basic skills have indeed a direct impact only on children's cognitive outcomes, once the effects of other aspects of family background are netted out. This also reassures us on the validity of our specification in the sense that it seems that we are in fact identifying the specific effects of parents' literacy and numeracy, without capturing other aspects of parents' behaviour, such as attitude or aspirations.

6. Conclusion

The main aim of this report is to assess how basic skills in literacy and numeracy of parents translate into the performance of their children. The data set used is the British Cohort Survey (BCS). It is a sample of 18,000 individuals born in one week in 1970 who have been interviewed and tested at regular intervals. In 2004, all cohort members' were assessed in terms of their numeracy and literacy skills. Of the 9,665 cohort members in the 2004 core dataset, about 4,800 had been randomly selected into the 'Parent and Child' elements of the survey and their children have also been tested. This report investigates how the children's performances in these tests are affected by their parents' basic numeracy and literacy skills. In particular, we address the question of whether parents' basic skills influence their children's cognitive outcomes in early (3 to 6 years) and later (6 to 17) childhood.

As our main result, we find strong evidence that parents with higher basic skills have children who perform better in test scores. This main result remains true within each educational group, and controlling for a wide range of variables: socio-professional status of the parents, income levels of parent, gender of the child, whether first-born, number of siblings, single parenthood, and parents' ability measured at age 5, and different measures of parenting style. In terms of the size of the observed impact, our estimates reveal that the increase of one standard deviation of parents' basic skills index (1.3) would lead to an increase in their young children's cognitive skill index by 10 per cent of a standard deviation. For older children the effect is slightly lower (9.7 per cent of a standard deviation).

When splitting the sample into two groups according to the highest level of education attained by parents, we find that the transfer of basic skills is always significant for parents with low levels of qualifications. This lends support for skills enhancing policies targeted at adults with low levels of qualifications. For parents with high levels of qualifications, having higher basic skills is associated with higher test scores for school-aged children only (aged from 6 to 17 years).

We then proceed to a gender-specific investigation of the intergenerational transfer. Our results show that there are no significant differences between the transfer of skills from mothers and fathers to children. However, when we run separate regressions for daughters and sons, we find some evidence of a gender-specific transfer: mothers' basic skills are more significant for daughters than for sons whilst for fathers the opposite is observed. The relationship between fathers' basic skills and sons is particularly strong for school-aged children.

We also try to separate the effect of literacy from that of numeracy and thus investigate in more detail the channels by which basic skills affect children's performance. Using a unique composite index relies on the assumption that a lot of the skills measured in the two tests are highly positively correlated. The tests are designed to differentiate very low levels of basic skills, so that for example someone who cannot read properly will also score very low in the numeracy test. For policy purposes, however, it may be interesting to try to relax this assumption and investigate whether it is possible to observe separate effects of parents' literacy and numeracy on their children's tests scores. Our results suggest that the effects observed previously come mainly from parents' literacy skills. We also try to indentify possible discontinuities in the relationship between parents' basic skills and child performance, by looking at the *levels* of literacy and numeracy achieved by parents (as defined in the new Skills for Life standards) instead of using a continuous measure.

Focusing on the younger children, the results reveal a significant cut-off between parents at Entry level 3 literacy and higher levels. Children in families with parents at Level 1 or 2 in literacy assessment perform significantly better than children of parents at the very lowest literacy level (below Entry level 2). In the case of numeracy the cut-off appears to be between parents at Entry level 3 and higher levels. It seems that having reached the literacy and numeracy levels set as a minimum target by the Government (Level 1 and Entry level 3 respectively) significantly affects the performance of young children. For older children, the picture is rather different in that the impact of literacy seems to be more continuous. Each level of literacy above the lowest one leads to better performance of children. As shown previously, numeracy has a lower impact, and only children of parents with numeracy Level 2 are significantly advantaged with respect to the others.

We then try to implement an Instrumental Variable (IV) analysis to identify a causal relationship. Using the age at which grandparents left school as an instrument for the parents' basic skills, we find a very significant and strong relationship between parental skills and children's cognitive skill but only for younger children. For older children, the IV estimates are not significant, probably because our instruments are weakly associated with parents' numeracy and literacy.

Further results based on quantile regressions are then provided, where we attempt to explore the impact of parents' basic skills on children's cognitive skill in different parts of the child skill distribution. We find that the transfer is stronger for children with low levels of skill.

Investigating in more detail the channels by which basic skills affect children's performance, it appears that parents' literacy could be more important than numeracy. Using levels in literacy and numeracy instead of continuous measures, we find also that tests results of children with parents at Level 1 and 2 in literacy are considerably higher than those with parents at very poor literacy levels (i.e. below Entry level 2).

The final section tests whether parents' basic skills have in an impact on non-cognitive outcomes as well. The idea is that if we find similar effects from parental basic skills on the non-cognitive outcomes of children, we might suspect that our apparent impact from parental basic skills is actually picking up other aspects of parents' behaviour, such as attitude or aspirations. We find no support for this possibility.

As main policy conclusions, these results suggest that policy aimed at increasing parents' basic skills may have potentially large intergenerational effects on the cognitive performance of children. There is particular scope for policies targeted at low qualified adults and young parents, for which our results show the intergenerational transfer is especially strong.

Appendix A

Warmth and conflict variables

From *Child–Parent Relationship Scale (Pianta Scale)*, the first principal component can be identified with conflict, while the second component with warmth.

The ‘conflict’ loads positively with the following items

- My child and I always seem to be struggling with each other.
- My child easily becomes angry at me.
- My child remains angry or is resistant after being disciplined.
- When my child wakes in a bad mood, I know we’re in for a long and difficult day.
- My child’s feelings towards me can be unpredictable or can change suddenly.
- My child is sneaky or manipulative with me.

The ‘warmth’ loads positively with the following items

- Cohort member (cm) and child (currently) share affectionate, warm relationship
- Child will (currently) seek comfort from cm
- Child (currently) spontaneously shares information about themselves
- Cm (currently) finds it easy to be in tune with child’s feelings

Strength and difficulties scale

Items

- Restless, overactive and not able to sit still for long.
- Often complaining of headaches, stomach aches or sickness.
- Has often had temper tantrums or hot tempers.
- Rather solitary, tending to play alone.
- Many worries, often seeming worried.
- Constantly fidgeting and squirming.
- Has often had fights with other children or bullied them.
- Often unhappy, downhearted or tearful.
- Generally liked by other children.
- Easily distracted, concentration wandered.
- Nervous or clingy in new situations, easily loses confidence.
- Picked on or bullied by other children.
- Getting on better with adults than with other children.

• Many fears, easily scared.

Appendix B

OLS estimates using the same sample size for all the regressions

Table 35: Younger children

	(1)	(2)	(3)	(4)	(5)	(6)
Parents' skills	0.175*** (0.041)	0.176*** (0.040)	0.152*** (0.039)	0.153*** (0.040)	0.137*** (0.042)	0.0998** (0.044)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√	√
Socio-economic occupation			√	√	√	√
Household (log) income and poverty status				√	√	√
Education					√	√
Parents' ability at age 5						√
Observations	481	481	481	481	481	481
R-squared	0.49	0.49	0.51	0.51	0.52	0.53

Table 36: Older children

	(1)	(2)	(3)	(4)	(5)	(6)
Parents' skills	0.175*** (0.034)	0.173*** (0.034)	0.146*** (0.037)	0.138*** (0.038)	0.127*** (0.039)	0.113*** (0.040)
Child characteristics (age, gender, whether first-born)	√	√	√	√	√	√
Family structure (no. of siblings, lone parent)		√	√	√	√	√
Socio-economic occupation			√	√	√	√
Household (log) income and poverty status				√	√	√
Education					√	√
Parents' ability at age 5						√
Observations	881	881	881	881	881	881
R-squared	0.44	0.44	0.45	0.45	0.46	0.46

Appendix C

Table 37: Different characteristics between parents of younger and older children

		Parents of young children	Parents of older children
Whole sample			
Qualification	No qualification	4.0	11.3
	Level 1	24.9	33.1
	Level 2	21.7	23.3
	Level 3	12.8	11.7
	Level 4	27.3	17.6
	Level 5	9.3	3.0
Literacy and numeracy scores	Mean	0.14	-0.24
	Std	(1.12)	(1.35)
Low qualified only (less than Level 2)			
Qualification	No qualification	7.9	16.7
	Level 1	49.2	48.9
	Level 2	42.9	34.5
Literacy and numeracy scores	Mean	-0.24	-0.49
	Std	(1.22)	(1.41)
High qualified only (more or equal to Level 2)			
Qualification	Level 3	25.9	36.1
	Level 4	55.3	54.5
	Level 5	18.8	9.4
Literacy and numeracy scores	Mean	0.51	0.27
	Std	(0.75)	(1.03)

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