

Appendix 1. Representative nature of the sample

A1.1 Comparison of Avon with England as a whole

The ALSPAC study aimed to recruit all pregnant women who were resident in the county of Avon, and whose expected date of delivery lay between 1 April 1991 and 31 December 1992. ALSPAC therefore covers children in three school years: those taking Key Stage 2 in 2001/02, 2002/03 and 2003/04. One question that arises is how representative Avon is of the country as a whole. The Avon area has a population of 1 million and includes the city of Bristol (population 0.5 million), and a mixture of rural areas, inner city deprivation, leafy suburbs and moderate sized towns. The 1991 census was used to compare the population of mothers with infants under 1 year of age resident in Avon with those in the whole of Britain. The sample is broadly representative of the national population although the mothers of infants in Avon were slightly more likely to be affluent, on average, than those in the rest of Britain (as measured by, for example, living in owner occupied accommodation, having a car available to the household and having one or more persons per room)¹.

We have also taken information from the National Pupil Database (NPD) to compare the Key Stage results of all children in the four Avon Local Education Authorities (LEAs) with those in the rest of England². LEAs that are wholly or partly covered by the ALSPAC sample are City of Bristol, Bath and North-East Somerset, South Gloucestershire and North Somerset. We find little evidence of systematic differences between children in Avon and those in the rest of the country in terms of Key Stage and value added measures at 7, 11 and 14. However, value added between 14 and 16 is lower in Avon, on average, in all the years examined (2001/2 to 2005/6), and this is associated with significantly poorer performance at Key Stage 4, at least until 2004. With regard to social composition, Avon contains a somewhat lower percentage of FSM children than the rest of the country, although these differences are not large. Attainment gaps between FSM and non-FSM children, however, are wider in Avon, and this gap increases markedly as the children age. In terms of value-added between 14 and 16, the FSM/non-FSM gap is noticeably larger in Avon than in the rest of England. Overall, this analysis suggests that data from Avon can give us a reasonably accurate picture of

¹ See www.alspac.bris.ac.uk for further details on the representative nature of the sample, enrolment rates and response rates.

² Detailed analyses available on request.

national trends up to the age of 14, but after this age concerns about the representative nature of schools in the area will surface. In particular, there is evidence that, in relative terms, children in Avon struggle to progress between 14 and 16, and that this is especially acute for pupils on free school meals.

A1.2 Sample selection

A unique feature of the ALSPAC cohort is that each child's ID has been linked to the equivalent ID in the NPD. Linking to the NPD means that we are able to observe educational outcomes for all children in state schools in the relevant birth cohort, even if they were not initially recruited to the study, or if they dropped out soon after recruitment. Specifically, we define the 'outcome sample' as the 17 214 children for whom we observed a valid Key Stage score, 16 797 of whom have a Key Stage 1 measure and 15 994 of whom have a Key Stage 2 measure. We convert the Key Stage scores into percentiles, or standardize them, using data from this full outcome sample (see the first three rows of column 1, Table A1.1). Hence in all our results, one percentile point (or one standard deviation unit) of a Key Stage measure relates to the distribution of the full underlying population.

Our study requires that in addition to outcome data, we have sufficient information from the ALSPAC survey to classify the family's socio-economic position. We use the criterion that an observation have non-missing measures of at least two of the following 10 socio-economic indicators: maternal and paternal educational qualifications; maternal and paternal occupational class; household income at age 3 or 4, at age 7 and at age 11; the Index of Multiple Deprivation for the ward of residence at birth; at least one measure of housing tenure; and at least one measure of subjective financial difficulties. This gives a sample of 13,800 observations. Remaining missing values of the 10 SEP measures within this sample are then imputed using multiple imputation³, creating full records for 13,800 children. It is this sample – referred to as the 'SEP sample' – over which our SEP quintile groups are defined (see column 2 of Table A1.1)⁴.

The children in the SEP sample do not all have valid outcome measures. Key Stage results are not available for children attending independent primary schools in England, or those receiving home schooling, or for those in schools outside England. 11 009 children have both

³ The 'ice' command in Stata10.

⁴ And see Appendix 2, Section A2.2 for details of the variables and methodology used to derive the SEP quintiles.

Key Stage 1 and Key Stage 2 scores and an SEP quintile indicator – the group we refer to as the ‘outcome and SEP sample’⁵. Column 3 of Table A1.1 shows that this group is not a random subset of either the outcome sample or the SEP sample. The mean Key Stage 1 score for this group is 12.7% of a standard deviation higher than in the outcome sample as a whole, and the mean Key Stage 2 score is 9.9% higher. Hence children in state schools whose mothers were recruited into ALSPAC in the early 1990s have substantially better educational outcomes at 7 and 11 than their school peers who were not part of the study. This is despite the fact that, of the children who *were* recruited into the study, it is the most advantaged who are the most likely to lack valid Key Stage records. The proportion of the sample in the highest SEP quintile group falls from 20% to 17% when observations without outcome records are excluded, presumably because these children are the most likely to be in independent schools and/or to have left the country.

Our final data requirement is that we have information on child and parent attitudes, behaviours and beliefs during primary school, or specifically at age 9, since these mediators are also the focus of our analysis. Of the 11 009 sample with both Key Stage outcomes and SEP quintile, 3037 (28%) dropped out of the study prior to this date and hence cannot be used. We refer to the remaining 7972 observations as the ‘working sample’, and it is this group of children, only 46 percent of the total outcome sample, to whom our analysis relates. Moving from columns 3 to 4 in Table A1.1 shows that children whose families remained in the study until age 9 are positively selected both socially and academically. Their average Key Stage scores are around a quarter of a standard deviation higher than those of the sample of all children in the relevant state schools. Higher attrition rates of the most disadvantaged reduce the proportion in the lowest SEP quintile by almost a quarter, while children in the third and fourth quintiles are over-represented in the final working sample.

The lower rows of Table A1.1 provide some additional information on patterns of social selection by sample definition. Only one indicator of socio-economic position – eligibility for free school meals (FSM) at age 11 – is available from the NPD for all the children in the outcome sample⁶. 12.5% of that sample are eligible for FSM, but this proportion falls to 9.8% for the subset with SEP indicators in ALSPAC, and falls to nearly a half (6.6%) for the subset who remained in ALSPAC until at least age 9. Average net household income at age 11 is 559 pounds per week (in June 2009 prices) for the full sample for whom we can construct a measure. This falls to 544 pounds per week when children outside English state schools are dropped from the sample, again illustrating the loss of relatively advantaged families at this

⁵ This group makes up 71% of the outcome sample and 80% of the SEP sample.

⁶ FSM status is not available for these cohorts at age 7 in the NPD, although it is for cohorts born later.

stage. However mean income at 11 in our working sample rises to 572 pounds per week as a result of higher attrition levels among low income families⁷.

The conclusion from Table A1.1 is that our working sample is strongly positively selected in relation to the population of English children aged 11 in 2002 to 2004. However, the fact that we observe information on children who are excluded from our working sample means that we can adjust our estimates to make them as representative as possible. We standardize the outcome measures over all available observations so that our estimated effect sizes relate to this population, rather than to the less representative working sample. Note that if standardization were carried out using the working sample only as reference, we would normalize Key Stage 2 to a standard deviation that is 11% smaller than that of the outcome sample, leading us to overestimate the effect sizes associated with the explanatory variables. Further, our method of imputing SEP indicators for the widest possible sample, and defining quintile cut-points on this distribution, avoids the misclassification of nearly a quarter of the lowest SEP quintile, who in fact belong in the quintile above.

Even if our chosen boundary points are accurate, it is still possible that the observations within a given SEP quintile are not representative as a result of non-random attrition. In particular, we may be concerned that the most vulnerable children are the most likely to drop out of the bottom quintile, such that the remaining observations are disproportionately drawn from the relatively more affluent among the disadvantaged. We explore this in two ways. Table A1.2 shows the proportion FSM and average family income at 11 in each quintile, as we progressively lose observations to attrition. Even when we drop 42% of the sample, moving from the outcome sample to the working sample, the proportion FSM in the lowest SEP quintiles falls only from 33.4% to 31.0%, and mean income rises only from £286 to £291 per week. Figures for the other quintiles suggest that this type of within-study attrition is unlikely to be severe.

Table A1.3 compares the regression coefficients on SEP, parental education and demographic characteristics in models of Key Stage 2 outcomes for two samples: including and excluding the children that dropped out of the study by age 9. Since these regressions do not include age 9 variables, they allow us to compare whether the effects associated with different characteristics are attenuated by non-random attrition. In general the results are remarkably similar.

⁷ See Appendix 2, Section A2.5 for the construction of this age 11 income measure.

Table A1.1. Means of key variables, by sample selection criteria

Variable	(1) Outcome sample (N=17 214) ^a	(2) SEP sample (N=13 800)	(3) Outcome and SEP sample (N=11 009)	(4) Working sample (N=7972)
KS1 standardized score	0.00 (1.00)	-	0.127 (0.929)	0.263 (0.882)
KS2 standardized score	0.00 (1.00)	-	0.099 (0.958)	0.238 (0.890)
KS2 percentile score	50.50 (28.87)	-	53.37 (28.60)	57.60 (27.77)
SEP quintile 1 (dv)	-	20.0%	20.4%	15.6%
SEP quintile 2 (dv)	-	20.0%	20.8%	19.5%
SEP quintile 3 (dv)	-	20.0%	21.4%	22.4%
SEP quintile 4 (dv)	-	20.0%	20.1%	22.1%
SEP quintile 5 (dv)	-	20.0%	17.1%	20.3%
Not eligible for FSM at 11 (dv)	81.7%	-	89.0%	92.2%
Eligible for FSM at 11 (dv)	12.5%	-	9.8%	6.6%
FSM eligibility at 11 missing (dv)	5.8%	-	1.2%	1.2%
Weekly household net income at 11	-	559 (295)	544 (283)	572 (282)

^a Contains 16 797 valid Key Stage 1 scores and 15 994 valid Key Stage 2 scores. Standard deviations in brackets. dv indicates dummy variable. Income at 11 expressed in June 2009 prices using the All Items RPI. Income values rounded to the nearest pound.

Table A1.2. Free school meals eligibility and household income at 11, by SEP quintile and sample selection criteria

	(1)	(2)	(3)
	SEP sample (N=13800)	Outcome and SEP sample (N=11009)	Working sample (N=7972)
% Eligible for FSM ^a :			
SEP quintile 1	33.4%	32.4%	31.0%
SEP quintile 2	10.6%	10.3%	7.0%
SEP quintile 3	3.1%	2.9%	1.2%
SEP quintile 4	1.8%	1.7%	0.5%
SEP quintile 5	0.6%	0.6%	0.2%
Mean (SD) weekly household net income at 11:			
SEP quintile 1	286 (154)	289 (156)	291 (149)
SEP quintile 2	418 (185)	417 (183)	415 (169)
SEP quintile 3	535 (208)	533 (202)	532 (192)
SEP quintile 4	672 (230)	674 (227)	669 (221)
SEP quintile 5	884 (263)	863 (259)	874 (256)

^a Percentage of non-missing observations.

Income at 11 expressed in June 2009 prices using the All Items RPI. Income values rounded to the nearest pound.

Table A1.3. Regressions of Key Stage 2 scores on selected characteristics using alternative sample selection criteria

Variable	(1)	(2)	(3)	(4)
	Without KS1 control Outcome and SEP sample (N=11009)	Working sample (N=7972)	With KS1 control Outcome and SEP sample (N=11009)	Working sample (N=7972)
SEP quintile 2	3.2*** (0.8)	3.1*** (1.0)	0.7 (0.5)	1.0 (0.7)
SEP quintile 3	5.4*** (0.8)	5.8*** (1.1)	1.5** (0.6)	1.8** (0.7)
SEP quintile 4	8.4*** (0.9)	8.4*** (1.1)	2.9*** (0.6)	3.2*** (0.8)
SEP quintile 5	11.6*** (1.0)	11.5*** (1.2)	3.5*** (0.7)	3.8*** (0.9)
Mother: Vocational/O-level	6.0*** (0.7)	5.8*** (0.8)	1.4*** (0.5)	1.5*** (0.6)
Mother: A-level	11.1*** (0.8)	11.4*** (1.0)	4.9*** (0.6)	5.1*** (0.7)
Mother: Degree	18.0*** (1.1)	18.1*** (1.3)	8.5*** (0.8)	8.8*** (0.9)
Father: Vocational/O-level	6.0*** (0.7)	5.9*** (0.8)	2.0*** (0.5)	2.3*** (0.6)
Father: A-level	8.0*** (0.7)	7.8*** (0.9)	3.2*** (0.5)	3.2*** (0.6)
Father: Degree	14.9*** (1.0)	14.5*** (1.1)	6.3*** (0.7)	6.0*** (0.8)
Female	1.9*** (0.5)	2.0*** (0.5)	-2.8*** (0.3)	-3.2*** (0.4)
Non-white	0.2 (1.3)	0.3 (1.7)	-0.4 (0.9)	0.0 (1.2)
Resident step-father at 7	-1.4 (1.3)	-1.7 (1.4)	0.5 (0.9)	0.5 (1.0)
Single parent at 7	2.6** (1.1)	2.0* (1.2)	2.1*** (0.8)	2.3*** (0.8)
Month of birth (Sept = 0)	-1.1*** (0.1)	-1.2*** (0.1)	0.2*** (0.0)	0.1*** (0.1)
Mother's age at birth: <20	-2.4* (1.3)	-2.1 (1.8)	-0.2 (0.9)	0.7 (1.3)
Mother's age at birth: 20-24	-2.0*** (0.7)	-2.2*** (0.9)	-1.0** (0.5)	-0.9 (0.6)
Mother's age at birth: 30-34	1.5** (0.6)	1.2* (0.7)	0.9** (0.4)	0.7 (0.5)
Mother's age at birth: 35+	3.4*** (0.9)	3.3*** (1.0)	2.1*** (0.6)	1.9*** (0.7)
One older sibling	-3.0*** (0.7)	-3.2*** (0.7)	-1.3*** (0.5)	-1.2** (0.5)
Two older siblings	-6.3*** (0.9)	-6.4*** (1.0)	-2.7*** (0.6)	-2.5*** (0.7)
Three or more older siblings	-5.8*** (1.3)	-6.2*** (1.4)	-1.5* (0.9)	-1.4 (1.0)

Variable	(1)	(2)	(3)	(4)
	Without KS1 control Outcome and SEP sample (N=11009)	Working sample (N=7972)	With KS1 control Outcome and SEP sample (N=11009)	Working sample (N=7972)
One younger sibling by 9	0.2 (0.7)	-0.2 (0.7)	0.1 (0.5)	-0.1 (0.5)
2+ younger siblings by 9	0.2 (1.0)	-0.4 (1.0)	0.8 (0.7)	0.3 (0.7)
Child is twin	-2.3 (1.5)	-1.6 (1.8)	1.7 (1.0)	1.2 (1.2)
Statement of SEN at 11	-23.6*** (1.9)	-26.3*** (2.4)	5.9*** (1.3)	4.1** (1.7)
FSM eligible at 11	-7.7*** (0.9)	-6.3*** (1.2)	-2.2*** (0.6)	-1.2 (0.9)
English 2 nd language at 11	5.9* (3.0)	7.3** (3.7)	5.2** (2.1)	5.0* (2.6)
Mother employed at age 4	-0.7 (0.6)	-1.3* (0.7)	-0.3 (0.4)	-0.5 (0.5)
Father employed at age 4	2.2** (1.1)	2.6** (1.2)	0.3 (0.7)	0.9 (0.8)
Mother's health at 4 (scale 1-4)	0.5 (0.5)	0.3 (0.5)	0.2 (0.3)	0.1 (0.4)
Father's health at 4 (scale 1-4)	-1.0** (0.5)	-1.0* (0.5)	-0.5 (0.4)	-0.5 (0.4)
KS1 standardized score			22.3*** (0.2)	22.8*** (0.2)
Constant	45.3*** (2.4)	47.2*** (2.7)	45.4*** (1.7)	45.3*** (1.9)
R-squared	0.289	0.258	0.652	0.640

Regressions also include controls for missing values on all explanatory variables.

Appendix 2. Variable definitions and summary statistics

A2.1 Key Stage outcomes

Our main outcome measure, Key Stage 2, is taken from the National Pupil Database (NPD), which contains records for every child within the state system. Both Key Stage 2 data, measured when the child is in Year 6 of primary school and Key Stage 1 data, measured when the child is in Year 2, have been matched into ALSPAC. Key Stage 2 results are usually given as a final level award for each of the three subjects, English, maths and science; however these measures are very discrete, with levels ranging from 2-6 in 2002 and 2-5 in 2003 and 2004. In addition, the marks needed to award a level at Key Stage 2 vary over subjects and years and therefore averaging across subjects and years can only be done once all are adjusted to the same scale. We can therefore construct a finer measure for each subject using the additional information we have on the individuals' marks, and apply a calculation to create an interpolated level for each pupil.

$$\text{Adjusted level for numerical levels} = L + \left(\frac{M - M_L^0}{R_L + 1} \right)$$

Where L is the test level awarded, M is the actual mark obtained, M_L^0 is the minimum mark required to achieve level L and R_L is the range of marks corresponding to level L . As noted the boundaries for the marks assigned to each level change every year and by subject and can be found on the Qualifications and Curriculum Development Agency website⁸. For those who receive a compensatory level N as their mark is too low to qualify for a numeric level, a numerical level can be created through a further calculation.

$$\text{Adjusted level for compensatory level } N = \frac{M}{\left(\frac{M_N^* + 1}{L^0} \right)} = L^0 \left(\frac{M}{M_N^* + 1} \right)$$

Where M is the actual mark obtained, M_N^* is the maximum possible mark needed to be assigned a level N and L_0 is the lowest awardable numerical level. Once these measures are

⁸ <http://testsandexams.qcda.gov.uk/18985.aspx>

all homogenised to the same scale, we can calculate and average Key Stage 2 score for each individual by taking an average of their interpolated level for the three subjects.

To create our Key Stage 1 measure we do not have information on the individuals' test marks so we construct a less continuous measure. Before the score is created, an overall reading level is derived. If the pupil achieves a level 3 or higher in the comprehension test this is allocated as their overall reading level. If the pupil achieves below a level 3, or was not entered for the comprehension test, the level achieved in the reading task is allocated as their overall reading level. The level assigned for each subject (reading, writing and maths) can then be transformed into a point score using the information in Table A2.1. This is common practice when working with Key Stage 1 data and consistent with the methods used for analysing the full NPD. A total Key Stage 1 score can then be constructed by taking an average across the three numerical values assigned.

The resulting measures are standardized to mean 0, standard deviation 1, and also converted into percentile scores, for use in the analysis

Table A2.1. Transformation of Key Stage 1 levels to point scores

KS1 task/test level	Key Stage 1 point scores for all subjects		
	Reading	Writing	Mathematics
Absent (A)	Disregarded	Disregarded	Disregarded
Disapplied (D)	Disregarded	Disregarded	Disregarded
Missing (M)	Disregarded	Disregarded	Disregarded
W - Working towards level 1	3	3	3
1	9	9	9
2C	13	13	13
2B	15	15	15
2A	17	17	17
3	21	21	21
4+	27	27	27

A2.2 Measures of socio-economic position

Our SEP measure combines data from a number of different indicators into a single index, which we then use to classify children into quintile groups. This approach is likely to give a more accurate classification of the family's long-term social position than measures taken at a single point in time (which will exhibit greater fluctuation), or that capture only one aspect of the family's material resources (such as income). It is an approach that recognises that the

resources or ‘capitals’ that convey advantage or disadvantage are multi-dimensional, and that the best and least well-off families exhibit clusters of a number of different kinds of characteristic⁹.

We begin with the SEP sample of 13800, all of which have at least two non-missing socio-economic indicators. To deal with item non-response within this sample we use a multiple imputation procedure to fill the missing values (the ‘ice’ command in Stata10). The procedure uses switching regression, an iterative multivariable regression technique that predicts the likely values of missing items on the basis of the non-missing data¹⁰. Of the set of 10 imputed socio-economic indicators, seven are retained in the construction of the SEP index and are detailed in Table A2.2. Summary statistics for the unimputed variables are given in Table A2.5. We use measures of maternal and paternal education in the imputation procedure to improve the prediction of missing values, but exclude them from the SEP index so that they are available as independent control variables. This enables us to explore the distinction between education as an indicator of non-material parental resources – such as knowledge and cognitive ability – and material resources like earnings capacity. The third indicator excluded from the SEP index is the Index of Multiple Deprivation for the child’s ward at birth, which we drop to ensure comparability of our SEP measure with those in the companion studies.

We then conduct polychoric principle components analysis (PCA) on the seven retained indicators. This data reduction technique adapts standard principle components analysis in a manner that is appropriate for dealing with discrete variables such as parental occupation and housing tenure¹¹. It extracts a single component or index from the data, such that the index accounts for the maximum variation possible in the underlying indicators. Results from the PCA show that our SEP index captures 48 percent of the variation in the 7 individual components. Table A2.2 shows the PCA scoring coefficients that are used to weight each variable in the construction of the final index.

⁹ See, e.g. Galobardes, Lynch and Davey Smith (2007). “Measuring socioeconomic position in health research.” *British Medical Bulletin*. 1-17.

¹⁰ For details see van Buuren, Boshuizen and Knook (1999). “Multiple imputation of missing blood pressure covariates in survival analysis.” *Statistics in Medicine* 18: 681–694.

¹¹ See Kolenikov and Angeles (2004). *The Use of Discrete Data in Principal Component Analysis: Theory, Simulations, and Applications to Socioeconomic Indices*. Working Paper of MEASURE/Evaluation project, No. WP-04-85, Carolina Population Center, UNC.

Table A2.2. Components of the SEP index

Variable	Description	PCA scoring coefficient
Income at 2 to 3	Derived from postal questionnaires completed by the main carer at 33 and 47 months (weekly take-home family income in 5 bands). Band medians were imputed with data from the Family Expenditure Survey, and an adjustment was made for families on Housing Benefit. Incomes were deflated by the RPI and equivalized using the modified OECD scale. The variables used is the log of the average of the two variables.	0.43
Income at 7	From a postal question completed by the main carer at 85 months on weekly take-home family income. We treat the 5 bands as separate discrete categories, rather than attempting to convert to a continuous measure, because only 4% of the sample fall in the lowest (<£100 per week) band, and 44% fall in the top (>£400 per week) band.	0.43
Income at 11	From a postal questionnaire completed by the main carer at 115 months, again on weekly take-home family income. This measure has 11 bands, and so contains substantially more information than the earlier income measures. Data on family composition at this date are unavailable, so we do not equivalize the measure, but we do impute band medians using the Family Resources Survey and deflate to June 2009 prices (see Section A2.3 for further details).	0.40
Mother's occupational class	Variables constructed from mother-reported information 18 weeks into the pregnancy. Responses coded according to the following OPCS job codes: 1 = unskilled; 2 = semi-skilled; 3 = skilled manual; 4 = skilled non-manual; 5 = managerial/technical; 6 = professional.	0.30
Father's occupational class		0.33
Average financial difficulties score	Variable constructed from postal questionnaire data at 8, 21, 33, 61 and 85 months. At each date, the main carer asked to evaluate how difficult it has been to afford food, clothing, heating, rent/mortgage, and items for the child. Responses are coded 0 = not difficult; 1 = slightly difficult; 2 = fairly difficult; 3 = very difficult. The total score is derived by summing over the 5 components and then averaging over the 5 dates.	-0.31
Housing tenure: Social housing Other	Variable constructed from mother-reported information at 21, 33 and 61 months. Coded 1 = always owner/occupied; 2 = ever in social housing; 3 = other	-0.41 0.04

A2.3 Measures of demographic and school characteristics

In all our models we control for a range of family background indicators in addition to SEP. Where possible we use indicators from the National Pupil Database so that they are defined for the widest possible sample. Our measures of primary school characteristics – which are designed to capture both the quality and the composition of the school – are calculated from the NPD data and are averages over all children in the relevant school, regardless of whether they are in the ALSPAC sample or not. A description of all variables is given in Table A2.3, with summary statistics in Table A2.5.

Table A2.3. Demographic and school characteristics variables

Variable	Description
	Demographics
Mother's education	Taken from information reported by the mother and father at 18 weeks gestation. Variables are constructed from each parent's report of their highest qualification. Where the response is missing spousal reports are used. Categories are: CSE/no qualifications; Vocational/O-level; A-level; Degree.
Father's education	
Girl	Dummy variable.
Non-white	Dummy variable for child's ethnicity is non-white, taken from the NPD record.
Family structure	Taken from mother-reported information at 85 months (the latest date available to the researchers). Responses are: natural father resident (intact); resident partner not natural father (step-father); no resident partner (lone parent).
Month of birth	Coded from 0 = September to 11 = August. Higher scores hence indicate younger children within a given school year.
Mother's age at birth	Coded into 5 categories: <20; 20-24; 25-29; 30-34; 35 and over
Older siblings	Mother-reported information at 47 months. Coded as first-born; 1; 2; 3 or more
Younger siblings	Mother-reported information at 9 years. Where the response is missing, information from 47 months is used. Coded as 0; 1; 2 or more.
Twin	Dummy variable for child is twin/triplet.
EAL	English as an Additional Language. Taken for NPD record. Status in Year 6 (age 10-11; year of Key Stage 2 assessment).
Mother's employment	Taken from mother-reported information at 47 months (the latest date available to the researchers). Binary indicator for whether each parent is currently employed. The 'father' is whoever the mother chose to define as her partner at the time of the questionnaire.
Father's employment	
Mother's health	Taken from mother-reported information at 47 months, as above. General health rated on a scale of 1 (Poor) to 4 (Excellent).
Father's health	
	Schools
Average pupil Key Stage 1	School averages of pupils taking Key Stage 1 in the 3 ALSPAC cohort years (1997/8, 1998/9, 1999/2000). Average point score for each year normalised using the mean and standard deviation of scores for all pupils in the ALSPAC LEAs in the relevant period. Normalised scores then averaged.
Average pupil value-added between KS1 and KS2	Value-added measured as the difference in standardised scores between KS1 and KS2. School averages across pupils taking Key Stage 2 in each of the 3 ALSPAC cohort years (2001/02, 2002/03, 2003/04). Mean for each year expressed such that 1 unit = 1 sd of all Key Stage 2 scores in the ALSPAC LEAs in the relevant period. Normalised scores then averaged across years.
Proportion in school on FSM	Proportion Year 6 pupils (Key Stage 2 year) in school on free school meals. Averaged over 3 ALSPAC cohort years (2001/02, 2002/03, 2003/04).

A2.4 Measures of attitudes, behaviours and beliefs

Our analysis distinguishes between the attitudes, behaviours and beliefs of parents (dividing preschool environments from other influences) and those of the children themselves. The child-level variables are measured at ages 8 to 9, between the Key Stage 1 and Key Stage 2 assessments. Table A2.4 gives a description of how each variable is defined, and summary statistics are given in Table A2.5.

Table A2.4. Attitudes, behaviours and beliefs variables

Variable	Description
Preschool environments	
Birth weight	In kilograms
Gestation at birth	Dummy equal to 1 if gestation less than 37 weeks
Breast feeding	Taken from information at 6 and 15 months. Coded to: never initiated breast feeding; initiated but breast fed less than 3 months; 3 to 6 months; 6 months or more
Mother smoked in pregnancy	Derived from information in 3 antenatal questionnaires and one at 8 months post-birth. Coded to 1 if the mother ever smoked during pregnancy.
Post-natal depression	Derived from the mother-completed 10-item Edinburgh Post-natal Depression Scale administered at 18 and 32 weeks gestation; and 2, 8, 21 and 33 months post-birth. Each item is scored from 0 to 3 and summed. Validation studies have used cut-offs of 9 to 13 to determine women in need of referral. We average the scales at the 6 dates and code a mother as having suffered depression if the average is 11 or more.
Home learning environment index	From 9 items in the 42 month mother-reported questionnaire. Frequency child taken to the library; frequency mother reads to child; frequency mother sings to child (each coded from 0=never to 4=nearly every day). Mother tries to teach child: colours; alphabet; numbers; nursery rhymes; songs; shapes and sizes. (each coded yes=1, no=0). 9 items standardised to mean 0, sd 1 and averaged. Index grouped into 5 quintiles.
Child read to daily at 3	From mother-reported 42 month questionnaire. Responses never to 3-5 times per week coded as 0, nearly every day as 1.
Child has regular sleeping routine at 3.	From mother-reported 42 month questionnaire. (Yes=1, no=0)
Centre-based care pre-age 3	From mother-reported information at 2, 8, 15 and 24 months. Coded 1 if child regularly in crèche/day nursery at any of 4 dates.
Nursery at age 3 to 4	Mother-report at 54 months.
Parental attitudes, behaviours and beliefs	
Mother found school valuable	Was school a valuable experience for you? 0=No, of no value; 1=No, generally not; 2=I'm not sure; 3=Yes, generally valuable; 4=Yes, very valuable. Variable standardised to mean 0, sd 1.
Maternal locus of control	12-item Adult Nowicki-Strickland Locus of Control scale. Yes/no answers scored such that 1 indicates a more internal locus of control

Variable	Description
	<p>(greater sense of personal control), summed and the total then standardised.</p> <p>Items:</p> <p>Did getting good marks at school mean a great deal to you?</p> <p>Are you often blamed for things that just aren't your fault?</p> <p>Do you feel that most of the time it doesn't pay to try hard because things never turn out right anyway?</p> <p>Do you feel that if things start out well in the morning that it's going to be a good day no matter what you do?</p> <p>Do you believe that whether or not people like you depends on how you act?</p> <p>Do you believe that when bad things are going to happen they are just going to happen no matter what you try to do to stop them?</p> <p>Do you feel that when good things happen they happen because of hard work?</p> <p>Do you feel that when someone doesn't like you there's little you can do about it?</p> <p>Did you feel that it was almost useless to try in school because most other children were cleverer than you?</p> <p>Are you the kind of person who believes that planning ahead makes things turn out better?</p> <p>Most of the time, do you feel that you have little to say about what your family decides to do?</p> <p>Do you think it's better to be clever than to be lucky?</p>
Mother's aspirations for child's education at age 9.	<p>What sort of education do you hope your child will have? (Just tick one): To get some good GCSEs then leave; To take at least 1 A-level; To go to university; Other.</p> <p>Responses of: The minimum – and leave as school as soon as possible (10 obs) and Don't really care (65 obs) coded to missing because of small cell sizes.</p>
Mother-child interactions at age 9 (educational)	<p>Frequency mother: Makes things with child; Reads to child; Sings to child; Draws or paints with child; Plays with toys with child; Does homework with child; Has conversations with child; Helps child prepare things for school.</p> <p>Responses coded from never=0 to nearly every day=4, standardised and averaged. Variable set to missing if 2 or more items missing.</p>
Mother-child interactions at age 9 (non-educational)	<p>Frequency mother: Cuddles child; Does active play with child (eg ball games, hide-and-peek); Takes child to park; Puts child to bed; Takes child swimming, fishing or other activity; Prepares food with child; Takes child to classes; Takes child shopping; Takes child to watch sports/football.</p> <p>Responses coded from never=0 to nearly every day=4, standardised and averaged. Variable set to missing if 2 or more items missing.</p>
Child attitudes, behaviours and beliefs	
Ability beliefs at age 8.	<p>Child-completed during a clinic at age 8. 6-item scholastic competence sub-scale from Harter's Self Perception Profile for Children. Possible responses are: Yes, really like me; Yes, a bit like me; No, not really like me; No, not at all like me. Items scored from 1 to 4 such that 4 indicates higher self esteem, summed and standardised.</p> <p>Items:</p> <p>Some children feel that they are very good at their school work.</p> <p>Some children feel like they are just as clever as other children their age.</p> <p>Some children are pretty slow in finishing their school work.</p> <p>Some children often forget what they learn.</p>

Variable	Description
	Some children do very well at their classwork. Some children have trouble working out the answers in school.
Enjoyment of school (intrinsic values)	<i>4 mother-report items at age 9.</i> Scored Always (4); Usually (3); Sometimes (2); Not at all (1). How does your child feels about school? He/she: Enjoys school. Is stimulated by school. Seems bored by school. Looks forward to lessons. <i>8 mother-report items at age 9.</i> Scored Likes a lot (2); Quite likes (1); Doesn't like (0). At school, how much do you think he/she likes: Science/natural history; Maths; English; Games/PE; Art/painting; Music; Geography; History. <i>3 child-report items at age 8.</i> I like going to school: Always (4); Mostly (3); Not much (2); Never (1) I think my schoolwork is: Always boring (1); Mostly boring (2); Mostly interesting (3); Always interesting (4). I feel happy at school: Always (4); Often (3); Sometimes (2); Never (1). Each of 15 items standardised then averaged. Scale score set to missing if more than 3 items missing.
Extrinsic values at 9	Mother-report at age 9. What does your child consider important in life? School results Hobbies & interests Clothes/money/material possessions/holidays & trips (4 categories collapsed to 1 dummy variable if answered yes to any).
Locus of control at age 8.	Child completed during a clinic. 12-item Nowicki-Strickland Internal-External Scale (short version). Yes/no answers scored such that 1 indicates a more internal locus of control (greater sense of personal control), summed and the total then standardised. Items: Do you feel that wishing can make good things happen? Are people nice to you no matter what you do? Do you usually do badly in your school work even when you try hard? When a friend is angry with you is it hard to make that friend like you again? Are you surprised when your teacher praises you for your work? When bad things happen to you is it usually someone else's fault? Is doing well in your class-work just a matter of 'luck' for you? Are you often blamed for things that just aren't your fault? When you get into an argument or fight is it usually the other person's fault? Do you think that preparing for tests is a waste of time? When nice things happen to you is it usually because of 'luck'? Does planning ahead make good things happen?
Anti-social behaviours at 8	Child completed during a clinic. 11-item Self-reported Antisocial Behavior for Young Children questionnaire. Ever/never responses scored 1/0, standardised then averaged. Scale set to missing if child answered no to all of three dummy questions (Have you ever talked in class when you were not meant to? Have you ever told a lie? Have you ever been told off by a teacher?) Items: Have you ever stolen, or tried to steal, a bicycle or skateboard? Have you ever taken something from a shop without paying for it?

Variable	Description
	<p>Have you ever taken something out of somebody's house, garden or garage that did not belong to you?</p> <p>Have you ever taken something that does not belong to you from a car?</p> <p>Have you ever drunk alcohol without your parents' permission?</p> <p>Have you ever tried a cigarette?</p> <p>Have you ever deliberately set fire, or tried to set fire to a building, a car or other property?</p> <p>Have you ever carried a weapon in case you needed it in a fight?</p> <p>Have you ever gone into or tried to go into a building to steal something?</p> <p>Have you ever snatched someone's purse or wallet (or 'picked someone's pocket')?</p> <p>Have you ever been cruel to an animal or bird on purpose?</p>
Pro-social behaviour at 9	<p>Mother-report at 9. Sub-scale from the Strengths and Difficulties Questionnaire (SDQ). Responses scored: Certainly true (2), somewhat true (1), Not true (0), reversed if necessary such that higher scores indicate more pro-social behaviour, then summed and the total (out of 10) standardised.</p> <p>Items: In last 6 months...</p> <p>The child has been considerate of other people's feelings.</p> <p>Child has shared readily with other children.</p> <p>Child is helpful if someone hurt, upset or feeling ill.</p> <p>Child is kind to younger children.</p> <p>Child often volunteers to help others.</p>
Hyperactivity at 9	<p>Mother-report at 9. Sub-scale from the Strengths and Difficulties Questionnaire (SDQ). Responses scored: Certainly true (2), somewhat true (1), Not true (0), reversed if necessary such that higher scores indicate more behaviour problems, then summed and the total (out of 10) standardised.</p> <p>Items: In last 6 months...</p> <p>Child has been restless, overactive and cannot stay still for long.</p> <p>Child is constantly fidgeting or squirming.</p> <p>Child is easily distracted, concentration wandered.</p> <p>Child thinks things out before acting.</p> <p>Child sees tasks through to the end and has good attention span.</p>
Emotional symptoms at 9	<p>Mother-report at 9. Sub-scale from the Strengths and Difficulties Questionnaire (SDQ). Responses scored: Certainly true (2), somewhat true (1), Not true (0), reversed if necessary such that higher scores indicate more behaviour problems, then summed and the total (out of 10) standardised.</p> <p>Items: In last 6 months...</p> <p>Child has often complained of headaches, stomach aches or sickness.</p> <p>Child has many worries and often seemed worried.</p> <p>Child is often unhappy, downhearted or tearful.</p> <p>Child is nervous or clingy in new situations and easily loses confidence.</p> <p>Child has many fears and is easily scared.</p>
Conduct problems at 9	<p>Mother-report at 9. Sub-scale from the Strengths and Difficulties Questionnaire (SDQ). Responses scored: Certainly true (2), somewhat true (1), Not true (0), reversed if necessary such that higher scores indicate more behaviour problems, then summed and the total (out of 10) standardised.</p> <p>Items: In last 6 months...</p> <p>Child has often had temper tantrums or hot tempers.</p> <p>Child is generally obedient, usually has done what adults request.</p>

Variable	Description
	<p>Child often fights with other children or bullies them.</p> <p>Child often lies or cheats.</p> <p>Child steals from home school or elsewhere.</p>
Experience of bullying at 8	<p>Child completed during a clinic. From the Bullying and Friendship Interview Schedule (modified version). The child was asked about 9 events that happened to them at school or to/from school which involved other children in the last six months. Scored: Never (0), 1-3 times (1), Frequently, 4+ times (2), Very frequently, at least once a week (3). Items standardised and averaged. Scale score set to missing if 2 or more items missing.</p> <p>Items:</p> <p>Personal belongings taken.</p> <p>Threatened/blackmailed.</p> <p>Hit/beaten up.</p> <p>Tricked in a nasty way.</p> <p>Called bad/nasty names.</p> <p>Others wouldn't play with them to upset them.</p> <p>Been made to do things they didn't want to.</p> <p>Had lies/nasty things said about them.</p> <p>Had games spoilt.</p>
Teacher-child relations	<p><i>2 mother-report items at age 9.</i> Scored Always (4); Usually (3); Sometimes (2); Not at all (1).</p> <p>How does your child feels about school? He/she:</p> <p>Is frightened by the teachers (reversed)</p> <p>Looks forward to seeing his/her teachers.</p> <p><i>4 child-report items at age 8.</i></p> <p>My teacher is fair: Always (4); Most of the time (3); Sometimes (2); Never (1)</p> <p>My teacher thinks my work is: Very good (4); Quite good (3); Isn't very good (2); Terrible (1)</p> <p>My teacher thinks I behave: Well, always (4); Well, most of the time (3); Badly, most of the time (2); Badly, always (1)</p> <p>My teacher tells me how to make my work better: Always (4); Often (3); Sometimes (2); Never (1).</p> <p>Each of 6 items standardised then averaged. Scale score set to missing if 3 or more items missing.</p>
Peer problems at 9	<p>Mother-report at 9. Sub-scale from the Strengths and Difficulties Questionnaire (SDQ). Responses scored: Certainly true (2), somewhat true (1), Not true (0), reversed if necessary such that higher scores indicate more behaviour problems, then summed and the total (out of 10) standardised.</p> <p>Items: In last 6 months...</p> <p>Child is rather solitary, tends to play alone.</p> <p>Child has at least one good friend.</p> <p>Child is generally liked by other children.</p> <p>Child is picked on or bullied by other children.</p> <p>Child gets on better with adults than with other children.</p>
Participation in leisure/out-of-school activities at 9	<p>8 mother-reported items at age 9. Responses coded: Nearly every day (6); 2-5 times a week (5); Once a week (4); 1-3 times a month (3); Less than once a month (2), Not at all (1). Items standardised then averaged. Scale score set to missing if 2 or more items missing.</p> <p>Items: How often does your child do the following:</p> <p>Go swimming</p>

Variable	Description
	Play a musical instrument
	Go to special groups (e.g. Scouts)
	Go to Sunday School
	Go to special classes or clubs for some activity (e.g. dancing, judo, sports)
	Go to foreign language classes
	Go to singing group
	Go to other types of classes or group.

A2.5 Variables used in supplementary analyses

This section provides details of all variables used in the analysis and not described elsewhere.

The rank of the Index of Multiple Deprivation (IMD) of child’s ward at birth. This variable does not enter the analysis directly, but is used in the imputation process for missing values of SEP indicators. It is useful in this context because it is available for virtually the whole SEP sample. The IMD is taken from *Indices of Deprivation 2000*, produced by the DETR¹². The published statistics rank every ward in England (from 1 to 8414) from the most deprived to the least.

Total behaviour problems score (SDQ) at 9. This variable is used in Chapter 7 when we focus on the predictors of key attitudes, behaviours and beliefs. It provides a summary measure of overall behaviour problems from the Strengths and Difficulties Questionnaire. It is calculated as the sum of the 20 items that make up the Hyperactivity, Conduct problems, Emotional symptoms and Peer problems sub-scales described in Table A2.4. The items – each scored 0, 1, or 2 – are summed to derive a total score out of 40. We standardize this variable on the full sample available for use in the analysis.

Weekly net income at age 11 with imputation for missing values (June 2009 prices). This variable is used to benchmark the mean incomes of the SEP quintiles in Table A1.2. We impute missing values, and use data from the Family Resources Survey (FRS) to create a continuous measure of income.

The raw data are derived from a postal questionnaire to the main carer when the child was 132 months old: ‘On average, about how much is take-home family income each week (include social benefits, etc.)?’ 10 possible responses were listed (< £120; £120-£189; £190-

¹² <http://www.communities.gov.uk/archived/general-content/communities/indicesofdeprivation/indicesofdeprivation/>

£239; £240-£289; £290-£359; £360-£429; £430-£479; £480-£559; £560-£799; £800+; Don't know).

Income data are available for only 5332 of the 7972 working sample observations. The income band for missing observations is imputed by ordered logit (using the procedure described in Section A2.2) with the 9 other SEP indicators as predictors.

Very little information on household composition at 132 months was collected, so equalization is not possible. A continuous income measure was derived, using data from the 2002/3 to 2006/7 FRS surveys. The FRS sample is all households containing a child aged between 10 and 12 at the survey date (12474 households). Net family income was defined by summing over all individual adult net incomes in the household, and then expressed in June 2009 prices¹³.

The boundaries of the 10 ALSPAC income categories (shown above) were also deflated to June 2009 prices using information on the year and month of questionnaire completion. A continuous income variable was then derived, using the median FRS income between these month-specific lower and upper income boundaries. The median was calculated using the FRS survey weights in order to correct for non-random sampling and non-response.

Key Stage 2 standardized score. This variable measures our key outcome in an alternative metric, as shown in Appendix 4, Section A4.1. We take the adjusted level Key Stage 2 described in Section A2.1 and standardize it to mean zero, standard deviation 1, on the full available sample of 15994 children.

Quintiles of alternative income measures. In Appendix 4, Section A4.2, we check the sensitivity of our estimates of the socio-economic gaps at Key Stage 2 to alternative definitions of SEP. We divide the sample into quintiles on the basis of three different measures of income: the age 11 income measure described above, the income at 2 to 3 measure described in Table A2.2 and a composite index that combines data on income at 2 to 3, 7 and 11. This last measure uses the polychoric PCA method described in Section A2.2 to extract a single income component. We use this method, rather than an average real income measure for example, because one income measure is categorical, and only one is equalized for household size. The creation of a unit-free income 'score' avoids the problems these differences in measurement would generate in a measure expressed in pounds per week. The

¹³ Using the monthly All Items RPI (CHAW).

quintile groups over all three income measures are defined over the full 13800 observation SEP sample, using imputed values to correct for item non-response (see Sections A1.2 and A2.2).

School fixed effects. In Appendix 4, Section A4.3 we show results using an alternative method of capturing school quality and composition. Because ALSPAC is a regional survey, it contains observations of multiple children in the same schools. We can thus include school-fixed effects: a set of dummy variables, one for each school in the sample. Children with less than 4 peers in the working sample in their school are grouped into a single category (856 children, or 11% of the sample). The ‘largest’ single school contains 161 children from the 7972 working sample, and there are nine schools containing exactly 5 sample children. Overall, 27% of the sample are in schools with 50 or more observed peers, and 66% are in schools with at least 25 observed peers.

Additional measures of prior cognitive ability. In Appendix 4, Section A4.4 we explore the sensitivity of our results to using additional controls for children’s ability at age 7 to 8. These scores are all taken from tests administered directly to the children at ALSPAC clinics, and standardized to mean 0, standard deviation 1 on the full available sample.

We use three sub-scales from the Wechsler Objective Reading Dimensions (WORD) assessment administered at the age 7 clinic: Reading, Spelling and Phoneme Deletion. From the age 8 clinic, we use four sub-scales of the Wechsler Objective Listening Dimensions (WOLD) assessment (Listening comprehension, Non-word repetition, Oral expression and Articulatory skill), and two sub-scales (Verbal IQ and Performance IQ) from the WISC-III. See www.bris.ac.uk/alspac for further details.

A2.6 Summary statistics of all variables

All statistics in Table A2.5 relate to the working sample of 7972 observations used in the main analysis.

Table A2.5. Summary statistics of all variables in the working sample

Variable	Obs	Mean	Std. Dev.	Min	Max
Educational outcomes					
Key Stage 2 percentile score	7972	57.60	27.77	1	100
Key Stage 1 standardized score	7972	0.26	0.88	-3.29	2.72
SEP component indicators					
Income at 2 and 3 (log)	6823	5.29	0.47	3.08	6.41
Income at 7 (categories)	5891	3.88	1.18	1	5
Income at 11 (Jun 09 prices)	5332	585.24	281.84	88.96	1222.58
Mother's class: Unskilled	6320	0.02	0.13	0	1
Mother's class: Semi-skilled	6320	0.09	0.29	0	1
Mother's class: Skilled manual	6320	0.07	0.26	0	1
Mother's class: Skilled non-manual	6320	0.45	0.50	0	1
Mother's class: Managerial/technical	6320	0.32	0.47	0	1
Mother's class: Professional	6320	0.05	0.22	0	1
Father's class: Unskilled	6831	0.03	0.17	0	1
Father's class: Semi-skilled	6831	0.10	0.30	0	1
Father's class: Skilled manual	6831	0.31	0.46	0	1
Father's class: Skilled non-manual	6831	0.12	0.32	0	1
Father's class: Managerial/technical	6831	0.34	0.47	0	1
Father's class: Professional	6831	0.10	0.30	0	1
Average financial difficulties score	7622	2.65	2.71	0	15
Always owner-occupier	7600	0.59	0.49	0	1
Ever in social housing	7600	0.16	0.36	0	1
Other housing tenure	7600	0.25	0.44	0	1
Socio-economic position (SEP)					
Quintile 1	7972	0.16	0.36	0	1
Quintile 2	7972	0.20	0.40	0	1
Quintile 3	7972	0.22	0.42	0	1
Quintile 4	7972	0.22	0.42	0	1
Quintile 5	7972	0.20	0.40	0	1
Parental education					
Mother: CSE/none	7702	0.17	0.38	0	1
Mother: Vocational/O-level	7702	0.47	0.50	0	1
Mother: A-level	7702	0.24	0.43	0	1
Mother: Degree	7702	0.12	0.33	0	1
Father: CSE/none	7497	0.22	0.42	0	1
Father: Vocational/O-level	7497	0.32	0.47	0	1
Father: A-level	7497	0.28	0.45	0	1
Father: Degree	7497	0.17	0.38	0	1
Demographic characteristics					
Female	7723	0.50	0.50	0	1
Non-white	7652	0.03	0.17	0	1
Resident bio father at 7	6423	0.85	0.36	0	1
Resident step-father at 7	6423	0.05	0.22	0	1
Single parent at 7	6423	0.10	0.29	0	1
Month of birth (Sept = 0)	7767	5.52	3.70	0	11
Mother's age at birth: <20	7767	0.03	0.16	0	1
Mother's age at birth: 20-24	7767	0.15	0.36	0	1
Mother's age at birth: 25-29	7767	0.41	0.49	0	1

Variable	Obs	Mean	Std. Dev.	Min	Max
Mother's age at birth: 30-34	7767	0.31	0.46	0	1
Mother's age at birth: 35+	7767	0.11	0.31	0	1
Firstborn child	6818	0.44	0.50	0	1
One older sibling	6818	0.36	0.48	0	1
Two older siblings	6818	0.14	0.35	0	1
Three or more older siblings	6818	0.05	0.22	0	1
0 younger siblings by 9	7255	0.46	0.50	0	1
1 younger sibling by 9	7255	0.41	0.49	0	1
2 or more younger siblings by 9	7255	0.12	0.33	0	1
Child is twin	7972	0.02	0.15	0	1
English second language at 11	7855	0.01	0.08	0	1
Mother employed at age 4	6053	0.58	0.49	0	1
Father employed at age 4	6164	0.92	0.28	0	1
Mother's general health at age 4	6777	3.47	0.60	1	4
Father's general health at age 4	6327	3.42	0.59	1	4
School composition and quality					
Mean pupil Key Stage 1 (std score)	7972	0.06	0.33	-2.34	1.30
Mean pupil value added KS1-2 (std sc)	7972	0.07	0.22	-2.06	0.88
Proportion pupils FSM	7960	0.11	0.10	0	0.65
Pre-school environments					
Birth weight (kg)	7640	3.42	0.55	0.65	5.64
Gestation < 37 weeks	7723	0.05	0.22	0	1
Breast fed: Never	7524	0.25	0.43	0	1
Breast fed: < 3 mths	7524	0.25	0.43	0	1
Breast fed: 3-6 mths	7524	0.17	0.37	0	1
Breast fed: 6 mths +	7524	0.34	0.47	0	1
Mother smoked in pregnancy	7365	0.24	0.43	0	1
Mother had post-natal depression	7759	0.12	0.33	0	1
HLE at 3: Lowest quintile	6935	0.19	0.40	0	1
HLE at 3: Second quintile	6935	0.21	0.41	0	1
HLE at 3: Middle quintile	6935	0.20	0.40	0	1
HLE at 3: Fourth quintile	6935	0.20	0.40	0	1
HLE at 3: Highest quintile	6935	0.20	0.40	0	1
Child read to daily at 3	6944	0.63	0.48	0	1
Child has regular sleeping routine at 3	6913	0.92	0.27	0	1
Centre-based child care pre-age 3	7006	0.12	0.32	0	1
Nursery age 3 to 4	6869	0.41	0.49	0	1
Parental attitudes, behaviours and beliefs					
Mother's locus of control	6454	0.07	0.97	-3.52	2.02
Mother found school valuable	6765	0.03	0.97	-3.18	1.22
Mother hopes child will get good GCSEs	6615	0.11	0.31	0	1
Mother hopes child will get at least 1 A-level	6615	0.16	0.37	0	1
Mother hopes child will go to university	6615	0.55	0.50	0	1
Mother hopes other for child	6615	0.18	0.38	0	1
Mother-child interactions: Education	6607	-0.01	0.59	-3.66	1.72
Mother-child interactions: Non-educational	6590	0.00	0.51	-2.39	2.05

Variable	Obs	Mean	Std. Dev.	Min	Max
Child's attitudes, behaviour and beliefs					
Ability beliefs	5810	0.01	1.00	-2.99	1.91
Locus of control (scale)	5338	-0.02	0.99	-2.89	2.88
Enjoyment of school (intrinsic values, scale)	6440	0.00	0.50	-2.44	1.11
School results important in life (extrinsic values)	6745	0.60	0.49	0	1
Hobbies/interests important in life (extrinsic values)	6745	0.75	0.43	0	1
Material possessions important in life (extrinsic values)	6745	0.78	0.42	0	1
Anti-social behaviours (scale)	5266	-0.01	0.44	-0.18	6.80
Hyperactivity (scale)	6234	-0.01	0.98	-1.30	3.15
Emotional symptoms (scale)	6333	-0.01	0.99	-0.85	4.88
Conduct problems (scale)	6276	0.01	1.00	-0.90	6.40
Experience of bullying (scale)	5751	-0.01	0.53	-0.49	3.44
Pro-social behaviours (scale)	6366	0.02	0.98	-5.10	1.01
Peer problems (scale)	6104	-0.02	0.97	-0.74	6.13
Participation in leisure/out-of-school activities (scale)	6357	-0.04	0.45	-1.02	2.04
Teacher-child relations (scale)	6248	0.01	0.49	-2.40	1.15
Variables used in supplementary analyses					
Total behaviour problems (SDQ) at 9	5599	-0.01	0.98	-1.37	6.03
Rank of Index of Multiple Deprivation of ward at birth	7338	4539.9	2494.1	133	8379
Key Stage 2 standardized score	7972	0.24	0.89	-5.47	1.84
Weekly net income at 11 with imputed missing values (Jun 09 prices)	7972	571.54	282.05	83.52	1222.58
Income composite: Quintile 1	7972	0.16	0.37	0	1
Income composite: Quintile 2	7972	0.19	0.39	0	1
Income composite: Quintile 3	7972	0.22	0.41	0	1
Income composite: Quintile 4	7972	0.22	0.41	0	1
Income composite: Quintile 5	7972	0.21	0.40	0	1
Income at 3 to 4: Quintile 1	7972	0.17	0.37	0	1
Income at 3 to 4: Quintile 2	7972	0.19	0.39	0	1
Income at 3 to 4: Quintile 3	7972	0.23	0.42	0	1
Income at 3 to 4: Quintile 4	7972	0.21	0.41	0	1
Income at 3 to 4: Quintile 5	7972	0.20	0.40	0	1
Income at 11: Quintile 1	7972	0.16	0.37	0	1
Income at 11: Quintile 2	7972	0.20	0.40	0	1
Income at 11: Quintile 3	7972	0.21	0.41	0	1
Income at 11: Quintile 4	7972	0.23	0.42	0	1
Income at 11: Quintile 5	7972	0.20	0.40	0	1
WORD Reading scale at 7	6195	0.01	0.97	-3.02	2.54
WORD Spelling scale at 7	6122	0.00	0.99	-1.78	1.63
WORD Phoneme deletion scale at 7	6205	0.01	0.98	-2.08	2.15
WOLD Listening comprehension scale at 8	6147	-0.02	0.98	-2.79	3.85
WOLD Non-word repetition scale at 8	6140	-0.02	0.99	-2.88	1.89

Variable	Obs	Mean	Std. Dev.	Min	Max
WOLD Oral expression scale at 8	6127	-0.02	1.00	-4.07	1.40
WOLD Articulatory skill scale at 8	6115	0.01	1.00	-1.88	2.60
WISC-III Verbal IQ	6106	-0.02	0.98	-3.66	2.71
WISC-III Performance IQ	5795	-0.01	0.99	-3.26	3.13

Appendix 3. Sub-group contributions to the socio-economic gradient in educational achievement at 11

In this section we explore an alternative method for assessing the importance of specific attitudes, behaviours and beliefs in explaining the socio-economic gradient at 11. In a similar approach to that of Chapter 5, we introduce sub-groupings of variables one at a time to a baseline model of Key Stage 2 scores, and contrast the extent to which their inclusion reduces the estimated socio-economic gradient. Here, however, we use eleven narrowly-defined sub-groupings, rather than broad categories, and each previous group of controls is dropped before adding the next group. The aim of this analysis is to assess the relative explanatory power different types of attitudes and behaviours when each is tested in a common framework.

Unlike the fully-conditioned models in Section 6, this method estimates the ‘maximum’ potential contribution of each grouping, in that it allows both direct effects and indirect effects via their knock-on influence on other factors. When added to the baseline model, each grouping will hold constant the effects of the variables in question on the outcome, but also the effects of omitted factors that are correlated with them. This has an advantage, in that the estimates include the indirect effects of the variables via mediating mechanisms (such as the influence of parental aspirations on children’s valuation of schooling). But there is also the disadvantage that they will pick up the effect of factors that are only correlated with, but not shaped by, the variables of interest (for example, if parents with high aspirations also happen to enrol their children in a lot of extra-curricular activities the effects of the two will be conflated). Table A3.1 provides estimates for the levels model, without a Key Stage 1 control, and Table A3.2 provides estimates for the value-added model.

The first four models shown in Table A3.1 are identical to the first four models in Table 5.1, and show the successive contribution of broad measures of family and school characteristics to the socio-economic achievement gaps at 11. The following eleven models, however, each take Model 4 as the baseline, and add a single set of

control variables. Model 16 then repeats the results of the fully controlled model from Chapters 5 and 6 by including all the controls simultaneously.

The facts we seek to explain are the drop in the middle SEP quintile coefficient from 5.9 in Model 4 to 3.4 and Model 16 (accounting for $41 - 24 = 17\%$ of the raw middle-bottom gap), and the drop in the top SEP quintile coefficient from 9.8 points in Model 4 to 4.5 points in Model 16 (accounting for $31 - 14 = 17\%$ of the raw top-bottom gap). It is clear that no single group can account for this decline in its entirety. The two factors which have the largest influences are maternal attitudes to education (Model 8), which consists of maternal aspirations and the mother's valuation of schooling; and child's behaviour problems (Model 12), which adds controls for anti-social behaviours, hyperactivity, emotional symptoms and conduct problems. These factors can individually account for 7% and 9% of the raw middle-bottom SEP gap respectively, and 8% and 6% of the raw top-bottom SEP gap respectively.

The mother's locus of control (Model 7), the child's self-concept (Model 10), and the child's educational values (Model 11) are roughly next in importance, accounting for 4%, 2% and 6% of the middle-bottom gap and 3%, 4% and 4% of the top-bottom gap. The remaining six groups of factors make only very minor individual contributions to the socio-economic gradients.

Table A3.2 repeats the exercise including a control for Key Stage 1 score in all the models. These are stringent specifications in that any positive influence of attitudes, behaviours and beliefs on earlier attainment is netted out by the prior ability control. As a result, comparing Models 4 and 16 shows that in total attitudes, behaviours and beliefs reduce the middle SEP coefficient by only 0.4 percentile points (9% of the value-added gap) and the top SEP coefficient by 1.2 percentile points (11% of the value-added gap).

The ordering of the contribution of the individual groups of controls remains the same as in the levels model, however. Adverse maternal attitudes to education and greater child behaviour problems are the two most powerful single factors in explaining the slower progress of disadvantaged children between 7 and 11. Maternal locus of control, child's self-concept and child's educational values play smaller individual

roles, while early health and home learning environments, mother-, peer- and teacher-interactions and extra-curricular leisure activities are of negligible importance.

Overall, these results are line with the fully-conditioned models in Section 6.2. The attitudes, behaviours and beliefs – on the part of both parents and children – that contribute to educational deficits of disadvantaged children are multi-faceted. Different dimensions of this diverse group of factors combine to hold disadvantaged children back early in life, and to stunt their progress between 7 and 11. Although we cannot identify a single key driver, maternal aspirations and children’s behaviour problems stand out as two of the most powerful explanatory factors, followed by maternal locus of control and the child’s self-concept and educational values.

Table A3.1. Socio-economic gaps in Key Stage 2 scores, conditional on sub- groups of controls

Variable	(1) No controls	(2) (1) + Parent education	(3) (2) + Demo- graphics	(4) (3) + School variables
Middle SEP quintile	14.3***	8.7***	7.3***	5.9***
<i>As % of column (1)</i>	100%	61%	51%	41%
Top SEP quintile	31.3***	15.1***	12.9***	9.8***
<i>As % of column (1)</i>	100%	48%	41%	31%
Adjusted R-squared	0.136	0.205	0.24	0.275
Variable	(5) (4) + Early health	(6) (4) + Early HLE	(7) (4) + Maternal locus	(8) (4) + Maternal attitudes to ed
Middle SEP quintile	5.4***	5.7***	5.3***	4.8***
<i>As % of column (1)</i>	38%	40%	37%	34%
Top SEP quintile	9.2***	9.3***	8.7***	7.1***
<i>As % of column (1)</i>	29%	30%	28%	23%
Adjusted R-squared	0.282	0.281	0.279	0.321
Variable	(9) (4) + Mother interactions	(10) (4) + Self- concept	(11) (4) + Educa- tional values	(12) (4) + Behav- iour
Middle SEP quintile	5.9***	5.6***	5.0***	4.5***
<i>As % of column (1)</i>	41%	39%	35%	32%
Top SEP quintile	9.6***	8.3***	8.4***	7.9***
<i>As % of column (1)</i>	31%	27%	27%	25%
Adjusted R-squared	0.285	0.332	0.319	0.337
Variable	(13) (4) + Peer interactions	(14) (4) + Leisure activities	(15) (4) + Teacher interactions	(16) All controls
Middle SEP quintile	5.5***	5.8***	5.7***	3.4***
<i>As % of column (1)</i>	39%	40%	40%	24%
Top SEP quintile	9.3***	9.3***	9.6***	4.5***
<i>As % of column (1)</i>	30%	30%	31%	14%
Adjusted R-squared	0.284	0.28	0.285	0.439

Early health: Birth weight, gestation, breast feeding, smoking, post-natal depression. *Early HLE*: Home learning environment quintiles, reading and bedtimes at 3, centre care pre-3, nursery. *Maternal attitudes to ed*: Mother found school valuable, mother's hopes for child's education. *Self-concept*: Child's ability beliefs and locus of control. *Educational values*: Enjoyment of school, school results/hobbies/ possessions important in life. *Behaviour*: Anti-social behaviours, hyperactivity, conduct problems, emotional symptoms. *Peer interactions*: Experience of bullying, pro-social behaviours, peer problems.

The lowest SEP quintile is the omitted category in each of the 16 regressions. Dummy variables for the second and fourth SEP quintiles are included in all regressions but not shown.

***, **, and * indicate significance at the 1, 5 and 10% levels respectively. N=7972 in all regressions.

Table A3.2. Socio-economic gaps in Key Stage 2 scores, conditional on Key Stage 1 and sub-groups of controls

Variable	(1) + KS1 only	(2) (1) + Parent education	(3) (2) + Demo- graphics	(4) (3) + School variables
Middle SEP quintile	3.9***	2.1***	2.1***	2.2***
<i>As % of column (1)</i>	100%	53%	54%	55%
Top SEP quintile	11.0***	4.3***	4.1***	3.4***
<i>As % of column (1)</i>	100%	39%	37%	31%
Adjusted R-squared	0.617	0.632	0.637	0.68
Variable	(5) (4) + Early health	(6) (4) + Early HLE	(7) (4) + Maternal locus	(8) (4) + Maternal attitudes to ed
Middle SEP quintile	2.1***	2.2***	2.0***	1.9***
<i>As % of column (1)</i>	54%	55%	50%	48%
Top SEP quintile	3.3***	3.3***	3.0***	2.6***
<i>As % of column (1)</i>	30%	30%	27%	24%
Adjusted R-squared	0.681	0.680	0.680	0.684
Variable	(9) (4) + Mother interactions	(10) (4) + Self- concept	(11) (4) + Educa- tional values	(12) (4) + Behav- iour
Middle SEP quintile	2.2***	2.2***	2.0***	1.8***
<i>As % of column (1)</i>	56%	55%	51%	46%
Top SEP quintile	3.4***	3.1***	3.1***	2.9***
<i>As % of column (1)</i>	31%	28%	29%	26%
Adjusted R-squared	0.680	0.688	0.683	0.687
Variable	(13) (4) + Peer interactions	(14) (4) + Leisure activities	(15) (4) + Teacher interactions	(16) All controls
Middle SEP quintile	2.1***	2.1***	2.1***	1.8***
<i>As % of column (1)</i>	53%	54%	55%	46%
Top SEP quintile	3.3***	3.3***	3.4***	2.2***
<i>As % of column (1)</i>	30%	30%	31%	20%
Adjusted R-squared	0.681	0.680	0.680	0.703

Early health: Birth weight, gestation, breast feeding, smoking, post-natal depression. *Early HLE*: Home learning environment quintiles, reading and bedtimes at 3, centre care pre-3, nursery. *Maternal attitudes to ed*: Mother found school valuable, mother's hopes for child's education. *Self-concept*: Child's ability beliefs and locus of control. *Educational values*: Enjoyment of school, school results/hobbies/ possessions important in life. *Behaviour*: Anti-social behaviours, hyperactivity, conduct problems, emotional symptoms. *Peer interactions*: Experience of bullying, pro-social behaviours, peer problems.

The lowest SEP quintile is the omitted category in each of the 16 regressions. Dummy variables for the second and fourth SEP quintiles are included in all regressions but not shown.

***, **, and * indicate significance at the 1, 5 and 10% levels respectively. N=7972 in all regressions.

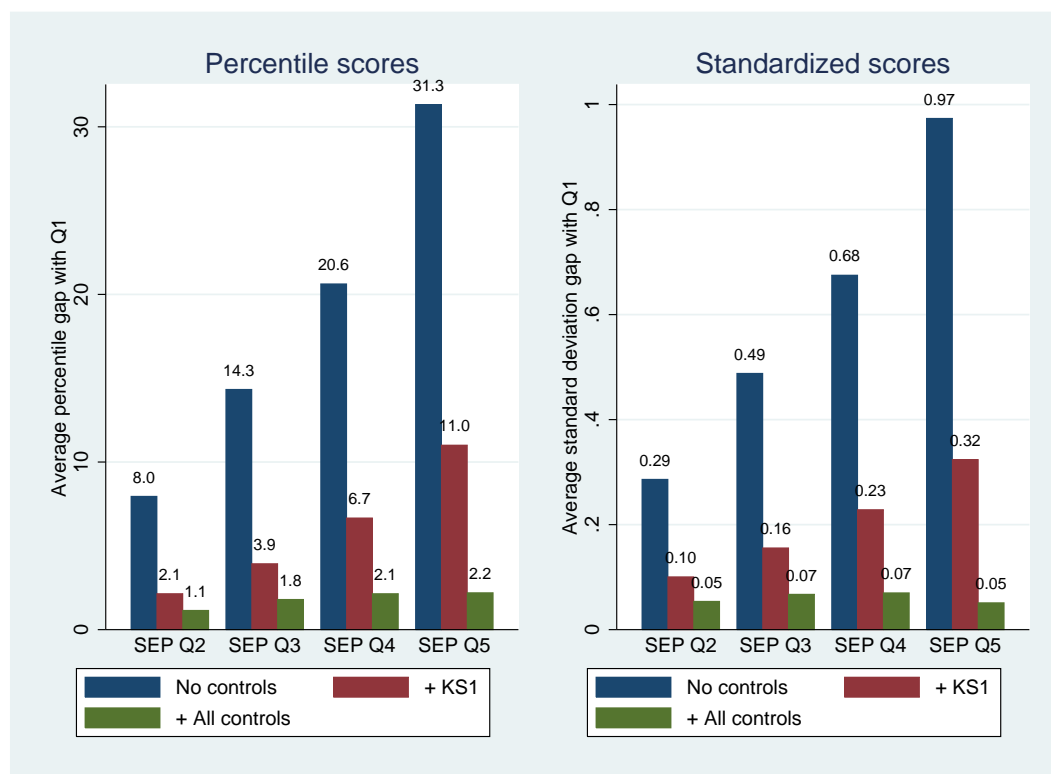
Appendix 4. Sensitivity of results to alternative definitions of key variables

A4.1 Key Stage 2 outcomes

In section we compare the size of the socio-economic gaps when Key Stage 2 is measured in an alternative metric. In the main body of the report, we express the outcome as a percentile score. This has the advantage of ease of interpretation, but it involves a loss of information compared with the original raw Key Stage 2 scores. To illustrate, the 156 children with the lowest Key Stage 2 scores (the bottom 1%) are all assigned a percentile score of 1. No distinction is made between those who scored lower or higher within this group. Secondly, the percentile score is a ranking, and as such collapses information on differences in absolute performance between percentile groups. Hence the difference between a child at the 10th percentile and one at the 20th percentile is the same as between children at the 55th and 65th percentile, when in reality the difference in educational attainment is likely to be much smaller in the second case. In practice, this means we could underestimate the educational deficits of disadvantaged children if there is a large gap in skills between the bottom of the distribution and the rest.

Figure A4.1 shows measures of the socio-economic gaps using our original percentile score, and a score that is standardized to mean zero, standard deviation 1, and so preserves all the information contained in the raw test scores. The patterns revealed by the two graphs are virtually identical, so we can be confident that our conclusions are affected little by the loss of information associated with the percentile scores.

Figure A4.1. Socio-economic gaps in Key Stage 2 scores, using alternative metrics for Key Stage 2



A4.2 Socio-economic position

In this section we check the sensitivity of our estimates of the socio-economic gaps at Key Stage 2 to alternative definitions of socio-economic position. The top panel of Table A4.1 repeats the gaps used in the main body of the paper, where SEP quintile is assigned according to a composite index of income, social class, subjective financial difficulties and housing tenure. We then repeat the analysis, using three different measures of family income, maternal education and free school meals status as the key stratifying variable.

The first income measure combines information on income at ages 2 to 3, 7 and 11 (See Appendix 2, Section A2.5 for details.) As such, this is the best available measure of ‘permanent’ or long-term family income, and shows the consequences of dropping only social class, subjective financial difficulties and housing tenure from our SEP measure. The results are not dramatically different, but the coefficients are somewhat smaller, suggesting that this measure is slightly less good at distinguishing those with different levels of educational performance.

The second two income measures use data from a single developmental stage in the child's life: the early years in the first case and the date of Key Stage 2 assessment in the second case. The results are similar, but slightly smaller again than in the case of the combined income measure. Income measured at a single point in time will therefore tend to underestimate socio-economic educational gaps, but we find no evidence that the distance in time between income and outcome measurement matters, or that income in the early years is disproportionately consequential.

The Key Stage 2 gaps associated with maternal educational attainment are, in some cases, even larger than those associated with quintiles of the SEP index. For example, children of mothers with a degree score, on average, 36.0 percentile points higher than the children of mothers with at most a CSE, compared with a difference of 31.1 between the lowest and highest SEP quintiles. Further, the unexplained gaps that remain when all measured controls are accounted for are noticeably larger than in the case of the other socio-economic indicators. This is perhaps unsurprising, as maternal education is an indicator of both material and non-material resources within the home. Note, however, that maternal education does not divide the sample into equal groups. 47% have mothers in the second category (Vocational/O-level) and the top degree category contains a highly selected 12% of the sample¹⁴.

As a final example, we explore the difference between FSM and non-FSM children. This is useful as the FSM indicator is frequently the only socio-economic variable available to education researchers. The raw gap of 19.2 percentile points, while lower than some of the other gaps shown in Table A4.1, is in fact very large when it is considered that the reference group contains children of a wide range of abilities (93% of the sample).

¹⁴ See Table A2.5 for variable means.

Table A4.1. Socio-economic gaps in Key Stage 2 scores, using alternative definitions of SEP

SEP indicator (Omitted group) Model	Regression coefficient (Dependent variable = KS2 percentile score)			
Combined SEP index (Quintile 1)	Quintile 2	Quintile 3	Quintile 4	Quintile 5
A. No controls	8.0***	14.3***	20.6***	31.3***
B. KS2 adjusted for KS1	2.1***	3.9***	6.7***	11.0***
C. KS2 adjusted for all controls	1.1*	1.8***	2.1***	2.2***
Combined income index (Quintile 1)	Quintile 2	Quintile 3	Quintile 4	Quintile 5
A. No controls	7.3***	11.8***	17.6***	26.1***
B. KS2 adjusted for KS1	1.7***	3.5***	4.7***	8.7***
C. KS2 adjusted for all controls	1.0*	2.1***	1.2*	1.7**
Income at age 2 to 3 (Quintile 1)	Quintile 2	Quintile 3	Quintile 4	Quintile 5
A. No controls	6.8***	11.4***	17.6***	23.8***
B. KS2 adjusted for KS1	2.0***	3.2***	6.1***	8.0***
C. KS2 adjusted for all controls	0.8	1.0*	1.4**	1
Income at age 11 (Quintile 1)	Quintile 2	Quintile 3	Quintile 4	Quintile 5
A. No controls	7.8***	10.3***	15.9***	22.3***
B. KS2 adjusted for KS1	2.4***	3.2***	4.7***	7.8***
C. KS2 adjusted for all controls	1.8***	1.4**	1.2**	2.0***
Maternal education (CSE/None)		Voc/ O-level	A-level	Degree
A. No controls		10.9***	22.0***	36.0***
B. KS2 adjusted for KS1		3.1***	8.4***	14.8***
C. KS2 adjusted for all controls		0.8	2.7***	5.0***
FSM at 11 (Eligible)				Not eligible
A. No controls				-19.2***
B. KS2 adjusted for KS1				-4.7***
C. KS2 adjusted for all controls				-1.0

Each row shows results from a separate regression.

N=7972 in all regressions.

Models labelled 'KS2 adjusted for KS1' include the KS1 standardized score as an explanatory variable.

Models labelled 'KS2 adjusted for all controls' include controls for KS1, parental education, demographic characteristics, school characteristics, parental attitudes and behaviours, and child attitudes and behaviours. See Table 3.1 for details.

A4.3 School composition and quality

This section explores the consequences of using an alternative method of capturing school quality and composition. Because ALSPAC is a regional survey, it contains observations of multiple children in the same schools. We can thus include school-fixed effects: a set of dummy variables, one for each school in the sample (see Appendix 2, Section A2.5 for details of these variables). Taken jointly, the set of binary indicators captures the average difference in outcomes of children at school i , relative to the omitted school, after adjusting for the other covariates included in the model. Hence the fixed effects control for the influence of all factors common to children at a given school, both observed and unobserved. This is likely to be a more flexible way of accounting for the influence of school composition and quality on outcomes, but has the drawback that it is silent on *which* school characteristics are the most salient for individual achievement. In addition, lack of sufficient peers for some pupils means that the dummies are undefined for 11% of our sample.

Table A4.2 explores the sensitivity of our findings to the replacement of the school characteristics variables (mean pupil Key Stage 1, value-added between Key Stage 1 and 2, and proportion FSM) with the school-level dummies. Columns 1 to 3 explore which of the groups of variables can account for more of the SEP gradients in Key Stage 2 when added to a parsimonious model, holding constant only parental education and demographic characteristics. The results are highly similar, but if anything the school fixed effects are somewhat less powerful than the measured characteristics (as the remaining SEP coefficients are slightly higher). Columns 4 to 6 test a parsimonious value-added model, and find virtually no difference between the two specifications. This conclusion also holds for both the levels and value-added models (Columns 7 to 12) when all observed covariates are held constant before the addition of the school-level variables. Hence we find no evidence that our conclusions are changed by the use of within-school models.

Table A4.2. Socio-economic gaps in Key Stage 2 scores, using school fixed effects models

	Raw KS2, selected controls			Adjusted KS2, selected controls			Raw KS2, all controls			Adjusted KS2, all controls		
	(1) Baseline	(2) + School chars	(3) + School FE	(4) Baseline	(5) + School chars	(6) + School FE	(7) Baseline	(8) + School chars	(9) + School FE	(10) Baseline	(11) + School chars	(12) + School FE
SEP quintile												
Quintile 2	4.4*** (1.0)	3.1*** (1.0)	3.4*** (1.0)	1.3* (0.7)	1.2* (0.6)	1.0 (0.7)	3.0*** (0.9)	2.2** (0.9)	2.3*** (0.9)	1.1* (0.7)	1.1* (0.6)	0.9 (0.6)
Quintile 3	7.3*** (1.0)	5.9*** (1.0)	6.3*** (1.1)	2.1*** (0.7)	2.2*** (0.7)	2.1*** (0.7)	4.4*** (0.9)	3.4*** (0.9)	3.6*** (1.0)	1.7** (0.7)	1.8*** (0.7)	1.7** (0.7)
Quintile 4	9.9*** (1.1)	7.5*** (1.1)	7.9*** (1.1)	3.4*** (0.8)	2.9*** (0.7)	2.7*** (0.8)	5.3*** (1.0)	3.7*** (1.0)	3.8*** (1.0)	2.5*** (0.7)	2.1*** (0.7)	1.9** (0.7)
Quintile 5	12.9*** (1.2)	9.8*** (1.2)	10.4*** (1.3)	4.1*** (0.9)	3.4*** (0.8)	3.1*** (0.8)	6.6*** (1.1)	4.5*** (1.1)	4.9*** (1.1)	2.7*** (0.8)	2.2*** (0.8)	1.9** (0.8)
Observations	7972	7972	7972	7972	7972	7972	7972	7972	7972	7972	7972	7972
R-squared	0.244	0.280	0.310	0.639	0.681	0.691	0.419	0.447	0.472	0.669	0.707	0.717
<u>Controls:</u>												
Parental education	√	√	√	√	√	√	√	√	√	√	√	√
Demographic characteristics	√	√	√	√	√	√	√	√	√	√	√	√
Key Stage 1				√	√	√				√	√	√
All other controls							√	√	√	√	√	√

A4.4 Prior ability

Throughout the main body of the report we make the distinction between socio-economic gaps that emerge before the age of 7, and those that emerge between 7 and 11, conditional on initial ability. We state, for example, that around 35% (11.0 of the 31.3 percentile point raw gap) of the average differences in Key Stage 2 between children in the lowest and highest SEP quintiles develops during the last four years of primary school.

However, as discussed in Appendix 2, Section A2.1, our measure of ability at 7 – Key Stage 1 performance – is relatively discrete. If it does not fully capture ability differences between disadvantaged and better-off children at that age, then we may overestimate the widening of the gap from that point on.

We explore this further by extending our measure of prior ability to include scores on a number of cognitive tests administered to the ALSPAC children at the ages of 7 and 8. The tests capture reading and listening skills and IQ – see Section A2.5 for further details. The timing of the age 8 measures is slightly problematic, in that they were administered at the same time as many of the psychological assessments used to measure children’s attitudes, behaviours and beliefs, around a year into the four-year period of interest.

Table A4.3 shows the effects of including these additional prior ability controls on the breakdown of the value-added gap first shown in Chapter 6, Table 6.2. The top rows show that the gap estimated to emerge between bottom and middle SEP quintile children after age 7 falls from 3.94 percentile points when Key Stage 1 is the sole prior ability control to 3.05 percentile points when the full set of measures are included, a drop of 23%. The estimated value-added gap between top and bottom SEP quintile children falls by an even larger 36%. Hence it appears that some of it what we have attributed to a widening socio-economic gap disappears when we allow for measurement error in prior ability.

The lower part of the table explores which explanatory factors were picking up these unobserved differences in the absence of the extra ability controls. Parental education is the most important correlate – 9 percentage points of the original middle-bottom value-added gap were originally attributed to widening differences between parental education groups, when in fact they reflected differences in unmeasured prior ability between children in those groups. 11 percentage points of the original top-bottom gap were misattributed in the same way. Together the contribution of all our measures of attitudes, behaviours and beliefs (preschool,

parents and children) to the value-added gap falls from 24% to 18% in the case of the middle-bottom gap, and from 29% to 18% in the case of the top-bottom gap.

There is some evidence, then, that children's attainment may already differ more by socio-economic status when they begin junior school at the age of 7 than our headline results suggest. However, to the extent that ability at 7 is poorly measured by Key Stage 1, ability at 11 is also likely to be poorly measured by Key Stage 2. We do not have multiple outcome measures available at the latter age to test this, but non-random measurement error in the outcome would tend work in the opposite direction by biasing downwards our estimates of the extent of educational inequality at the end of primary schooling.

Table A4.3. Breakdown of the socio-economic gaps in Key Stage 2 scores, conditional on alternative measures of prior ability

Variable grouping	Middle-bottom gap Percentile points (% of original gap)			Top-bottom gap Percentile points (% of original gap)		
	(1) Gap w/o extra ability controls	(2) Gap with extra ability controls	(2)-(1) <i>Change in gap</i>	(1) Gap w/o extra ability controls	(2) Gap with extra ability controls	(2)-(1) <i>Change in gap</i>
Gap emerging between 7 and 11 (sum of rows below)	3.94 (100%)	3.05 (77%)	-0.89 (-23%)	11.01 (100%)	7.07 (64%)	-3.94 (-36%)
Of which attributed to:						
Parental education	1.13 (29%)	0.79 (20%)	-0.34 (-9%)	3.58 (33%)	2.36 (21%)	-1.22 (-11%)
Demographic characteristics	0.2 (5%)	0.04 (1%)	-0.16 (-4%)	0.59 (5%)	0.17 (2%)	-0.42 (-4%)
School characteristics	0.14 (4%)	0.03 (1%)	-0.11 (-3%)	1.79 (16%)	1.45 (13%)	-0.34 (-3%)
Preschool environments	-0.2 (-5%)	-0.17 (-4%)	0.03 (1%)	-0.05 (0%)	-0.09 (-1%)	-0.04 (0%)
Parental attitudes and behaviours	0.74 (19%)	0.54 (14%)	-0.20 (-5%)	1.97 (18%)	1.43 (13%)	-0.54 (-5%)
Child attitudes and beliefs	0.38 (10%)	0.32 (8%)	-0.06 (-2%)	1.19 (11%)	0.63 (6%)	-0.56 (-5%)
Missing flags	-0.25 (-6%)	-0.36 (-9%)	-0.11 (-3%)	-0.27 (-2%)	-0.46 (-4%)	-0.19 (-2%)
Residual unexplained component	1.80 (46%)	1.85 (47%)	0.05 (1%)	2.20 (20%)	1.58 (14%)	-0.62 (-6%)