Measuring cognitive ability in the National Child Development Study (NCDS), the British Cohort Study (BCS70), the Longitudinal Study of Young People in England (LSYPE), and the Avon Study of Parents and Children (ALSPAC)

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1 Introduction

The purpose of this document is twofold: to describe the approach taken to measuring cognitive ability in the three earlier birth cohorts (NSHC 1946, NCDS 1958 and BCS 1970), and to outline the possibilities for the construction of similar variables in the two later cohorts (LSYPE and ALSPAC). Regarding the latter point, there are two main concerns: first, an understanding of the way in which 'cognitive ability' has previously been conceptualised and measured is important so that a high degree of comparability can be attained across the datasets and, while taking account of this, the second concern is to determine whether Key Stage 2 performance (the only measure available in LSYPE) can be considered adequate as a proxy for cognitive ability. For detailed information on each of the datasets used please see Bourne and Betthaeuser (2016); Betthaeuser and Bourne (2016a, 2016b, 2016c); and Bourne (2016). Further information on the ASLPAC data, the data dictionary and detailed acknowledgements can be found in Appendix E.

Section 2 describes how variables in the earlier three cohorts were constructed. In Section 3, the options available when using LSYPE and ALSPAC are described. Section 4 examines associations between cognitive ability (variously measured) and other key variables; both descriptive statistics and multivariate analyses are presented. In Section 5, the changing role of cognitive ability over time is considered; BCS70 with ALSPAC data, then BCS70 with LSYPE data are employed for this purpose, determining whether any over-time changes detected are sensitive to the use of alternative proxies (and/or samples). Section 6 provides a summary. See Table 1 for a list of all relevant variables.

Table 1. Cognitive Ability Measures Used (or Available for Use) in NCDS, BCS70, LSYPE and ALSPAC

Dataset	Variable name	Description
NCDS 1958	n914	Verbal score on general ability test
	n917	Non-verbal score on general ability test
BCS 1970	i3504 – i3540	BAS word definitions test (37 items)
	i3575 – i3616	BAS word similarities test (42 items)
	i3541 – i3574	BAS recall of digits test (34 items)
	i3617 – i3644	BAS matrices test (28 items)
LSYPE	cvap2aps	KS2 average points score (using fine grading) for contextual value added
	cvap2eng	KS2 English points score (using fine grading) for contextual value added
	cvap2mat	KS2 Maths points score (using fine grading) for contextual value added
	cvap2sci	KS2 Science points score (using fine grading) for contextual value added
ALSPAC	f8ws020 – f8ws030	WISC-III: All subtest raw scores (13 items)
	f8ws050 – f8ws060	WISC-III: All subtest scaled scores (11 items – excluding two digit span)
	f8ws100	WISC-III: Sum of all verbal subtests
	f8ws101	WISC-III: Sum of all performance subtests
	f8ws110	WISC-III: Verbal IQ
	f8ws111	WISC-III: Performance IQ
	f8ws112	WISC-III: Total IQ
	k2_read; k2_writ	Mark achieved in English reading test; Mark achieved in English writing test
	k2_hwrit; k2_spell	English handwriting test mark; English spelling test mark
	k2_tote	Total mark achieved in English test (sum of reading and writing tests)
	k2_extem	English extension mark
	k2_pap1m; k2_pap2m	Mark achieved in paper A of maths test; Mark achieved in paper B
	k2_marit	Mark achieved in mental arithmetic paper of maths test
	k2_totm	Total mark achieved in maths test (sum of paper A, B and mental arithmetic)
	k2_extmm	Maths extension mark
	k2_papas; k2_papbs	Mark achieved in paper A of science test; Mark achieved in paper B
	k2_tots	Total mark achieved in science test (sum of paper A and paper B tests)
	k2_extsm	Science extension mark
	k2_totps	Total KS2 point score used in the value added calculations
	ks4_cvap2aps	KS2 average points score (using fine grading) for contextual value added
	ks4_cvap2eng	KS2 English points score (using fine grading) for contextual value added

	ks4_cvap2mat	KS2 Maths points score (using fine grading) for contextual value added
	ks4_cvap2sci	KS2 Science points score (using fine grading) for contextual value added

2 Previous Approaches: Conceptual and Operational Implications

With the three earlier cohorts, cognitive ability was measured using the results from a range of tests administered by survey interviewers. Information relating to the test scores used has been found in Bukodi et al (2014) and Schoon (2010; 2008). In the 1946 cohort, the results from a 'general cognitive ability' test taken at age 11 were used, which yielded scores for verbal intelligence and non-verbal ability (Schoon 2010; Richards et al 2010).[1] In the 1958 cohort, scores from a general ability test taken at age 11, again comprising the assessment of both verbal and non-verbal skills, were used (Schoon 2008).[2] In the 1970 cohort, scores from four sub-tests of the British Ability Scales (BAS), taken at age 10, were used: Word Definitions and Word Similarities to measure verbal ability, and Recall of Digits and Matrices to measure non-verbal ability (Schoon 2010).

For each cohort, a principal components analysis (PCA) was carried out on the sub-tests. In each case, a single component could be confirmed and this was taken to represent a 'general cognitive ability factor (g)' (Schoon 2010; 2008), or a 'latent (g) factor in intelligence' (Bukodi et al 2014).

I have attempted to reconstruct the cognitive ability measures previously used by Schoon (2010) and Bukodi et al (2014) as follows. For the 1958 cohort, a PCA was conducted on the two variables listed in Table 1 and scores from the first unrotated factor were saved for each valid case. The first component accounted for 90% of the total variance, which is the same as was found by Schoon (2008). For the BCS70 cohort, for each item making up the different tests listed in Table 1, cases with responses coded 'no questionnaire' (-6), 'not stated' (-3) or 'no response' (9) were set to missing, those with a correct response (1) were given a value of 1 and those with an incorrect response (2) were given a value of 0. Items from the similarities subtest were treated in pairs, so that cases were only assigned a value of 1 if they got both parts of the question correct.[3] The individual item variables were then summed to derive an overall score for each sub-test and a PCA was conducted on these four variables. The first principal component score accounted for 58% of the total variance, which is very close to the figure of 57% found by Schoon (2008); the slight discrepancy may be due to differences in sample exclusions. See Table 2 which describes the factor loadings.

Table 2. PCA to Derive Cognitive Ability Measures using NCDS and BCS70

	PCA						**New Variable**		
	Eigenvalue	Loading				% of variance	Min	Max	Mean (SD)
		Verbal		Non-verbal					
NCDS	1.81	0.71		0.71		0.90	-3.61	3.13	0.00 (1.34)
		Word Def	Word Sim	Recall	Matrices				
BCS70	2.31	0.55	0.55	0.39	0.49	0.58	-5.64	5.13	0.00 (1.52)

2.1 A Discussion of 'g'

There has been much discussion in the psychology, education and wider literature regarding the differences between intelligence, IQ and cognitive ability[4], how these concepts should be treated and measured, and what they can – and

[1] Scores form the Word Reading, Vocabulary and Arithmetic tests were not used by Schoon (2010).
[2] The variables listed in Table 1 – n914 and n917 – are the summed scores from the various tests.
[3] See http://www.cls.ioe.ac.uk/page.aspx?&sitesectionid=843&sitesectiontitle=Derived+variables from the CLS website which recommends treating the measures in this way.
[4] With 'cognitive ability' variously termed 'cognitive function', 'cognition', 'cognitive capital', and so on. It has been suggested that these are distinct (e.g. Bynner and Wadsworth 2010), but this is rarely recognised.

cannot – tell us about a person's intellectual capacity. The overriding message that emerges from these discussions is that there are both conceptual and operational distinctions that should be recognised, and these will have implications for the approach we take to constructing a similar measure of cognitive ability in ALSPAC.

In brief, there is a good degree of consensus in the literature that IQ and 'g' are in fact different things, despite these terms often being used interchangeably (e.g. Schoon 2008:76; Gregg and Macmillian 2010:263-4; Bukodi et al 2014:297). According to Colom et al (2002), the notion of general intelligence (g) rests on correlations among test scores (e.g. determined using PCA) and should be distinguished from 'intelligence in general' – or IQ – which rests on the summation of standardised test scores and therefore is in fact 'g' *plus* specific cognitive abilities and skills.[5] Capturing the common variance across ability tests – precisely the same approach as has been taken using the earlier cohorts – is seen as the closest approximation to determining the latent measure of intelligence (g) (Deary 2001).

3 Constructing Cognitive Ability Measures in ALSPAC and LSYPE

The main purpose of using the ALSPAC dataset is to examine how closely associated are the measures of cognitive ability, determined via the WISC-III intelligence test, and measures of performance on national ability tests, derived from scores at Key Stage 2.

The first consideration therefore relates to which WISC-III variables might be used to examine this (possibilities are listed in Table 1).[6,7] The verbal and performance IQ measures use scores which have been standardised and summed, and the full-scale IQ is then a summation of these. Kaufman (1994) warns against use of the full-scale IQ because it 'does not adequately reflect the diversity of cognitive capabilities that have been identified in many studies of children's thinking. Consequently, the notion of 'g' must be thought of as the global ability underlying a conventional intelligence test such as the WISC-III…, but not as a theoretical construct underlying human intellect' (1994:43). Similarly, Colom et al (2002) examine the Wechsler Adult Intelligence Scale (WAIS-III) (though this is broadly similar in content to the WISC-III), and determine that the full-scale IQ does not directly or exclusively measure 'g': 'there is no significant association between the scientific construct of general intelligence (g) and the differences in intelligence in general (IQ) assessed by the WAIS-III' (2002:449).

Taking account of this, as well as the need to differentiate between IQ and 'g' as outlined above, the variables measuring WISC IQs have not been used in the construction of the cognitive ability variables in ALSPAC. Instead, two WISC variables were constructed as follows: the first uses scaled scores from each of the 11 subtests (this is the approach that has been used in some previous studies [e.g. Kaufman 1994; Kamphaus 1993; Roid et al 1993], which have determined that the loadings on the first unrotated factor of a PCA can be used to adequately represent 'g') (variable "WISC-11", N=6,620), and the second uses the composite variables – f8ws100 and f8ws101 (the sum of all verbal and performance subtests, respectively) (variable "WISC-2", N=7,347). In both cases, the variables were used in a PCA, saving the scores from the first principal component extracted.

The second consideration relates to which Key Stage 2 variables might be used. According to the Key Stage 2 NPD User Guide, variables providing information on fine grading should be preferred for use over those with information on actual test scores because the latter are likely to introduce bias by omitting lower attaining pupils (see NPD 2011 for more information, including details of the algorithms used to create the fine graded scores from the original variables). In addition, the set of average point score variables (using fine grading) – cvap2aps, cvap2eng, cvap2mat and cvap2sci – are the only ones which are present in both ALSPAC and LSYPE. Two Key Stage 2 variables have been constructed using the ALSPAC data: the first uses Maths, English and Science points scores to

[5] There are also different origins of the concepts of intelligence as measured via IQ and the alternative, more theoretically-oriented, approach to capturing cognitive ability as a general capacity (Richards and Deary 2010; Spearman 1904); the latter of which is now more frequently employed (Deary 2001).
[6] Scaled scores are raw scores adjusted for differences in age.
[7] Verbal subtests are: Information, Similarities, Arithmetic, Vocabulary and Comprehension. Performance subtests are: Digit Span, Picture Completion, Coding, Picture Arrangement, Block Design and Object Assembly.

carry out a PCA, saving the scores from the first principal component extracted (variable "KS2ems", N=11,036), and the second uses just Maths and English points scores to carry out a PCA in the same way (variable "KS2em", N=11,081). The reason for excluding Science from one of the measures is that these tests are quite different in content from other – more general – ability tests, including those administered as a part of the WISC and also those used in the earlier cohorts. Other studies that have sought to examine the relationship between cognitive ability and scores in national assessments, such as Key Stage tests, have also taken this approach (e.g. Duckworth and Schoon 2010; Gregg and Macmillan 2010). The results of each of these PCAs are given in Table 3.[8]

Table 3. PCA to Derive Cognitive Ability Measures using ALSPAC

	PCA					**New Variable**		
	Eigenvalue	Loading			% of variance	Min	Max	Mean (SD)
		English	Maths	Science				
KS2em	1.75	0.71	0.71	--	0.88	-3.64	2.55	0.00 (1.32)
KS2ems	2.54	0.57	0.58	0.58	0.85	-5.09	3.03	0.00 (1.59)
		Verbal	Performance					
WISC-2	1.51	0.71	0.71		0.75	-5.07	3.84	0.00 (1.23)
WISC-11†	3.67	--	--		0.33	-7.58	6.13	0.00 (1.92)

Notes:

† Factor loadings are not presented for this variable because there are too many to list

Note that the PCA conducted using the 11 subtests of WISC-III identified two factors: the first with an eigenvalue of 3.67 and the second with a value of 1.14. Only values from the first component were saved.

Table 4 examines the correlations between the new variables WISC-2 and WISC-11 on the one hand, and KS2em and KS2ems on the other, which are all strong and are statistically significant ($p<0.00$).

Table 4. Pearsons Correlations between Key Stage 2 Measures and WISC Measures, derived using PCA

	KS2em	KS2ems	WISC-2	WISC-11
KS2em	1.00			
KS2ems	0.98**	1.00		
WISC-2	0.70**	0.71**	1.00	
WISC-11	0.74**	0.75**	0.98**	1.00

The only options for deriving a measure of cognitive ability in the LSYPE involve using Key Stage 2 scores. These variables have been constructed using the same approach as described above. See Table 5. (KS2em N=7,585; KS2ems N=7,565.)

Table 5. PCA to Derive Cognitive Ability Measures using LSYPE

	PCA					**New variable**		
	Eigenvalue	Loading			% of variance	Min	Max	Mean (sd)
		English	Maths	Science				
KS2em	1.75	0.71	0.71	--	0.87	-3.93	>2.45	0.00 (1.32)
KS2ems	2.53	0.57	0.58	0.58	0.84	-5.46	>2.95	0.00(1.59)

Notes:

Precise maximum values have been omitted to preserve anonymity

[8] There were a number of cases with zero scores on the point score measures in ALSPAC (N~850 [~5%], depending on the measure). These cases were set to missing before the PCA was carried out because they do not represent failure of the tests (NPD 2011:16–17). Examining the data, cases with a score of zero do in fact have valid (and often high) scores on the variables which give the actual test marks and further, the same variables from the NPD file linked to the LSYPE data have a range 15–36 while these measures have a minimum of 0, then a range of 15–36 (i.e. no cases have a point score between 1–14).

Figure 1 demonstrates that the percentile distributions of the KS2em and KS2ems variables in LSYPE and ALSPAC are almost identical. Figure 2 superimposes the percentile distributions of each Key Stage 2 variable onto each WISC variable (ALSPAC data only).

Figure 1. Percentile Distributions of KS2em and KS2ems in LSYPE and ALSPAC

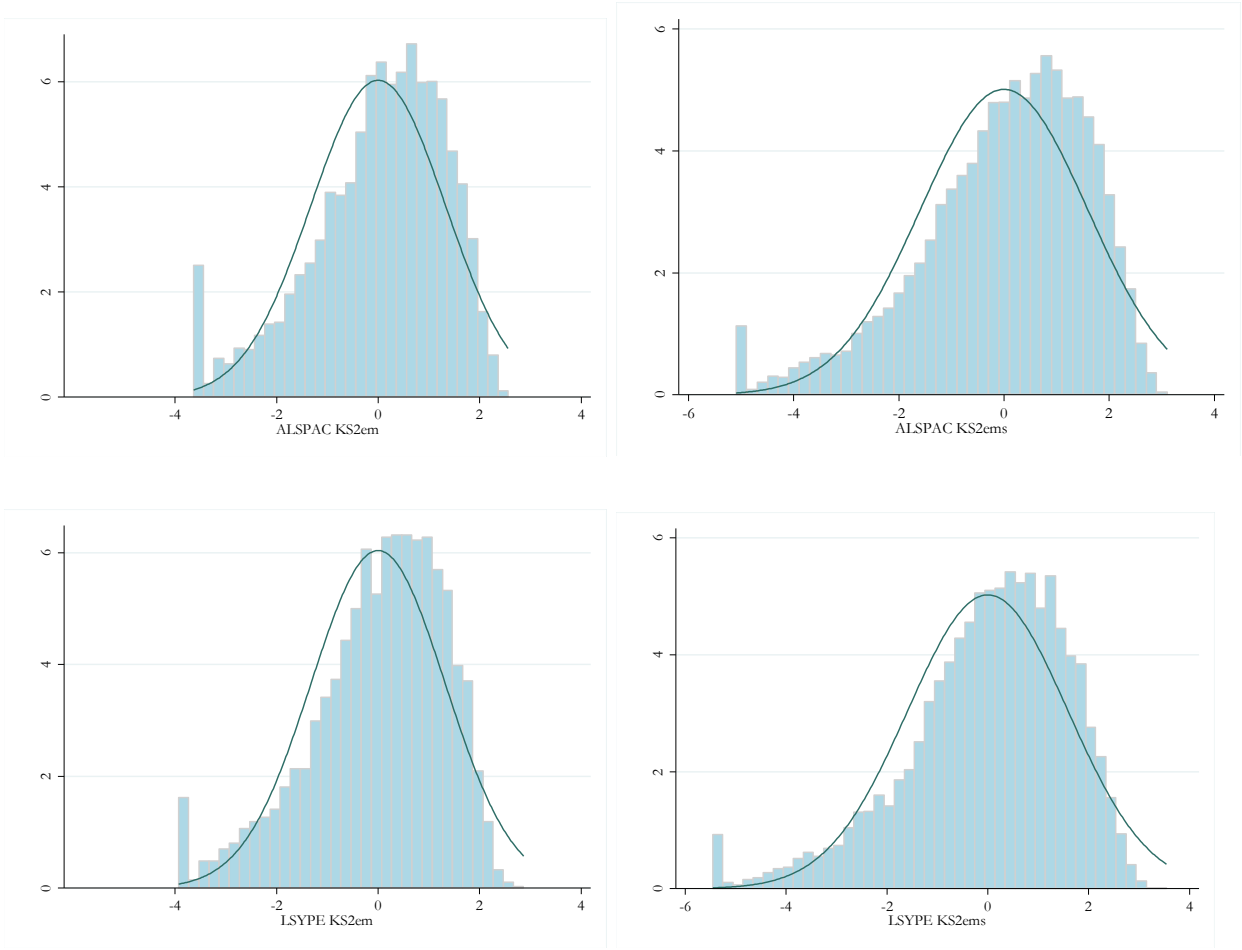
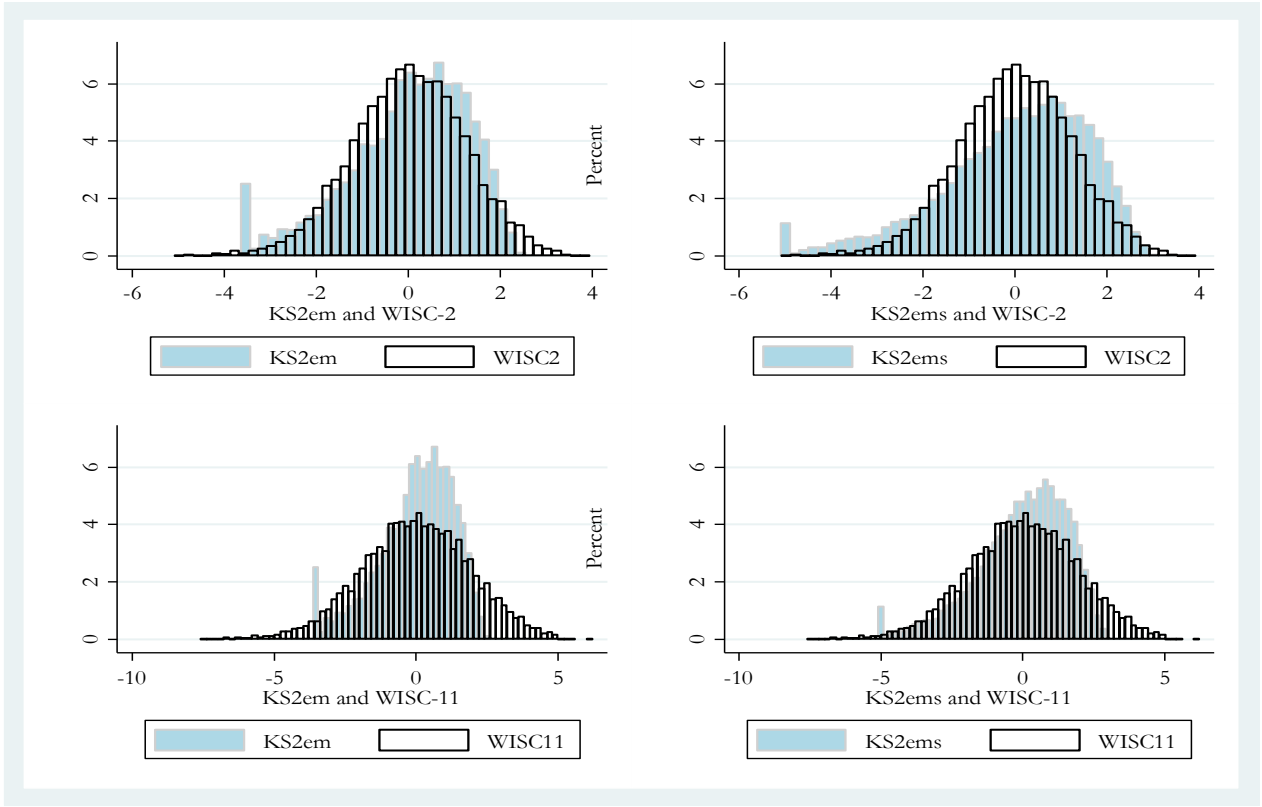


Figure 2. Percentile Distributions of Each Pair of Key Stage 2 and WISC Measures in ALSPAC



Tables 6-9 present cross tabulations of each pair of Key Stage 2 and WISC variables using ALSPAC data, after having transformed these into deciles. These four tables are summarised in Table 14.

Table 6. Cross-Tabulation of KS2em and WISC-2, Presented in Deciles, in ALSPAC (%)

	1	2	3	4	5	6	7	8	9	10 Top	Total
1	62	22	8	4	2	1	0	1	0	0	100
	31	11	4	2	1	1	0	0	0	0	5
2	37	24	15	10	4	5	3	2	1	0	100
	27	17	11	7	3	3	2	1	1	0	8
3	22	22	19	13	11	6	3	3	1	0	100
	17	17	15	10	9	5	3	3	1	0	8
4	11	19	17	15	15	8	5	6	2	1	100
	10	16	14	13	13	7	5	6	2	1	9
5	8	15	18	15	13	10	9	6	3	2	100
	8	14	17	14	13	10	9	6	3	2	10
6	4	10	12	15	13	17	11	10	6	2	100
	4	10	12	15	13	17	12	11	7	2	11
7	2	8	11	11	15	15	14	11	10	4	100
	2	8	12	12	16	16	16	13	11	6	11
8	1	3	8	9	12	15	15	16	13	8	100
	1	4	9	11	14	18	19	20	16	11	12
9	1	2	4	8	8	12	14	17	20	15	100
	1	3	5	10	10	15	19	22	27	22	13
10 Top	0	1	1	4	6	7	12	13	23	35	100
	0	1	2	5	8	9	17	19	32	56	14
Total	11	11	10	10	10	10	10	10	10	8	100
	100	100	100	100	100	100	100	100	100	100	100

Table 7. Cross-Tabulation of KS2em and WISC-11, Presented in Deciles, in ALSPAC (%)

	1	2	3	4	5	6	7	8	9	10 Top	Total
1	69	20	6	3	1	0	0	0	0	0	100
	32	9	3	2	1	0	0	0	0	0	5
2	40	28	13	8	6	3	1	1	0	0	100
	28	19	9	6	4	2	1	1	0	0	7
3	21	25	21	13	10	4	4	2	0	0	100
	17	19	16	10	8	4	3	2	0	0	8
4	12	20	20	15	12	8	7	4	1	0	100
	11	17	18	13	10	7	6	4	1	0	9
5	8	16	17	19	11	13	9	5	2	1	100
	7	14	16	17	10	12	8	5	2	1	10
6	3	8	14	17	16	14	13	10	5	1	100
	3	8	14	17	16	15	14	11	6	1	11
7	2	6	11	12	15	15	15	12	7	4	100
	2	7	12	13	17	17	17	14	9	5	11
8	1	3	6	11	13	15	16	15	14	7	100
	1	3	7	13	15	19	19	19	19	10	12
9	0	2	3	6	10	11	15	19	23	12	100
	0	3	4	7	13	14	19	25	32	19	163
10	0	0	1	2	5	7	11	15	21	39	100
Top	0	0	1	3	6	10	15	21	31	64	14
Total	11	11	10	10	10	10	10	10	9	8	100
	100	100	100	100	100	100	100	100	100	100	100

Table 8. Cross-Tabulation of KS2ems and WISC-2, Presented in Deciles, in ALSPAC (%)

	1	2	3	4	5	6	7	8	9	10 Top	Total
1	66	20	7	4	1	0	1	0	0	0	100
	34	10	4	2	1	0	0	0	0	0	5
2	37	25	17	8	5	5	2	1	1	0	100
	26	18	12	6	3	3	2	1	1	0	7
3	21	24	20	14	10	6	2	3	1	0	100
	16	18	16	11	8	5	2	2	1	0	8
4	13	21	17	16	11	8	6	6	1	0	100
	10	17	14	13	9	7	5	5	1	0	9
5	6	13	16	16	15	13	9	8	3	1	100
	6	12	15	15	14	13	9	8	3	1	10
6	4	12	14	15	13	14	11	8	7	3	100
	4	12	14	15	13	15	12	9	8	3	11
7	2	6	10	10	18	16	13	13	9	3	100
	2	6	11	11	20	17	15	15	10	5	11
8	1	4	8	10	12	14	16	14	13	7	100
	1	5	10	12	14	17	20	18	17	10	12
9	0	2	4	8	8	12	14	17	20	15	100
	0	2	5	10	10	15	19	23	27	24	13
10	0	1	1	3	5	7	11	14	23	35	100
Top	0	1	1	5	7	9	16	20	33	57	14
Total	11	11	10	10	10	10	10	10	10	8	100
	100	100	100	100	100	100	100	100	100	100	100

Table 9. Cross-Tabulation of KS2ems and WISC-11, Presented in Deciles, in ALSPAC (%)

	1	2	3	4	5	6	7	8	9	10	Total

										Top	
1	73	19	5	2	1	0	0	0	0	0	100
	35	9	2	1	0	0	0	0	0	0	5
2	38	29	14	9	6	2	1	0	0	0	100
	26	19	10	6	4	2	1	0	0	0	7
3	21	27	21	13	10	3	3	1	0	0	100
	16	21	6	10	8	3	2	1	0	0	8
4	14	20	21	15	10	9	7	4	1	0	100
	12	16	17	12	8	8	6	3	1	0	9
5	6	14	18	18	13	14	10	4	2	0	100
	6	13	17	17	13	14	9	4	2	0	10
6	3	10	14	18	15	11	12	9	5	2	100
	3	10	14	18	15	12	13	10	6	2	11
7	1	6	10	12	17	18	14	13	8	3	100
	2	6	11	13	18	21	15	15	9	4	11
8	1	3	7	11	12	14	17	16	13	5	100
	1	3	8	13	14	17	20	20	17	8	12
9	0	2	3	6	10	11	14	18	23	14	100
	0	2	4	8	13	15	18	24	33	23	13
10	0	1	1	2	5	7	12	15	21	38	100
Top	0	1	1	2	7	9	16	22	32	63	14
Total	11	11	10	11	10	10	10	10	9	8	100
	100	100	100	100	100	100	100	100	100	100	100

Tables 10–13 present cross tabulations for each of these pairs of variables, after having instead been transformed into quintiles. These four tables are summarised in Table 14.

Table 10. Cross-Tabulation of KS2em and WISC-2, Presented in Quintiles, in ALSPAC (%)

	1 Bottom	2	3	4	5 Top	Total
1 Bottom	71	19	7	3	1	100
	43	12	4	2	1	13
2	37	32	20	9	2	100
	30	27	17	8	2	17
3	19	30	27	18	7	100
	18	29	27	19	7	20
4	7	20	28	28	17	100
	7	22	32	33	22	23
5 Top	2	8	16	28	46	100
	2	11	21	38	68	27
Total	21	21	20	20	18	100
	100	100	11	100	100	100

Table 11. Cross-Tabulation of KS2em and WISC-11, Presented in Quintiles, in ALSPAC (%)

	1 Bottom	2	3	4	5 Top	Total
1 Bottom	77	16	6	1	0	100
	44	10	3	1	0	12
2	39	34	17	8	1	100
	32	28	15	7	1	17
3	17	33	27	18	4	100
	16	32	27	19	5	20
4	6	20	29	29	16	100
	6	22	34	34	21	23
5 Top	1	6	16	29	48	100

	2	8	21	40	73	27
Total	21	21	20	20	18	100
	100	100	100	100	100	100

Table 12. Cross-Tabulation of KS2ems and WISC-2, Presented in Quintiles, in ALSPAC (%)

	1 Bottom	2	3	4	5 Top	Total
1 Bottom	72	19	6	2	1	100
	43	12	4	2	0	13
2	39	33	18	9	1	100
	31	27	15	7	1	17
3	18	30	27	18	7	100
	17	30	27	19	7	20
4	6	19	30	28	16	100
	7	22	34	34	21	23
5 Top	2	8	16	28	47	100
	2	10	21	39	70	27
Total	21	21	20	20	18	100
	100	100	100	100	100	100

Table 13. Cross-Tabulation of KS2ems and WISC-11, Presented in Quintiles, in ALSPAC (%)

	1 Bottom	2	3	4	5 Top	Total
1 Bottom	77	16	5	1	0	100
	44	10	3	1	0	12
2	41	35	16	7	0	100
	32	28	13	6	0	17
3	17	34	27	18	5	100
	16	33	27	18	5	20
4	5	20	30	30	15	100
	6	22	35	35	19	23
5 Top	1	6	16	29	48	100
	2	7	22	40	75	28
Total	21	21	20	20	18	100
	100	100	100	100	100	100

Table 14 provides summary statistics, based on the cross-classifications of the decile and quintile measures presented in Tables 6–13 above.

Table 14. Summary Statistics based on Cross-Classifications of Decile and Quintile Measures

	Decile Measures		
	% Same decile	% KS2 higher than WISC	% WISC higher than KS2
KS2em & WISC-2	22	54	24
KS2em & WISC-11	23	55	22
KS2ems & WISC-2	22	54	24
KS2ems & WISC-11	23	56	21
	Quintile Measures		

	% Same quintile	% KS2 higher than WISC	% WISC higher than KS2
KS2em & WISC-2	39	43	16
KS2em & WISC-11	40	44	16
KS2ems & WISC-2	40	43	17
KS2ems & WISC-11	41	44	15

Examining Figures 1 and 2 alongside Table 14 above, it is clear that there are some differences in the distributions of Key Stage and WISC measures. Less than half of cases fall into the same quintile, and relatively high proportions of respondents score higher on Key Stage examinations than they do on WISC tests; this suggests that using scores from Key Stage tests will result in a general overestimation of cognitive ability.

3.1 An Alternative Treatment of Cases with Zero Scores on Key Stage 2 Measures in ALSPAC

An apparent difference between the distributions of the various measures, as shown in Figures 1 and 2, is that the Key Stage variables have a notable proportion of cases with zero scores[9] (N=278, 2.5% in the case of KS2em and N=125, 1.1% in the case of KS2ems) – representing those that failed the tests – while the WISC variables display a smooth continuum of those with low scores at the left tail. The WISC tests presumably include a number of extremely easy items, making it far more unusual to fail completely. A question that then arises is whether there is an alternative approach to the treatment of those that have failed Key Stage tests which would thereby facilitate more of a 'like-with-like' comparison.

Two alternative measures have been constructed using ALSPAC data, and these are considered in this section. Both are based on the KS2em variable, as this is the measure we expect to use in analyses. The first measure excludes cases who have failed either Key Stage 2 Maths or English by setting those with zero scores to missing before running the PCA (variable "KS2emX1"). The second measure 'imputes' non-failed scores for those who have failed either English or Maths from other Key Stage tests, where these are available. First, failed English scores are replaced with non-failed Maths scores and vice versa. Then, of those who failed both (or failed one and are missing on the other), failed scores are replaced with non-failed Science scores. Table 15 justifies this approach by showing that mean non-failed scores tend to be lower on other tests for those who have failed Maths or English, than for those who have not failed. Finally, those who failed all Maths, English and Science tests are set to missing (variable "KS2emX2").

Table 15. Comparison of Non-Failed Scores on Alternative Key Stage Tests

	% Also failed		**Mean non-failed scores**		
	English	Maths	English	Maths	Science
Failed Maths	66%	--	20.51	--	22.13
Non-failed Maths	2%	--	27.27	--	29.14
Failed English	--	58%	--	20.66	23.18
Non-failed English	--	1%	--	27.74	29.14

The results of the PCAs used to derive these two new measures are given in Table 16. The first approach – setting cases with failed scores to missing – of course results in a variable with fewer valid cases than does the latter approach (KS2emX1 N=10,461; KS2emX2 N=10,948).

Table 16. PCA to Derive Alternative Key Stage 2 Cognitive Ability Measures using ALSPAC

PCA	**New Variable**

[9] Note that these cases do not actually take a value of 0 in the original measure, but a value of 15. Nonetheless, they represent those at the lowest end of the distribution (captured by the 'spike' in Figures 1 and 2); the procedure for extracting the first principal component using PCA is the same as it would have been if the lower bound of the original scale had first been shifted to 0 (and thus the scores saved for each case would be identical).

	Eigenvalue	Loading		% of variance	Min	Max	Mean (SD)
		English	Maths				
KS2emX1	1.68	0.71	0.71	0.84	-3.68	2.78	0.00 (1.29)
KS2emX2	1.72	0.71	0.71	0.86	-3.55	2.76	0.00 (1.31)

Table 17 examines the correlations between KS2emX1 and KS2emX2 on the one hand, and WISC-2 and WISC-11 on the other. The correlations from Table 4, which compare the WISC measures with KS2em, are also presented for ease of comparison. The correlations are slightly weaker when using these new alternative measures.

Table 17. Pearsons Correlations between Alternative Key Stage 2 Measures and WISC Measures

	KS2emX1	KS2emX2	KS2em	WISC-2	WISC-11
KS2emX1	1.00				
KS2emX2	1.00**	1.00			
KS2em	1.00**	0.97**	1.00		
WISC-2	0.66**	0.68**	0.70**	1.00	
WISC-11	0.71**	0.73**	0.74**	0.98**	1.00

Figure 3 displays the percentile distributions of the KS2emX1 and KS2emX2 variables, with the KS2em variable superimposed on top of them. Figure 4 superimposes the percentile distributions onto each WISC variable. Having treated those with failed Key Stage 2 scores clearly brings the distribution of the measures closer to that of the WISC (compare Figures 2 and 4). This is particularly so when considering the WISC-2 variable, however, the closer association is in fact shown to be between these alternative Key Stage 2 measures and the WISC-11 variable when examining the correlations given in Table 17.

Figure 3. Percentile Distributions of KS2emX1 and KS2emX2

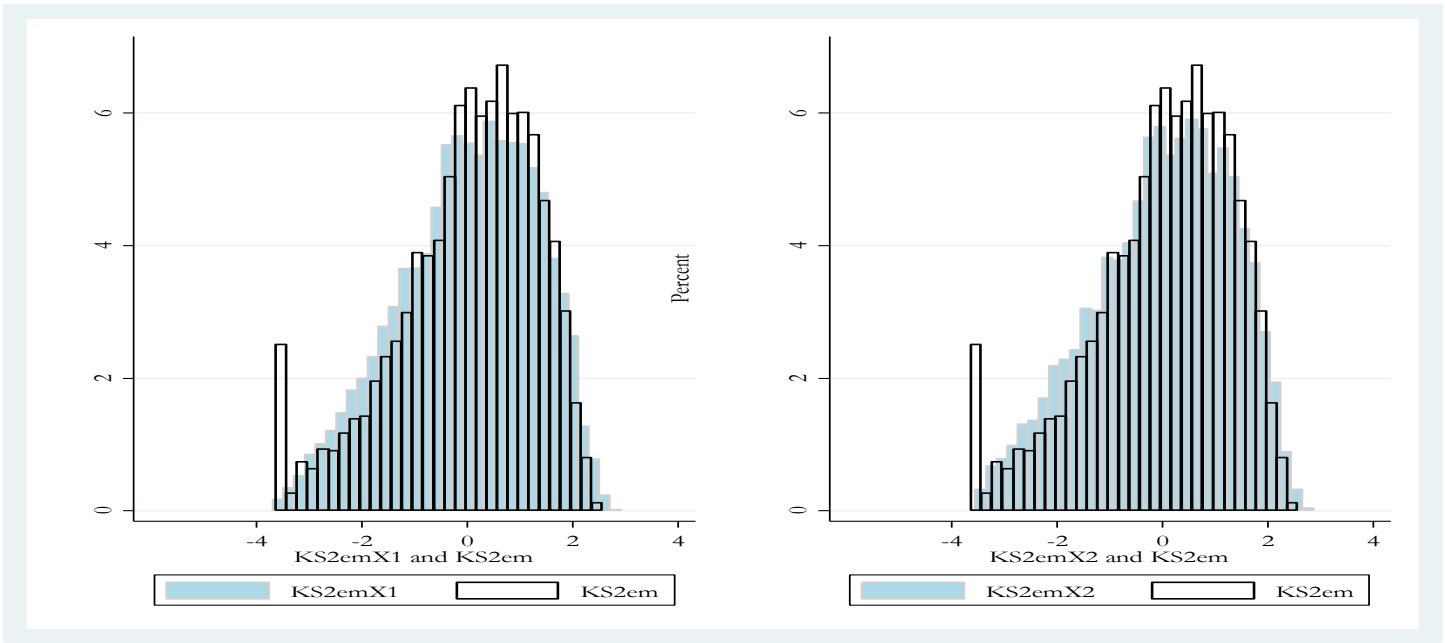
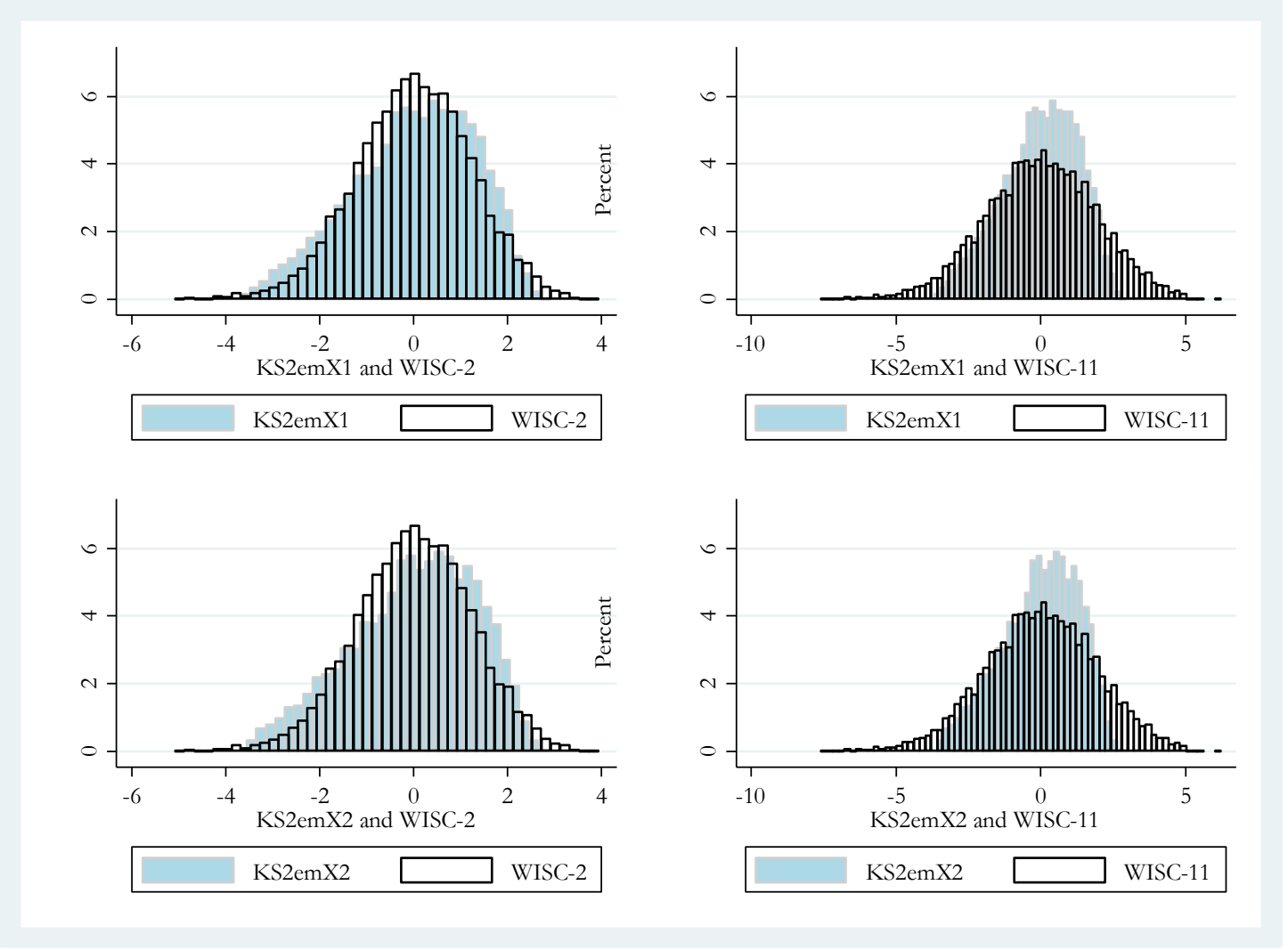


Figure 4. Percentile Distributions of Each Pair of Alternative Key Stage 2 and WISC Measures



Taking the same approach presented above, cross-classifications of each alternative Key Stage measure with each WISC measure were derived after having transformed the variables into deciles and quintiles. Each cross-tabulation is given in Tables A1–A8 in the Appendix, and a summary of these is presented in Table 18 below. These results should be contrasted with those given in Table 14 above, which displays the same summary for the cross-classifications of the constructed Key Stage measures before making any amendments to those with zero scores (KS2em and KS2ems). Reassigning failed scores to non-failed scores does not tend to increase the proportion of cases found in the same decile; the proportion found in a higher Key Stage than WISC decile is reduced, but this reduction is insubstantial.

Table 18. Summary Statistics based on Cross-Classifications of Alternative Key Stage 2 Decile and Quintile Measures with WISC measures

	Decile Measures		
	% Same decile	% KS2 higher than WISC	% WISC higher than KS2
KS2emX1 & WISC-2	21	51	28
KS2emX1 & WISC-11	24	51	25
KS2emX2 & WISC-2	22	53	25
KS2emX2 & WISC-11	23	54	23
	Quintile Measures		
	% Same quintile	% KS2 higher than WISC	% WISC higher than KS2
KS2emX1 & WISC-2	39	40	21
KS2emX1 & WISC-11	41	40	19

KS2emX2 & WISC-2	39	42	19
KS2emX2 & WISC-11	41	43	16

4 Associations between the Different Cognitive Ability Measures and Other Focal Variables[10]

In order to determine whether performance at Key Stage 2 can be considered adequate as a proxy for cognitive ability, it is important to demonstrate that these constructed measures are associated with social origin and educational attainment variables in a way which is similar to the WISC measures. In this section, the variables KS2em (which makes no adjustments for the 2.5% of cases with zero scores) and KS2emX2 (which replaces failed scores with non-failed scores on other tests where possible, setting others to missing) are examined using ALSPAC data. Parental class, status, education and income, and respondents' educational attainment have been constructed in ways which, as far as possible, mirror the approaches previously taken when using LSYPE data. Appendix B provides an explanation of how these measures were constructed, descriptive statistics and some notes on how their distributions compare with those found using LSYPE data.

Table 19 shows how the Key Stage 2 and WISC measures are distributed across these other focal variables, both by presenting the proportions found in the lowest and highest deciles across categories and also by presenting the means, using a normalised version of each measure.

Table 19. Key Stage 2 and WISC Distributions across Other Focal Variables, in ALSPAC

	% of category falling into lowest and highest deciles								Mean (variables normalised)			
	KS2em		KS2emX2		WISC2		WISC11		KS2em	KS2emX2	WISC2	WISC11
	1st	10th	1st	10th	1st	10th	1st	10th				
NS-SeC												
Hi managerial	3	21	3	21	5	17	5	18	0.69	0.67	0.62	0.61
Lo managerial	6	13	6	13	7	12	6	12	0.64	0.61	0.59	0.57
Intermediate	8	10	8	10	11	8	10	8	0.61	0.58	0.56	0.55
Small empl.	13	3	13	3	13	5	12	5	0.53	0.50	0.54	0.53
Lo supervisory	11	7	11	7	13	5	15	4	0.56	0.53	0.53	0.51
Semi routine	15	4	16	4	16	4	17	3	0.52	0.49	0.52	0.49
Routine	16	5	16	5	18	3	18	2	0.51	0.49	0.51	0.49
Education												
7. Both parents have degrees	2	38	1	38	2	28	2	29	0.77	0.75	0.67	0.66
6.	3	18	3	18	5	15	4	16	0.69	0.67	0.61	0.60
5.	3	16	3	16	5	13	5	13	0.68	0.65	0.60	0.58
4.	8	9	7	9	9	6	9	5	0.61	0.58	0.56	0.54
3.	12	5	13	5	15	4	15	4	0.55	0.52	0.53	0.51
2.	17	4	18	4	21	1	23	1	0.49	0.47	0.49	0.47
1. Neither has qualifications	30	1	27	1	37	1	38	2	0.41	0.40	0.42	0.39

[10] Note that a complete case analysis has not been done in this section; cases with valid information on the two relevant variables included in each bivariate relationship described are used. The initial (full) sample size in ALSPAC is 15,445.

CG Status (quintiles)												
5. Top	3	20	3	20	5	16	5	17	0.69	0.66	0.62	0.61
4.	5	17	4	17	7	15	6	15	0.67	0.64	0.60	0.59
3.	7	9	7	9	9	7	10	6	0.61	0.58	0.56	0.54
2.	12	5	12	5	12	5	14	5	0.56	0.53	0.54	0.52
1. Bottom	17	4	17	4	19	3	19	3	0.50	0.48	0.50	0.48
Income (quintiles)												
5. Top	2	26	2	25	3	20	3	20	0.72	0.70	0.63	0.62
4.	4	18	4	18	6	13	6	13	0.67	0.64	0.60	0.58
3.	5	11	6	11	9	10	8	10	0.64	0.61	0.57	0.56
2.	7	8	8	8	12	6	12	6	0.60	0.57	0.55	0.53
1. Bottom	12	6	11	6	16	6	16	5	0.56	0.53	0.53	0.51
Educational Attainment												
5. 2+A-levels	0	22	1	22	2	16	2	16	0.73	0.70	0.63	0.62
4.	1	7	2	7	6	4	6	3	0.65	0.61	0.56	0.54
3.	10	1	13	1	19	1	20	1	0.49	0.45	0.49	0.46
2.	40	0	39	0	45	0	48	0	0.34	0.32	0.41	0.38
1. No qualifications	54	1	38	1	40	1	43	0	0.28	0.35	0.41	0.39
A-level Transition												
No	17	2	17	3	20	2	21	2	0.49	0.46	0.50	0.47
Yes	1	19	1	19	4	14	3	14	0.71	0.68	0.62	0.60
Key Stage 5 Transition												
No	22	1	21	1	24	1	26	1	0.45	0.43	0.47	0.45
Yes	2	16	3	15	5	12	5	12	0.68	0.65	0.60	0.58
2+ A-level Threshold												
Did not pass	16	3	16	3	18	2	19	2	0.50	0.48	0.50	0.48
Passed threshold	0	22	1	22	2	16	2	16	0.73	0.70	0.63	0.62

Tables 20–23 examine the relationship between social class, having used a fivefold collapse to derive an ordinal measure, and the alternative measures of cognitive ability, given in quintiles.

Table 20. Cross-Tabulation of Social Class and KS2em Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
Higher managerial	8	12	18	26	37	100
	8	11	16	22	32	18
Lower managerial	13	17	20	23	26	100
	18	22	26	29	32	26
Intermediate	21	23	21	20	16	100
	35	37	33	31	24	32
Semi routine	30	24	21	15	10	100
	24	18	16	11	7	15
Routine	30	25	21	14	10	100
	16	12	10	7	5	10
Total	19	20	20	20	21	100
	100	100	100	100	100	100

Table 21. Cross-Tabulation of Social Class and KS2emX2 Quintiles, in ALSPAC (%)

	Quintiles

	1 Bottom	2	3	4	5 Top	Total
Higher managerial	8	13	18	26	37	100
	7	12	16	22	32	18
Lower managerial	14	16	20	23	26	100
	19	21	26	29	32	26
Intermediate	21	23	21	20	16	100
	35	36	33	31	24	32
Semi routine	29	25	21	15	10	100
	23	19	15	11	7	15
Routine	31	25	21	14	10	100
	16	12	10	7	5	10
Total	19	20	20	20	21	100
	100	100	100	100	100	100

Table 22. Cross-Tabulation of Social Class and WISC-2 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
Higher managerial	10	15	20	25	31	100
	13	19	24	31	38	25
Lower managerial	15	19	19	22	24	100
	23	28	28	32	34	29
Intermediate	24	22	21	18	15	100
	32	29	28	24	19	27
Semi routine	31	24	22	14	9	100
	18	14	12	8	5	12
Routine	33	27	17	13	40	100
	14	11	6	5	4	8
Total	20	20	20	20	20	100
	100	100	100	100	100	100

Table 23. Cross-Tabulation of Social Class and WISC-11 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
Higher managerial	9	15	20	25	31	100
	12	19	25	32	39	25
Lower managerial	16	18	20	22	24	100
	24	26	28	32	34	29
Intermediate	23	23	22	18	14	100
	31	30	28	24	19	26
Semi routine	31	27	21	13	9	100
	19	15	12	7	5	12
Routine	37	24	17	13	9	100
	15	10	7	5	3	8
Total	20	20	20	20	20	100
	100	100	100	100	100	100

For each of the Tables 20–23 above, global log odds ratios were calculated, using the method proposed by Cox and Jackson (2009). Differences between the averages of the centre four global log odds ratios for each pair of Key

Stage 2 and WISC measures were then tested for significance.[11] Similar cross-tabulations were also produced for each cognitive ability measure by parental education[12], status and income, and respondents' overall educational attainment as well as GCSE performance[13] (see Tables A9–A28 in the Appendix); differences between the averages of the centre four global log odds ratios were tested in the same way. The results of each test are given in Table 24.

Whether social origin is measured via parental class, education, status or income, and regardless of which pair of Key Stage–WISC measures is observed, there are no significant differences between the average global log odds ratios. However, differences between Key Stage measures and WISC measures in their association with educational attainment are statistically significant, and this is found to be so regardless of which pair of measures is assessed.

Table 24. Average Centre Four Global Log Odds Ratios and a Test of Significance in the Differences

	Average Centre Four		Difference	SE Difference	Lower CI	Upper CI
	KS2	WISC				
NS-SeC						
KS2em–WISC-2	0.94	0.91	0.03	0.06	-0.14	0.09
KS2em–WISC-11	0.94	0.99	0.05	0.06	-0.07	0.18
KS2emX2–WISC-2	0.94	0.91	0.03	0.06	-0.15	0.09
KS2emX2–WISC-11	0.94	0.99	0.05	0.06	-0.07	0.17
Education						
KS2em–WISC-2	1.22	1.11	0.12	0.06	-0.23	0.00
KS2em–WISC-11	1.22	1.20	0.02	0.06	-0.14	0.10
KS2emX2–WISC-2	1.23	1.11	0.13	0.06	-0.24	-0.01
KS2emX2–WISC-11	1.23	1.20	0.03	0.06	-0.15	0.09
Status						
KS2em–WISC-2	1.07	0.95	0.12	0.06	-0.23	0.00
KS2em–WISC-11	1.07	1.06	0.01	0.06	-0.12	0.12
KS2emX2–WISC-2	1.06	0.95	0.11	0.06	-0.22	0.00
KS2emX2–WISC-11	1.06	1.06	0.00	0.06	-0.11	0.12

Table 24 Continued. Average Centre Four Global Log Odds Ratios and a Test of Significance in the Differences

	Average Centre Four		Difference	SE Difference	Lower CI	Upper CI
	KS2	WISC				
Income						
KS2em–WISC-2	0.82	0.75	0.07	0.06	-0.20	0.05
KS2em–WISC-11	0.82	0.78	0.04	0.07	-0.17	0.09
KS2emX2–WISC-2	0.81	0.75	0.06	0.06	-0.18	0.06
KS2emX2–WISC-11	0.81	0.78	0.03	0.07	-0.15	0.10
Attainment						
KS2em–WISC-2	2.96	2.39	0.57**	0.12	-0.80	-0.35
KS2em–WISC-11	2.96	2.61	0.35**	0.13	-0.60	-0.09
KS2emX2–WISC-2	2.89	2.39	0.50**	0.12	-0.73	-0.27
KS2emX2–WISC-11	2.89	2.61	0.27**	0.13	-0.53	-0.02
GCSE Performance						
KS2em–WISC-2	2.76	1.93	0.83**	0.07	-0.97	-0.69
KS2em–WISC-11	2.76	2.11	0.65**	0.08	-0.80	-0.50
KS2emX2–WISC-2	2.72	1.93	0.79**	0.07	-0.93	-0.65

[11] From the global log odds ratios, covariances are calculated to determine the standard errors of the average. The significance tests take into account the dependence that is introduced by measuring the same individuals (Cox and Jackson 2009:484).
[12] The parental education variable was collapsed into a five-category measure in order to carry out the same exercise. The new variable was recoded so that 1=1, 2 & 3=2, 4=3, 5=4, 6 & 7=5.
[13] The number of A*–C GCSE grades variable was split into quintiles before running the cross-tabulation.

KS2emX2–WISC-11	2.72	2.11	0.61**	0.08	-0.76	-0.46

Notes:
** p<0.01

Correlations between the number of GCSEs attained and each cognitive ability measure are given below.
Number of GCSEs – KS2em: 0.72**
Number of GCSEs – KS2emX2: 0.72**
Number of GCSEs – WISC2: 0.57**
Number of GCSEs – WISC11: 0.60**

4.1 Multivariate Analyses

This section advances upon the examination of bivariate relationships presented above, by now considering differences between Key Stage and WISC measures in the context of multivariate analyses. A series of binary logistic regression models were run which altered the independent variable of cognitive ability, but kept the rest of the model specification otherwise unchanged. The dependent variable considered measures whether or not respondents attained the 2+ A-level threshold. See Table 25, in which cognitive ability is variously represented by the alternative measures KS2emX2, WISC-2 and WISC-11. The baseline models, M0, include only social origin variables, models M1 introduce cognitive ability z-scores and models M2 replace this with cognitive ability quintiles.

For the models presented in Table 25, social origin measures have been coded in the same way as presented in Table 3 of Bukodi et al (2014:300), with one exception: the parental class variable has been collapsed into a five-category ordinal measure due to problems associated with controlling for parents who are self-employed (namely, for 'small employers and own account workers' all cases are self-employed). Classes 3–5 have therefore been combined. Respondents' gender and parents' employment status (employer or self-employed vs employed) are included as controls. The same sample is employed for each model (i.e. those with complete information on all variables, including each cognitive ability measure).

Table 25. Binary Logistic Regression of Attaining the 2+ A-levels Educational Threshold on Parental Class, Status and Education, and [KS2 and WISC] Cognitive Ability (Average Marginal Effects) – ALSPAC Only

				KS2emX2						WISC-2						WISC-11					
	M0			M1			M2			M1			M2			M1			M2		
	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI
Parental class (5)																					
4. Semi-routine	[-.06]	-.00	[.06]	[-.05]	.01	[.07]	[-.05]	.01	[.06]	[-.05]	.01	[.06]	[-.05]	.01	[.06]	[-.05]	.01	[.06]	[-.05]	.01	[.07]
3. 3+4+5†	[.01]	.06*	[.12]	[-.02]	.03	[.08]	[-.02]	.03	[.08]	[-.01]	.04	[.09]	[-.01]	.04	[.09]	[-.01]	.04	[.09]	[-.01]	.04	[.09]
2. Lower managerial	[.02]	.08*	[.14]	[-.01]	.05	[.10]	[-.01]	.05	[.10]	[-.00]	.05	[.11]	[-.00]	.06	[.11]	[-.00]	.05	[.11]	[.00]	.06*	[.11]
1. Higher managerial	[.05]	.11*	[.18]	[.00]	.06*	[.12]	[.01]	.06*	[.12]	[.01]	.07*	[.14]	[.02]	.08*	[.14]	[.01]	.07*	[.13]	[.02]	.08*	[.14]
Parental status																					
0–1	[.17]	.24*	[.31]	[.08]	.14*	[.20]	[.09]	.15*	[.21]	[.10]	.17*	[.23]	[.11]	.18*	[.24]	[.09]	.16*	[.22]	[.09]	.16*	[.22]
Parental education																					
0–1	[.35]	.39*	[.42]	[.19]	.23*	[.27]	[.20]	.24*	[.28]	[.23]	.27*	[.31]	[.24]	.28*	[.32]	[.21]	.25*	[.29]	[.23]	.27*	[.30]
Self employed																					
0–1	[-.11]	-.04	[.04]	[-.08]	-.01	[.05]	[-.08]	-.02	[.05]	[-.11]	-.05	[.02]	[-.11]	-.04	[.03]	[-.11]	-.05	[.02]	[-.12]	-.05	[.02]
Gender (male)																					
Female	[.06]	.08*	[.11]	[.03]	.06*	[.08]	[.04]	.06*	[.08]	[.06]	.09*	[.11]	[.06]	.09*	[.11]	[.06]	.09*	[.11]	[.06]	.09*	[.11]
Cognitive ability																					
z-scores				[.22]	.23*	[.24]				[.06]	.17*	[.19]				[.18]	.19*	[.20]			
Cognitive ability (3rd)																					
Bottom							[-.39]	-.34*	[-.30]				[-.28]	-.23*	[-.19]				[-.33]	-.29*	[-.25]
2nd							[-.26]	-.22*	[-.18]				[-.11]	-.07*	[-.02]				[-.16]	-.12*	[-.08]
4th							[.11]	.15*	[.19]				[.07]	.12*	[.16]				[.06]	.10*	[.14]
Top							[.25]	.29*	[.33]				[.22]	.27*	[.31]				[.21]	.25*	[.29]
N	4,644			4,644			4,644			4,644			4,644			4,644			4,644		

Notes:

† 3+4+5 = Intermediate, small employers and own account workers, and lower supervisory and technical.

* $p<0.05$

For all of the models shown, each of the three components of social origin has significant effects, even after controlling for cognitive ability, on whether or not respondents reach the 2+ A-level threshold. This is shown to be the case regardless of whether Key Stage 2 or WISC scores are used to represent cognitive ability (though it is notable that the effects of social origin are more greatly reduced with the inclusion of the former [by ~41–45%] than they are with the latter [by ~33–36%]). As regards cognitive ability, Key Stage measures have a larger negative effect for those in lower-scoring quintiles, coupled with a slightly larger positive effect for those in higher-scoring quintiles, relative to WISC. This is largely parallel to what is shown in the descriptive statistics of Table 19. Similarly, using z-score measures, the Key Stage proxy is shown to have a more substantial influence on attainment.

Appendix C presents the results of a set of sensitivity analyses. In Table C1, the reference group chosen for the cognitive ability quintiles variable is changed; this serves only to reinforce the findings in Table 25. Tables C3–C4 use alternative coding approaches for social origin variables; these variations have little influence over the substantive findings of Table 25, though there are some differences between Key Stage and WISC models in the significance of estimates for the salariat classes (shown in Table C2 but not in Table C3) and the net effect of parental education is slightly larger in the WISC models. Cognitive ability estimates are unchanged and thus in sum, discrepancies of the kind described above are shown to be largely robust.

Table 26 replicates the models presented in Table 25, but with the inclusion of parental income as an additional component of social origins. Model M3 is equivalent to model M0+parental income. Models M4 and M5 introduce cognitive ability, as in Table 25. The indicator for parental income is statistically significant and the size of the effect is relatively substantial across models. Comparing model M0 in Table 25 to model M3 in Table 26, the inclusion of income does little to affect the size or significance of the other social origin variables. Aside from the (in)significance of the social class parameters once cognitive ability is controlled, patterns of association in Table 26 are, on the whole, not dissimilar to those presented in Table 25; notably, there is almost no change in the average marginal effects for each cognitive ability quintile. Appendix C, Tables C4 and C5 repeat the analyses, using parental income first in linear form and then in quintiles. These changes make no difference to the substantive conclusions drawn from Table 26.

The LSYPE dataset was then used to carry out the same exercise, generating a measure for cognitive ability constructed using an approach identical to that for KS2emX2[14] (i.e. a modified version of the variable KS2em. See Appendix D for the results of the PCA).[15] Table 27 presents the estimates from these models, with those from the ALSPAC data replicated again in the same table for ease of comparison. The same estimates for LSYPE models with confidence intervals are given in Table C6, Appendix C. Models M0–M5 correspond to those in Tables 25 and 26; i.e.:

Model M0: Parental class + Parental status + Parental Education (+ self-employment and gender controls)
Model M1: Model M0 + Cognitive ability (z-scores)
Model M2: Model M0 + Cognitive ability (quintiles)
Model M3: Model M0 + Parental income
Model M4: Model M3 + Cognitive ability (z-scores)
Model M5: Model M3 + Cognitive ability (quintiles)

Table 27 highlights some initial differences in both social origin and Key Stage measures in predicting the likelihood of exceeding the 2+ A-level threshold between the LSYPE and ALSPAC samples. The size and significance of estimates for parental class and status are similar, though those for parental education are larger using ALSPAC data. Conversely, the estimate for parental income in LSYPE is twice the size of that in ALSPAC (until cognitive ability

[14] The KS2emX1 variable was also constructed using LSYPE data but it is not used in the analyses which follow.
[15] Wave 7 longitudinal weights are applied and the survey design is accounted for using Stata's svyset command.

Table 26. Binary Logistic Regression of Attaining the 2+ A-levels Educational Threshold on Parental Class, Status, Education and Income, and [KS2 and WISC] Cognitive Ability (Average Marginal Effects) – ALSPAC Only

				KS2emX2						WISC-2						WISC-11					
	M3			M4			M5			M4			M5			M4			M5		
	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI
Parental class (5)																					
4. Semi-routine	[-.06]	.00	[.06]	[-.04]	.01	[.07]	[-.05]	.01	[.06]	[-.05]	.01	[.06]	[-.05]	.01	[.07]	[-.05]	.01	[.07]	[-.05]	.01	[.07]
3. 3+4+5†	[-.00]	.05	[.11]	[-.03]	.02	[.07]	[-.02]	.03	[.08]	[-.02]	.03	[.08]	[-.02]	.03	[.09]	[-.02]	.03	[.08]	[-.02]	.04	[.09]
2. Lower managerial	[.01]	.07*	[.13]	[-.01]	.04	[.09]	[-.01]	.04	[.09]	[-.01]	.05	[.10]	[-.01]	.05	[.10]	[-.01]	.04	[.10]	[-.00]	.05	[.11]
1. Higher managerial	[.02]	.09*	[.15]	[-.01]	.05	[.10]	[-.01]	.05	[.11]	[-.00]	.06	[.12]	[-.00]	.06	[.12]	[-.00]	.06	[.11]	[.00]	.06	[.12]
Parental status																					
0–1	[.14]	.21*	[.27]	[.06]	.12*	[.18]	[.06]	.13*	[.19]	[.08]	.14*	[.21]	[.09]	.15*	[.22]	[.07]	.13*	[.20]	[.07]	.13*	[.20]
Parental education																					
0–1	[.31]	.35*	[.39]	[.17]	.21*	[.25]	[.18]	.22*	[.26]	[.20]	.24*	[.28]	[.21]	.25*	[.29]	[.19]	.22*	[.26]	[.20]	.24*	[.28]
Parental income																					
0–1	[.16]	.21*	[.26]	[.08]	.13*	[.18]	[.09]	.14*	[.19]	[.12]	.17*	[.22]	[.12]	.17*	[.22]	[.11]	.16*	[.21]	[.11]	.16*	[.21]
Self employed																					
0–1	[-.10]	-.02	[.05]	[-.07]	-.00	[.06]	[-.07]	-.01	[.06]	[-.10]	-.03	[.03]	[-.09]	-.02	[.04]	[-.10]	-.04	[.03]	[-.10]	-.04	[.03]
Gender (male)																					
Female	[.05]	.08*	[.11]	[.03]	.06*	[.08]	[.04]	.06*	[.08]	[.06]	.09*	[.11]	[.06]	.09*	[.11]	[.06]	.09*	[.11]	[.06]	.08*	[.11]
Cognitive ability																					
z-scores				[.22]	.23*	[.24]				[.16]	.17*	[.19]				[.17]	.19*	[.20]			
Cognitive ability (3rd)																					
Bottom							[-.39]	-.34*	[-.30]				[-.27]	-.23*	[-.19]				[-.33]	-.29*	[-.25]
2nd							[-.26]	-.22*	[-.18]				[-.11]	-.07*	[-.03]				[-.16]	-.12*	[-.08]
4th							[.10]	.15*	[.19]				[.07]	.11*	[.15]				[.05]	.09*	[.13]
Top							[.25]	.29*	[.33]				[.22]	.26*	[.30]				[.20]	.24*	[.29]
N	4,644			4,644			4,644			4,644			4,644			4,644			4,644		

Notes:

†3+4+5 = Intermediate, small employers and own account workers, and lower supervisory and technical.

* p<0.05

Table 27. Binary Logistic Regression of Attaining the 2+ A-levels Educational Threshold on Parental Class, Status, Education and Income, and [KS2] Cognitive Ability (Average Marginal Effects) – LSYPE and ALSPAC

	KS2emX2_LSYPE						KS2emX2_ALSPAC					
	M0	**M1**	**M2**	**M3**	**M4**	**M5**	**M0**	**M1**	**M2**	**M3**	**M4**	**M5**
Parental class (5)												
4. Semi-routine	0.02	0.02	0.01	0.02	0.02	0.01	-0.00	0.01	0.01	0.00	0.01	0.01
3. 3+4+5†	0.04	0.00	0.01	0.03	0.00	0.00	0.06*	0.03	0.03	0.05	0.02	0.03
2. Lower managerial	0.06*	0.03	0.03	0.05	0.02	0.03	0.08*	0.05	0.05	0.07*	0.04	0.04
1. Higher managerial	0.12*	0.06*	0.06*	0.09*	0.05	0.05	0.11*	0.06*	0.06*	0.09*	0.05	0.05
Parental status												
0–1	0.27*	0.13*	0.14*	0.25*	0.13*	0.13*	0.24*	0.14*	0.15*	0.21*	0.12*	0.13*
Parental education												
0–1	0.33*	0.16*	0.16*	0.32*	0.15*	0.16*	0.39*	0.23*	0.24*	0.35*	0.21*	0.22*
Parental income												
0–1				0.45*	0.19*	0.20*				0.21*	0.13*	0.14*
Self employed												
0–1	0.06*	0.06*	0.05*	0.06*	0.05*	0.05*	-0.04	-0.01	-0.02	-0.02	-0.00	-0.01
Gender (male)												
Female	0.08*	0.07*	0.07*	0.09*	0.07*	0.07*	0.08*	0.06*	0.06*	0.08*	0.06*	0.06*
Cognitive ability												
z-scores		0.23*			0.23*			0.23*			0.23*	
Cognitive ability (3rd)												
Bottom			-0.27*			-0.27*			-0.34*			-.34*
2nd			-0.13*			-0.13*			-0.22*			-.22*
4th			0.20*			0.19*			0.15*			.15*
Top			0.44*			0.43*			0.29*			.29*
N	5,868						4,644					

Notes:
† 3+4+5 = Intermediate, small employers and own account workers, and lower supervisory and technical.
LSYPE data are weighted and clustering has been accounted for using the svyset command

is introduced). It should be noted that the measure of parental income in LSYPE is of far better quality (see Appendix B), and a direct comparison between them is problematic. Estimates of cognitive ability, measured via z-scores, are identical in LSYPE and ALSPAC models, but notable differences arise in the quintiles measure: estimates for those in the higher quintiles are larger in LSYPE, and for those in the lower quintiles they are smaller (implying a further divergence from scores determined via WISC). Overall, Key Stage 2 is shown to be an *even more powerful* predictor among the LSYPE sample than the ALSPAC sample.

5 The Changing Role of Cognitive Ability over Time

This section will consider the role of cognitive ability over time, both by analysing change between the BCS70 and ALSPAC samples and between the BCS70 and LSYPE samples.

5.1 Differences between Key Stage 2 and WISC in Assessing the Role of Cognitive Ability across Cohorts – Analyses using ALSPAC and BCS70

This section presents a set of preliminary analyses to examine the changing role of cognitive ability over time, using BCS70 and ALSPAC data. The intention is to determine, by alternating between the use of Key Stage 2 and WISC in otherwise-identical model specifications, whether we detect changes in cognitive ability effects of similar or different kinds. Table 28 (excluding parental income) and Table 29 (including parental income) present the results of a series of logistic regression models predicting whether or not individuals passed the 2+ A-level threshold. Models M1 include social origin variables, cognitive ability (z-scores), cohort and a cognitive ability-by-cohort interaction. Models M2 replace the z-scores measure with cognitive ability quintiles.[16]

[16] Coefficient values are presented instead of AMEs. The value of the interaction term cannot change independently of the value of component terms so a separate marginal effect for the interaction cannot be estimated (see Stata margins manual).

Table 28. Binary Logistic Regression of Attaining the 2+ A-levels Educational Threshold on Cohort, Parental Class, Status and Education, [KS2 and WISC] Cognitive Ability, and Cognitive Ability-by-Cohort – ALSPAC and BCS70

	KS2emX2						WISC-2						WISC-11					
	M1			M2			M1			M2			M1			M2		
	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI
Cohort (BCS70)																		
ALSPAC	[0.95]	1.08*	[1.22]	[1.10]	1.35*	[1.59]	[1.42]	1.55*	[1.67]	[1.24]	1.48*	[1.72]	[1.43]	1.56*	[1.69]	[1.38]	1.62*	[1.86]
Parental class (5)																		
4. Semi-routine	[-0.31]	-0.05	[0.21]	[-0.32]	-0.06	[0.20]	[-0.33]	-0.08	[0.17]	[-0.32]	-0.07	[0.18]	[-0.33]	-0.07	[0.19]	[-0.32]	-0.06	[0.19]
3. 3+4+5†	[-0.07]	0.15	[0.38]	[-0.05]	0.17	[0.40]	[-0.04]	0.19	[0.41]	[-0.02]	0.20	[0.42]	[-0.04]	0.18	[0.40]	[-0.02]	0.20	[0.42]
2. Lower managerial	[0.01]	0.26*	[0.51]	[0.01]	0.26*	[0.51]	[0.02]	0.27*	[0.51]	[0.03]	0.27*	[0.51]	[0.02]	0.26*	[0.50]	[0.04]	0.28*	[0.53]
1. Higher managerial	[0.13]	0.40*	[0.67]	[0.15]	0.42*	[0.69]	[0.16]	0.43*	[0.69]	[0.17]	0.43*	[0.69]	[0.16]	0.42*	[0.69]	[0.18]	0.45*	[0.71]
Parental status																		
0–1	[0.30]	0.57*	[0.85]	[0.33]	0.61*	[0.88]	[0.35]	0.62*	[0.89]	[0.38]	0.65*	[0.92]	[0.32]	0.60*	[0.87]	[0.34]	0.61*	[0.88]
Parental education																		
0–1	[1.07]	1.27*	[1.46]	[1.14]	1.33*	[1.53]	[1.14]	1.33*	[1.52]	[1.20]	1.39*	[1.58]	[1.10]	1.29*	[1.48]	[1.16]	1.35*	[1.54]
Self employed																		
0–1	[-0.23]	-0.01	[0.22]	[-0.25]	-0.03	[0.19]	[-0.29]	-0.07	[0.14]	[-0.29]	-0.07	[0.14]	[-0.29]	-0.07	[0.14]	[-0.30]	-0.09	[0.13]
Gender (male)																		
Female	[0.14]	0.25*	[0.35]	[0.14]	0.25*	[0.35]	[0.23]	0.34*	[0.44]	[0.22]	0.32*	[0.43]	[0.23]	0.34*	[0.44]	[0.22]	0.32*	[0.43]
Cognitive ability																		
z-scores	[0.72]	0.82*	[0.92]				[0.71]	0.82*	[0.92]				[0.72]	0.82*	[0.92]			
Cognitive ability*Cohort																		
z-score*ALSPAC	[0.46]	0.61*	[0.75]				[0.03]	0.16*	[0.30]				[0.12]	0.25*	[0.39]			
Cognitive ability (3rd)																		
Bottom				[-1.60]	-1.15*	[-0.71]				[-1.59]	-1.15*	[-0.70]				[-1.60]	-1.15*	[-0.71]
2nd				[-0.65]	-0.34*	[-0.02]				[-0.65]	-0.33*	[-0.02]				[-0.65]	-0.34*	[-0.02]
4th				[0.20]	0.45*	[0.70]				[0.19]	0.44*	[0.69]				[0.20]	0.45*	[0.70]
Top				[0.92]	1.16*	[1.39]				[0.91]	1.15*	[1.39]				[0.92]	1.16*	[1.40]
Cognitive ability*Cohort																		
Bottom*ALSPAC				[-1.45]	-0.89*	[-0.33]				[-0.53]	-0.04	[0.46]				[-0.81]	-0.31	[0.19]
2nd*ALSPAC				[-1.15]	-0.76*	[-0.38]				[-0.35]	0.02	[0.39]				[-0.57]	-0.21	[0.16]
4th*ALSPAC				[-0.07]	0.24	[0.56]				[-0.22]	0.09	[0.41]				[-0.31]	0.01	[0.32]
Top*ALSPAC				[-0.02]	0.29	[0.61]				[-0.15]	0.18	[0.50]				[-0.22]	0.11	[0.44]
Combined sample N	8,608			8,608			8,608			8,608			8,608			8,608		

Notes:

† 3+4+5 = Intermediate, small employers and own account workers, and lower supervisory and technical.

* $p<0.05$

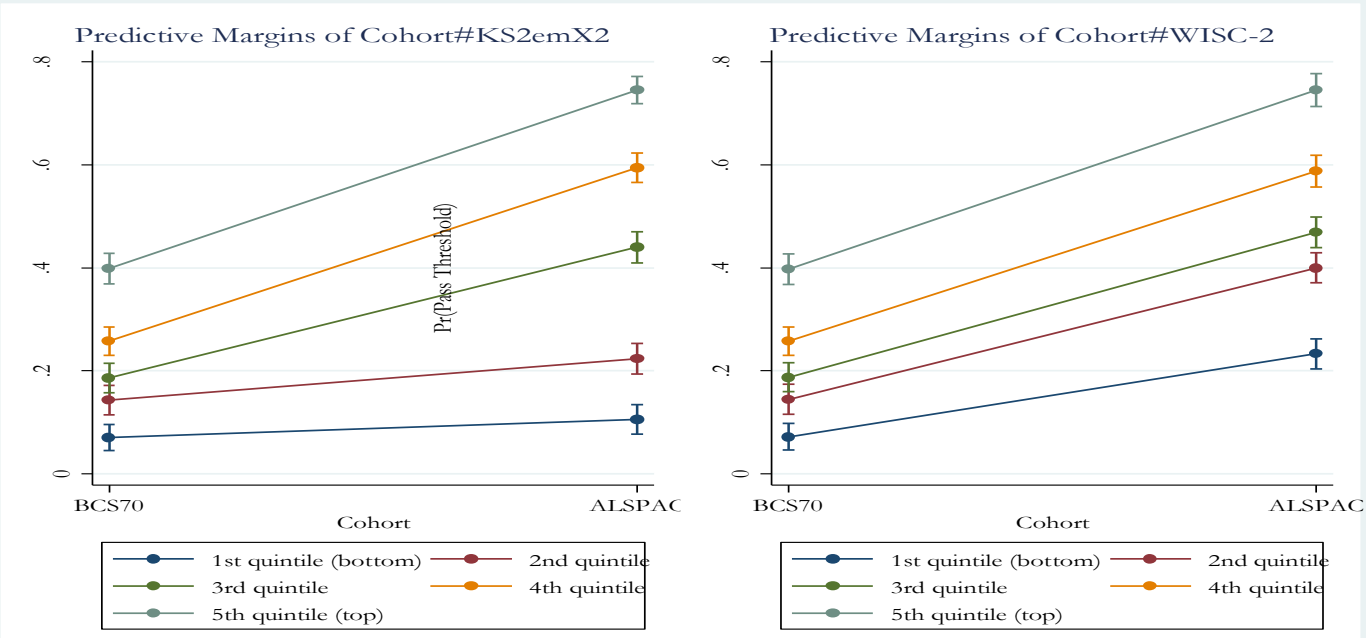
Table 29. Binary Logistic Regression of Attaining the 2+ A-levels Educational Threshold on Cohort, Parental Class, Status, Education and Income, [KS2 and WISC] Cognitive Ability, and Cognitive Ability-by-Cohort – ALSPAC and BCS70

	KS2emX2						WISC-2						WISC-11					
	M3			M4			M3			M4			M3			M4		
	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI	Lower CI	Est	Upper CI
Cohort (BCS70)																		
ALSPAC	[0.86]	0.99*	[1.13]	[1.01]	1.26*	[1.50]	[1.31]	1.44*	[1.58]	[1.14]	1.38*	[1.63]	[1.33]	1.46*	[1.59]	[1.28]	1.52*	[1.77]
Parental class (5)																		
4. Semi-routine	[-0.32]	-0.06	[0.20]	[-0.32]	-0.06	[0.20]	[-0.34]	-0.08	[0.17]	[-0.33]	-0.07	[0.18]	[-0.33]	-0.07	[0.18]	[-0.32]	-0.07	[0.19]
3. 3+4+5†	[-0.10]	0.13	[0.35]	[-0.08]	0.15	[0.37]	[-0.07]	0.15	[0.38]	[-0.06]	0.17	[0.39]	[-0.07]	0.15	[0.37]	[-0.06]	0.17	[0.39]
2. Lower managerial	[-0.05]	0.20	[0.45]	[-0.04]	0.21	[0.46]	[-0.03]	0.21	[0.45]	[-0.03]	0.21	[0.46]	[-0.04]	0.21	[0.45]	[-0.02]	0.23	[0.47]
1. Higher managerial	[0.03]	0.30*	[0.58]	[0.05]	0.32*	[0.59]	[0.05]	0.32*	[0.58]	[0.06]	0.33*	[0.59]	[0.05]	0.31*	[0.58]	[0.07]	0.34*	[0.60]
Parental status																		
0–1	[0.18]	0.46*	[0.74]	[0.20]	0.48*	[0.77]	[0.22]	0.49*	[0.77]	[0.25]	0.53*	[0.80]	[0.20]	0.48*	[0.75]	[0.21]	0.49*	[0.76]
Parental education																		
0–1	[0.94]	1.14*	[1.34]	[1.00]	1.20*	[1.40]	[0.99]	1.19*	[1.38]	[1.05]	1.25*	[1.44]	[0.95]	1.15*	[1.34]	[1.01]	1.21*	[1.40]
Parental income																		
0–1	[0.53]	0.77*	[1.02]	[0.57]	0.82*	[1.06]	[0.63]	0.87*	[1.11]	[0.64]	0.88*	[1.11]	[0.62]	0.86*	[1.10]	[0.63]	0.87*	[1.11]
Self employed																		
0–1	[-0.22]	-0.00	[0.22]	[-0.25]	-0.03	[0.19]	[-0.28]	-0.07	[0.15]	[-0.28]	-0.06	[0.15]	[-0.28]	-0.07	[0.15]	[-0.30]	-0.08	[0.14]
Gender (male)																		
Female	[0.13]	0.24*	[0.35]	[0.13]	0.24*	[0.35]	[0.23]	0.34*	[0.44]	[0.22]	0.32*	[0.43]	[0.23]	0.33*	[0.44]	[0.21]	0.32*	[0.42]
Cognitive ability																		
z-scores	[0.70]	0.80*	[0.91]				[0.70]	0.80*	[0.90]				[0.70]	0.81*	[0.91]			
Cognitive ability*Cohort																		
z-score*ALSPAC	[0.47]	0.61*	[0.76]				[0.04]	0.18*	[0.31]				[0.13]	0.26*	[0.40]			
Cognitive ability (3rd)																		
Bottom				[-1.58]	-1.13*	[-0.69]				[-1.57]	-1.12*	[-0.68]				[-1.58]	-1.13*	[-0.69]
2nd				[-0.64]	-0.32*	[-0.01]				[-0.63]	-0.32*	[-0.01]				[-0.64]	-0.33*	[-0.01]
4th				[0.18]	0.43*	[0.69]				[0.18]	0.43*	[0.68]				[0.18]	0.43*	[0.69]
Top				[0.90]	1.13*	[1.38]				[0.89]	1.13*	[1.38]				[0.90]	1.14*	[1.38]
Cognitive ability*Cohort																		
Bottom*ALSPAC				[-1.46]	-0.90*	[-0.34]				[-0.56]	-0.06	[0.43]				[-0.83]	-0.33	[0.17]
2nd*ALSPAC				[-1.17]	-0.78*	[-0.39]				[-0.37]	-0.00	[0.37]				[-0.60]	-0.23	[0.13]
4th*ALSPAC				[-0.07]	0.25	[0.56]				[-0.22]	0.10	[0.42]				[-0.31]	0.01	[0.32]
Top*ALSPAC				[-0.02]	0.29	[0.60]				[-0.15]	0.18	[0.51]				[-0.22]	0.11	[0.44]
Combined sample N	8,608			8,608			8,608			8,608			8,608			8,608		

The findings in Tables 28 and 29 suggest that inferences regarding the changing role of cognitive ability over time are sensitive to choice of proxy. Key Stage 2 measures are found to overstate both the negative influence of being in the lowest ability quintile as well as the positive influence of being in the highest ability quintile (though less so), relative to WISC. Differences in the magnitude of estimates for cognitive ability measured via z-scores serves to further highlight this discrepancy; put differently, Key Stage 2 has more predictive power. Coefficients for the interaction between cognitive ability and cohort for those with the lowest scores are significant in the Key Stage models: being in lower quintiles relative to the middle quintile is *more damaging* for those in the ALSPAC cohort than it is for those in the BCS70 cohort. This goes contrary to the pattern of a general decline in the importance of cognitive ability in predicting educational attainment shown by recent studies that have analysed the British birth cohorts (e.g. Bukodi et al 2014; Richards et al 2009; Galindo-Rueda and Vignoles 2005). This is not, however, shown to be true using WISC as a proxy, and the addition of income to the models in Table 29 does not alter either of these conclusions.

Interactions between cognitive ability, measured via z-scores, and cohort are significant across all models and suggest a general increase in its influence. Consistent across the Key Stage and WISC models, there is however no evidence to suggest that demonstrating a *high degree* of intellectual capacity (relative to the mid-quintile group) in early life is more beneficial for younger generations than it was for those born in the 1970s. In sum, WISC models using quintiles suggest there has been no over-time change in the influence of early-life cognitive ability while Key Stage models suggest that a significant trend can be identified, and it is one in which the role of cognitive ability is more influential for younger generations but only if their intellectual capabilities are low. Figure 4 plots the interaction effect (using quintile measures – models M4) using KS2emX2 and WISC-11 to illustrate this finding.

Figure 4. Cohort-by-Cognitive Ability Interaction Effects – BCS70 and ALSPAC



5.2 Assessing the Role of Cognitive Ability across Cohorts – Analyses using LSYPE and BCS70

In this section, LSYPE and BCS70 data are used to examine the changing role of cognitive ability over time, using only the measure for Key Stage 2. Table 30 presents the results of a series of logistic regression models using these data. The model specifications for M1–M4 are identical to those presented in Tables 28 and 29 above. Estimates from the models using ALSPAC and BCS70 data are replicated again in the same table for ease of comparison. The same estimates for LSYPE models with confidence intervals are given in Table C8, Appendix C.

Table 30. Binary Logistic Regression of Attaining the 2+ A-levels Educational Threshold on Cohort, Parental Class, Status Education and Income, [KS2] Cognitive Ability, and Cognitive Ability-by-Cohort – LSYPE and BCS70 vs. ALSPAC and BCS70

	LSYPE and BCS70				ALSPAC and BCS70			
	M1	**M2**	**M3**	**M4**	**M1**	**M2**	**M3**	**M4**
Cohort (BCS70)								
LSYPE/ALSPAC	0.99*	1.00*	1.22*	1.23*	1.08*	1.35*	0.99*	1.26*
Parental class (5)								
4. Semi-routine	-0.00	-0.01	-0.00	-0.01	-0.05	-0.06	-0.06	-0.06
3. 3+4+5†	0.08	0.09	0.07	0.08	0.15	0.17	0.13	0.15
2. Lower managerial	0.21	0.23	0.17	0.20	0.26*	0.26*	0.20	0.21
1. Higher managerial	0.41*	0.44*	0.35*	0.38*	0.40*	0.42*	0.30*	0.32*
Parental status								
0–1	0.64*	0.67*	0.59*	0.62*	0.57*	0.61*	0.46*	0.48*
Parental education								
0–1	1.05*	1.10*	1.00*	1.04*	1.27*	1.33*	1.14*	1.20*
Parental income								
0–1			0.66*	0.68*			0.77*	0.82*
Self employed								
0–1	0.21*	0.18*	0.20*	0.17*	-0.01	-0.03	-0.00	-0.03
Gender (male)								
Female	0.32*	0.32*	0.32*	0.32*	0.25*	0.25*	0.24*	0.24*
Cognitive ability								
z-scores	0.84*		0.82*		0.82*		0.80*	
Cognitive ability*Cohort								
z-score*LSYPE/ALSPAC	0.69*		0.71*		0.61*		0.61*	
Cognitive ability (3rd)								
Bottom		-1.17*		-1.14*		-1.15*		-1.13*
2nd		-0.35*		-0.33*		-0.34*		-0.32*
4th		0.47*		0.45*		0.45*		0.43*
Top		1.18*		1.15*		1.16*		1.13*
Cognitive ability*Cohort								
Bottom*LSYPE/ALSPAC		-0.65*		-0.68*		-0.89*		-0.90*
2nd*LSYPE/ALSPAC		-0.34		-0.36		-0.76*		-0.78*
4th*LSYPE/ALSPAC		0.41*		0.44*		0.24		0.25
Top*LSYPE/ALSPAC		0.92*		0.95*		0.29		0.29
Combined sample N	9,832				8,608			

Notes:

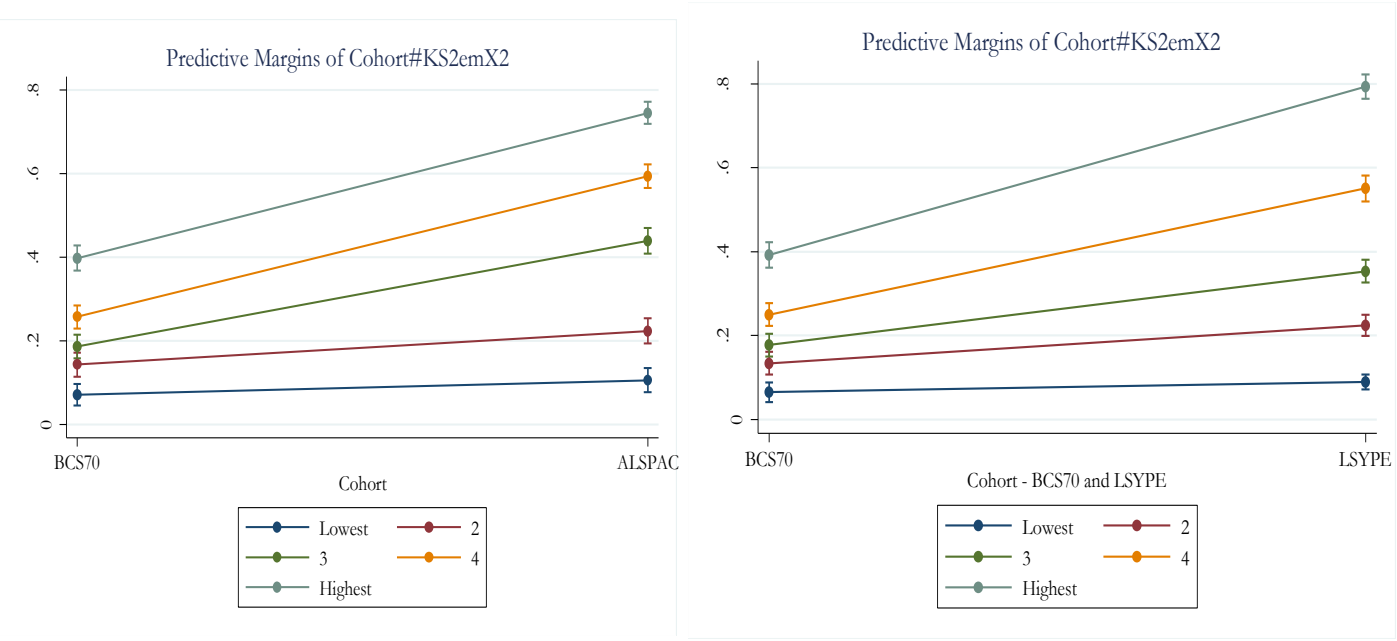
The longitudinal wave 7 weight provided in the LSYPE dataset has been applied for these models (while assigning all BCS70 cohort members a value equal to 1). The clustering variables provided (PSUs and Stratum) *have not* been applied (i.e. the svyset command was not used) because this would involve assigning an arbitrary value to BCS70 cohort members.

Table 30 highlights some interesting differences between the LSYPE and ALSPAC samples. The interaction between cohort and cognitive ability, as measured via z-scores, is larger for LSYPE, suggesting Key Stage scores are a stronger predictor. Observing the quintiles-by-cohort interaction, the negative influence of being of low ability is *somewhat less substantial* and the positive influence is *markedly more substantial* for the LSYPE sample than for the ALSPAC sample. Further, LSYPE data suggest that the importance of early-life cognitive ability for later-life educational attainment is statistically significant across the board: it has become more consequential not only for those who demonstrate low ability, but also – and in fact most drastically – for those in the highest scoring quintiles.

Thus, on balance, while differing estimates are drawn regarding whether it is high- or low-ability respondents who are affected most by their early-life capabilities, there is certainly no evidence to suggest that the role of cognitive ability has in any way declined in importance for this younger generation.

Figure 5 plots the interaction effects using both pairs of data.

Figure 5. Cohort-by-Cognitive Ability Interaction Effects – BCS70 and ALSPAC vs. BCS70 and LSYPE



6 Summary

Using ALSPAC data to examine the relationship between scores achieved in national Key Stage 2 assessments and scores achieved on WISC-III tests of ability has shown that these two measures have a strong association. Table 4 shows that, using PCA to derive individuals' 'g' score, each combination of measures is correlated above .70. The strongest associations are shown between WISC-11 (which uses scores from each individual WISC item) and the Key Stage measures (.75 for KS2ems and .74 for KS2em); however, comparing overall distributions by examining the histograms, the variables displaying the largest degree of similarity appear to be WISC-2 and KS2em (see the top left panel of Figure 2).

The main points of departure relate to the 'spike' in the left tail of the distribution of all Key Stage measures, which represent those who failed the tests, as well as that the Key Stage distributions are slightly shifted to the right, indicating that they may be overestimating cognitive ability relative to the WISC measures. This latter point is also apparent by looking at Table 14, such that ~55% of cases (depending on the pairing considered) are in a higher Key Stage than WISC decile and ~44% of cases are in a higher Key Stage than WISC quintile.

In an attempt to correct for this and to bring the distributions closer in alignment, an alternative approach was considered for treating the 2.5% of cases who failed Key Stage English and Maths tests; these were either set to missing (generating variable "KS2emX1") or given a score from an alternative Key Stage test where available (generating variable "KS2emX2"). Neither of these approaches served to improve the strength of association between Key Stage scores and WISC scores, assessed via Pearsons correlations (Table 17), nor to increase the proportions of cases found in the same Key Stage and WISC deciles or quintiles. These new measures did result in slightly fewer cases being found in a higher Key Stage than WISC percentile, but only by a few percentage points at best.

The right hand panel of Table 19, which gives mean scores by each social origin and educational attainment variable, reinforces the finding that Key Stage scores generally overestimate cognitive ability relative to WISC (though this is shown to be less so for the alternative measure that treats those with failed scores). The most notable point that arises from Table 19 is that, while Key Stage 2 tends to *overstate* cognitive ability compared to WISC for those with higher levels of educational attainment (as is so with all other social origin variables), it *understates* cognitive ability for those with lower levels of educational attainment; this is reflected in both the mean normalised scores and the proportions falling into the highest and lowest deciles (see beneath the dashed line, Table 19). Similarly, mean Key

Stage scores are higher than mean WISC scores for those who made the A-level transition (though mean scores for those who did not make the transition are broadly similar), the Key Stage 5 transition, and those that passed the 2+ A-levels threshold.

Assessing differences in associations between other focal variables and pairs of Key Stage and WISC measures (by examining global log odds ratios in square contingency tables; see Table 24) served to further highlight divergences between them in their relationship with educational attainment. No significant differences are apparent between Key Stage 2 and WISC in their associations with social origin variables; however differences are relatively substantial and are statistically significant when considering our dependent variable of educational attainment. Further analyses also showed significant differences between them when considering performance at GCSE.

This finding is not out of keeping with the literature. Strand (2006), for example, assessed differences in the roles of scores in a general Cognitive Abilities Test (CAT) and those in Key Stage 2 on later performance at GCSE, concluding that while both measures were predictive of later educational performance and also highly correlated with each other (~.75), they were 'not measuring the same thing' (2006:221). Nonetheless, and more encouraging for our purposes, other studies have cited the high correlation between Key Stage and WISC measures as alone being enough to claim that their 'scores contain similar information about pupils' cognitive development' (e.g. Crawford et al 2014:845).

Differences between Key Stage 2 and WISC measures in the context of various multivariate regression models predicting the likelihood of passing the 2+ A-level threshold were then examined (see Tables 25 and 26). Notable differences of the kinds found using descriptive statistics were apparent: in sum, Key Stage 2 is more predictive of educational attainment. Various sensitivity analyses showed this finding to be robust. Another important finding is that all of the different components of social origin have independent and significant effects on attainment, even after controlling for cognitive ability (however operationalised), with the exception of social class once parental income had been introduced (Table 26). LSYPE data were then used to run identical models (using only Key Stage measures); this exercise suggested that Key Stage 2 scores were shown to be an *even more powerful* predictor for the LSYPE sample than for the ALSPAC sample.

The final part of the document considered changes in the role of cognitive ability over time, comparing the experiences of this younger generation to those born in the 1970s (BCS70), which flagged up further divergences. Tables 28 and 29, which use ALSPAC data, suggest inferences are sensitive to choice of cognitive ability proxy. Key Stage 2 measures are found to overstate both the negative influence of being in the lowest ability quintile as well as the positive influence of being in the highest ability quintile, relative to WISC. WISC models (using quintile measures) suggest there has been no over-time change in the influence of early-life cognitive ability while Key Stage models suggest that the role of cognitive ability is significantly more influential for younger generations *but only if their scores are low*.

Using LSYPE data, the negative influence of being of low ability is shown to be *somewhat less substantial* and the positive influence is *markedly more substantial* than is the case for the ALSPAC sample. Further, LSYPE data suggest that the importance of early-life cognitive ability is statistically significant across the board: it has become more consequential not only for those who demonstrate low ability, but also – and in fact most drastically – for those in the highest scoring quintiles.

In summary, this document has shown that, while Key Stage 2 and WISC-III scores are highly correlated, there are notable differences, principally arising in their relation to educational attainment. The descriptive statistics presented, along with preliminary multivariate modelling exercises, show Key Stage 2 to be more predictive of later-life attainment. Supplementary analyses comparing ALSPAC and LSYPE data show that, for the latter (and nationally-representative) sample, this is exacerbated. While it is not possible to directly compare Key Stage 2 and WISC scores

for LSYPE respondents, the results imply that using the former as a proxy is likely to lead to an overestimation of the influence of cognitive ability.

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Appendix A: Cross-classifications

Table A1. Cross-Tabulation of KS2emX1 and WISC-2, Presented in Deciles, in ALSPAC (%)

	1	2	3	4	5	6	7	8	9	10 Top	Total
1	47	26	10	7	4	3	2	1	1	0	100
	34	16	6	4	2	2	2	1	1	0	6
2	29	23	17	12	7	5	2	3	1	0	100
	25	17	13	9	5	4	2	3	1	0	8
3	18	21	18	15	12	7	4	4	1	0	100
	16	16	14	11	10	6	3	3	1	0	8
4	10	18	19	16	13	7	7	7	2	1	100
	10	15	16	14	11	6	7	6	2	1	9
5	7	14	14	13	14	15	9	8	5	1	100
	7	14	14	13	14	14	8	8	5	2	10
6	3	8	14	15	14	15	13	7	7	2	100
	4	7	13	15	14	15	13	7	7	2	10
7	2	8	10	11	14	15	13	12	11	5	100
	2	8	11	11	14	16	14	13	12	6	11
8	1	3	8	9	12	14	17	16	12	9	100
	1	3	9	10	13	16	20	20	15	12	12
9	1	2	4	8	8	12	13	17	21	16	100
	1	2	4	9	10	14	16	21	26	22	12
10	0	1	1	4	6	6	12	13	23	35	100
Top	0	1	1	4	7	8	16	18	31	54	13
Total	9	11	11	11	10	11	10	10	9	9	100
	100	100	100	100	100	100	100	100	100	100	100

Table A2. Cross-Tabulation of KS2emX1 and WISC-11, Presented in Deciles, in ALSPAC (%)

	1	2	3	4	5	6	7	8	9	10 Top	Total
1	52	24	11	6	4	2	0	0	0	0	100
	37	14	6	4	2	1	0	0	0	0	6
2	28	30	16	9	8	3	3	2	1	0	100
	24	21	11	6	6	2	2	2	0	0	8
3	18	22	21	14	12	6	5	2	1	0	100
	16	17	16	11	9	4	4	2	1	0	8
4	11	18	21	18	9	9	8	5	1	1	100
	11	16	18	15	8	8	7	4	1	1	9
5	5	15	15	17	13	14	9	8	3	1	100
	6	14	14	16	12	13	9	8	3	1	10
6	3	6	14	16	17	17	13	9	5	1	100
	3	6	14	15	16	17	13	9	6	1	10
7	2	6	10	13	15	14	16	12	9	5	100
	2	6	10	13	15	14	16	13	10	6	11
8	1	3	6	10	13	14	16	16	15	7	100
	1	3	6	12	15	17	18	20	19	10	12
9	0	2	3	5	10	11	15	18	23	14	100
	0	2	3	6	11	14	18	23	30	20	13
10	0	0	1	2	5	7	11	15	21	39	100
Top	0	0	1	2	6	9	14	20	30	61	14
Total	9	11	11	11	11	10	10	10	10	9	100
	100	100	100	100	100	100	100	100	100	100	100

Table A3. Cross-Tabulation of KS2emX2 and WISC-2, Presented in Deciles, in ALSPAC (%)

	1	2	3	4	5	6	7	8	9	10 Top	Total
1	56	23	10	5	3	2	2	0	1	0	100
	32	13	5	3	2	1	1	0	1	0	6
2	35	24	15	11	5	5	2	3	1	0	100
	27	18	11	8	4	4	2	2	1	0	8
3	21	21	19	13	11	6	4	4	1	0	100
	16	16	14	10	8	5	3	3	1	0	8
4	10	19	18	15	15	15	6	6	2	1	100
	9	16	15	13	13	13	5	5	2	1	9
5	9	14	17	14	14	12	9	7	4	2	100
	8	13	17	13	14	11	9	7	4	2	10
6	4	10	12	15	13	17	11	10	6	2	100
	4	10	12	15	13	17	12	10	7	2	10
7	2	7	12	12	14	13	13	11	10	5	100
	2	8	12	12	16	15	15	13	12	6	11
8	1	3	8	9	12	15	16	16	12	8	100
	1	3	9	11	14	17	20	20	16	11	12
9	1	2	4	8	8	12	14	16	20	15	100
	1	3	5	10	10	15	18	21	26	22	13
10	0	1	1	4	6	7	12	13	23	35	100
Top	0	1	1	5	8	9	16	18	32	56	14
Total	10	11	10	10	10	10	10	10	10	8	100
	100	100	100	100	100	100	100	100	100	100	100

Table A4. Cross-Tabulation of KS2emX2 and WISC-11, Presented in Deciles, in ALSPAC (%)

	1	2	3	4	5	6	7	8	9	10 Top	Total
1	61	24	8	4	2	2	0	0	0	0	100
	33	12	4	2	1	1	0	0	0	0	6
2	38	28	14	8	6	2	2	1	0	0	100
	28	19	10	6	5	1	2	1	0	0	8
3	21	24	20	14	11	5	4	2	0	0	100
	16	18	15	10	8	4	3	2	0	0	8
4	12	19	21	17	11	9	7	3	2	0	100
	10	16	18	14	10	8	6	3	2	0	9
5	8	16	16	17	12	13	9	6	2	1	100
	7	15	15	16	11	12	9	6	2	1	10
6	3	8	14	17	15	15	13	9	6	1	100
	3	7	14	17	15	15	13	10	6	1	10
7	2	6	11	13	16	15	15	12	8	4	100
	2	6	12	13	17	16	16	13	9	5	11
8	1	3	6	10	12	15	16	16	15	7	100
	1	4	7	12	15	18	19	20	19	9	12
9	0	2	3	6	10	11	15	18	23	13	100
	0	2	4	7	13	14	18	24	31	19	13
10	0	0	1	2	5	7	11	15	21	38	100
Top	0	0	1	2	6	10	15	21	31	63	14
Total	10	11	10	11	10	10	10	10	9	8	100
	100	100	100	100	100	100	100	100	100	100	100

Table A5. Cross-Tabulation of KS2emX1 and WISC-2, Presented in Quintiles, in ALSPAC (%)

	1 Bottom	2	3	4	5 Top	Total
1 Bottom	61	23	10	4	1	100
	45	16	7	3	1	14
2	33	34	20	11	2	100
	29	27	16	10	2	17
3	16	28	29	19	8	100
	17	27	28	19	8	20
4	6	19	27	29	19	100
	8	20	30	33	23	23
5 Top	2	8	16	28	47	100
	2	10	19	35	66	26
Total	19	21	21	20	19	100
	100	100	100	100	100	100

Table A6. Cross-Tabulation of KS2emX1 and WISC-11, Presented in Quintiles, in ALSPAC (%)

	1 Bottom	2	3	4	5 Top	Total
1 Bottom	67	21	9	3	0	100
	46	14	6	2	0	14
2	34	37	18	10	1	100
	30	30	15	8	1	17
3	14	31	30	20	5	100
	15	29	29	19	5	20
4	6	19	27	30	18	100
	7	21	30	33	23	23
5 Top	1	5	16	29	49	100
	1	6	20	37	70	26
Total	20	21	21	21	18	100
	100	100	100	100	100	100

Table A7. Cross-Tabulation of KS2emX2 and WISC-2, Presented in Quintiles, in ALSPAC (%)

	1 Bottom	2	3	4	5 Top	Total
1 Bottom	67	21	7	4	1	100
	44	14	5	3	1	10
2	36	33	20	9	2	100
	29	26	16	8	2	17
3	19	29	28	18	7	100
	18	28	27	19	8	20
4	7	20	28	29	18	100
	7	22	31	34	22	23
5 Top	2	8	16	28	46	100
	2	10	21	37	67	26
Total	21	21	21	20	18	100
	100	100	100	100	100	100

Table A8. Cross-Tabulation of KS2emX2 and WISC-11, Presented in Quintiles, in ALSPAC (%)

	1 Bottom	2	3	4	5 Top	Total
1 Bottom	74	18	6	2	0	100
	46	11	4	1	0	13
2	37	36	18	8	1	100
	30	29	15	7	1	17
3	17	32	27	19	5	100
	16	31	27	19	5	20
4	6	20	29	29	17	100
	7	22	33	34	22	23
5 Top	1	6	16	29	48	100
	1	8	21	39	72	27
Total	21	21	20	20	18	100
	100	100	100	100	100	100

Table A9. Cross-Tabulation of Parental Education (5-category) and KS2em Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. Degree	6	9	17	25	43	100
	6	8	15	23	39	19
4.	8	16	17	27	32	100
	3	5	6	9	10	7
3.	16	21	22	22	20	100
	20	25	25	26	22	24
2.	26	24	22	17	12	100
	67	60	53	42	29	49
1. No qualifications	52	20	15	10	4	100
	5	2	1	1	0	2
Total	19	20	20	20	21	100
	100	100	100	100	100	100

Table A10. Cross-Tabulation of Parental Education (5-category) and KS2emX2 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. Degree	6	9	17	25	43	100
	6	8	16	23	39	19
4.	8	16	18	27	32	100
	3	5	6	9	10	7
3.	16	21	21	22	20	100
	20	25	25	26	22	24
2.	26	24	21	17	12	100
	67	59	52	42	28	49
1. No qualifications	48	23	16	10	4	100
	5	2	1	1	0	2
Total	19	20	20	20	21	100
	100	100	100	100	100	100

Table A11. Cross-Tabulation of Parental Education (5-category) and WISC-2 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. Degree	8	14	19	24	36	100
	12	20	27	35	53	29
4.	13	17	22	25	24	100
	6	7	9	11	10	9
3.	19	22	22	22	15	100
	23	26	26	25	18	24
2.	30	24	20	16	10	100
	57	46	38	29	19	38
1. No qualifications	56	28	7	6	3	100
	3	1	0	0	0	1
Total	20	20	20	20	20	100
	100	100	100	100	100	100

Table A12. Cross-Tabulation of Parental Education (5-category) and WISC-11 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. Degree	7	13	19	23	38	100
	11	19	28	34	56	30
4.	14	17	20	27	23	100
	6	7	9	11	10	9
3.	19	21	23	23	15	100
	23	24	26	27	17	23
2.	30	26	20	15	9	100
	57	48	37	28	17	37
1. No qualifications	62	27	7	3	2	100
	3	1	0	0	0	1
Total	20	20	20	20	20	100
	100	100	100	100	100	100

Table A13. Cross-Tabulation of Parental Status Quintiles and KS2em Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. Top	8	13	18	25	36	100
	7	10	14	19	26	15
4.	10	14	19	24	33	100
	12	15	20	24	33	21
3.	15	22	22	23	19	100
	17	23	23	24	19	21
2.	23	24	21	20	13	100
	23	22	19	18	11	18
1. Bottom	32	24	20	13	10	100
	42	30	25	16	11	24
Total	19	20	20	20	21	100
	100	100	100	100	100	100

Table A14. Cross-Tabulation of Parental Status Quintiles and KS2emX2 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. Top	8	13	18	25	35	100
	7	11	14	19	26	16
4.	10	14	19	24	33	100
	11	15	20	25	33	21
3.	16	21	22	22	19	100
	18	23	23	23	19	21
2.	23	24	21	20	12	100
	23	22	19	17	11	18
1. Bottom	32	24	20	14	10	100
	41	30	24	16	11	24
Total	19	20	20	19	20	100
	100	100	100	100	100	100

Table A15. Cross-Tabulation of Parental Status Quintiles and WISC-2 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. Top	10	14	21	25	31	100
	12	16	23	28	34	23
4.	13	18	18	22	27	100
	18	23	25	29	34	26
3.	22	22	21	20	15	100
	23	23	21	21	16	21
2.	24	25	22	16	13	100
	19	19	17	12	9	15
1. Bottom	35	26	17	14	9	100
	28	20	13	11	7	16
Total	20	20	20	20	20	100
	100	100	100	100	100	100

Table A16. Cross-Tabulation of Parental Status Quintiles and WISC-11 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. Top	9	15	21	24	32	100
	10	17	23	28	35	23
4.	14	15	20	24	27	100
	19	19	25	31	35	26
3.	22	24	20	19	15	100
	23	24	21	20	15	21
2.	25	27	22	15	12	100
	19	21	17	12	9	15
1. Bottom	37	25	18	13	8	100
	29	19	14	10	6	16
Total	20	20	20	20	20	100
	100	100	100	100	100	100

Table A17. Cross-Tabulation of Parental Income Quintiles and KS2em Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. Top	5	10	16	25	45	100
	3	5	7	10	15	9
4.	10	15	18	25	32	100
	18	23	25	31	37	28
3.	13	18	22	24	24	100
	12	14	15	16	14	15
2.	17	21	23	22	18	100
	30	30	29	25	19	26
1. Bottom	23	23	22	18	15	100
	36	28	24	18	14	23
Total	15	18	20	22	24	100
	100	100	100	100	100	100

Table A18. Cross-Tabulation of Parental Income Quintiles and KS2emX2 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. Top	5	10	16	26	43	100
	3	5	7	10	15	9
4.	10	15	18	25	32	100
	19	23	25	32	37	28
3.	14	18	21	23	24	100
	13	14	15	15	14	15
2.	17	21	23	22	18	100
	29	30	29	25	19	26
1. Bottom	24	23	22	18	15	100
	36	28	24	18	14	23
Total	15	18	20	22	24	100
	100	100	100	100	100	100

Table A19. Cross-Tabulation of Parental Income Quintiles and WISC-2 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. Top	7	15	18	25	35	100
	5	10	12	16	23	13
4.	15	17	20	23	25	100
	25	28	31	35	38	32
3.	17	20	25	20	19	100
	12	13	16	13	12	13
2.	23	23	21	19	14	100
	29	27	23	21	15	23
1. Bottom	28	23	19	16	13	100
	29	23	18	15	12	19
Total	19	20	20	20	21	100
	100	100	100	100	100	100

Table A20. Cross-Tabulation of Parental Income Quintiles and WISC-11 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. Top	7	14	18	25	37	100
	5	10	12	16	24	14
4.	14	18	20	23	25	100
	24	28	31	36	38	32
3.	18	22	21	21	19	100
	13	15	14	13	12	13
2.	23	24	20	19	14	100
	29	28	23	22	15	23
1. Bottom	29	22	21	15	13	100
	29	21	20	14	11	19
Total	19	20	20	20	21	100
	100	100	100	100	100	100

Table A21. Cross-Tabulation of Educational Attainment and KS2em Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. 2+A levels	2	9	19	30	41	100
	4	16	35	56	77	38
4.	5	21	29	27	17	100
	6	24	33	31	20	23
3.	30	36	22	9	3	100
	33	39	24	10	3	22
2.	64	25	9	2	0	100
	46	18	7	1	0	14
1. No qualifications	69	15	9	6	2	100
	11	2	1	1	0	3
Total	20	20	20	20	20	100
	100	100	100	100	100	100

Table A22. Cross-Tabulation of Educational Attainment and KS2emX2 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. 2+A levels	3	9	19	30	41	100
	5	16	36	56	77	38
4.	6	21	29	27	17	100
	8	25	34	31	19	23
3.	33	35	21	9	3	100
	36	38	23	10	3	22
2.	63	25	9	2	0	100
	45	18	6	2	0	14
1. No qualifications	59	22	11	7	2	100
	7	3	1	1	0	3
Total	20	20	20	20	20	100
	100	100	100	100	100	100

Table A23. Cross-Tabulation of Educational Attainment and WISC-2 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. 2+A levels	7	15	20	26	31	100
	18	37	50	66	82	50
4.	16	24	27	22	12	100
	18	26	31	25	15	23
3.	39	31	18	9	3	100
	32	26	15	8	3	17
2.	66	22	8	3	1	100
	28	9	4	1	1	9
1. No qualifications	60	23	12	1	4	100
	5	2	1	0	0	2
Total	21	20	20	20	19	100
	100	100	100	100	100	100

Table A24. Cross-Tabulation of Educational Attainment and WISC-11 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. 2+A levels	6	15	21	27	32	100
	16	37	52	67	85	50
4.	16	23	27	23	11	100
	18	26	31	26	13	23
3.	41	34	16	8	2	100
	33	28	13	7	2	17
2.	71	18	8	2	1	100
	28	8	3	1	0	8
1. No qualifications	63	22	9	4	2	100
	5	2	1	0	0	2
Total	21	20	20	20	19	100
	100	100	100	100	100	100

Table A25. Cross-Tabulation of GCSE Performance Quintiles and KS2em Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. Top	1	5	15	30	50	100
	1	5	15	30	51	20
4.	1	10	21	33	36	100
	1	8	16	26	28	16
3.	6	22	30	26	15	100
	7	25	35	30	18	23
2.	24	37	24	12	3	100
	19	30	19	9	3	16
1. Bottom	58	26	12	3	1	100
	72	32	14	4	1	25
Total	20	20	20	20	20	100
	100	100	100	100	100	100

Table A26. Cross-Tabulation of GCSE Performance Quintiles and KS2emX2 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. Top	1	5	15	30	50	100
	1	5	16	31	51	21
4.	2	9	21	33	35	100
	1	8	17	26	28	16
3.	7	22	30	26	15	100
	9	26	35	30	17	24
2.	26	37	23	11	3	100
	21	30	19	9	3	16
1. Bottom	57	27	12	3	1	100
	68	32	14	4	1	24
Total	20	20	20	20	20	100
	100	100	100	100	100	100

Table A27. Cross-Tabulation of GCSE Performance Quintiles and WISC-2 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. Top	5	13	19	27	36	100
	7	16	24	36	50	26
4.	8	16	24	25	27	100
	8	17	25	27	30	21
3.	16	24	25	22	13	100
	19	29	30	27	17	24
2.	36	31	19	11	3	100
	22	20	12	7	2	13
1. Bottom	58	25	11	4	2	100
	44	19	8	3	2	16
Total	21	20	20	20	19	100
	100	100	100	100	100	100

Table A28. Cross-Tabulation of GCSE Performance Quintiles and WISC-11 Quintiles, in ALSPAC (%)

	Quintiles					
	1 Bottom	2	3	4	5 Top	Total
5. Top	5	12	19	28	37	100
	6	16	25	36	52	26
4.	7	16	24	27	27	100
	7	16	26	29	31	21
3.	16	25	26	22	12	100
	19	29	31	26	15	24
2.	36	35	18	10	2	100
	23	22	11	7	1	13
1. Bottom	63	23	9	4	2	100
	46	17	7	3	1	15
Total	21	20	20	20	19	100
	100	100	100	100	100	100

Appendix B: Constructing Social Origin and Educational Attainment Variables in ALSPAC

The Avon Longitudinal Study of Parents and Children (ALSPAC)

The Avon Longitudinal Study of Parents and Children is an ongoing birth cohort study, which recruited more than 14,000 pregnant women from the former region of Avon (Bristol) between April 1991 and December 1992. The study was initially designed to investigate environmental, genetic and other effects on children's health outcomes, though it also provides a wealth of information on other background characteristics, cognitive ability and, via linkage with the National Pupil Database (NPD), details on formal educational achievements.

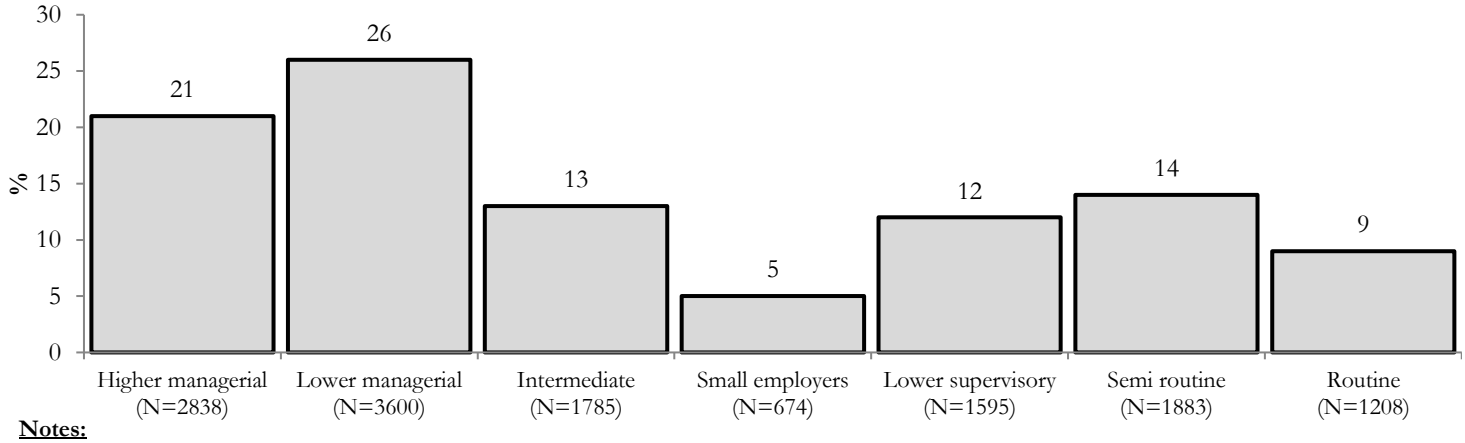
The ALSPAC sample was not randomly selected and thus is not representative of the national population, but analyses of respondents' demographic characteristics have shown that it is largely similar to that of the UK as a whole (Bristol 2016). The whole cohort, plus new cases (children invited to join from the age of seven onwards), is comprised of 15,445 children. 13,761 mothers completed at least one questionnaire (Fraser et al 2012).

Constructing Parental Class

The reduced approach was used to derive an NS-SeC category for each respondent, which required information on parents' SOC2000 codes and employment status. For mothers, the latest child age at which this information is available is three and for partners it is eight. In attempts to create a social-class variable which is as similar as possible to that created using LSYPE data (taken at age 14), partners' information at age eight was prioritised (i.e. this value was taken first, and was not subject to the dominance method).

All other information for partners at earlier waves was then used (ages 3, 2, 1, 8 months, and 32, 18 and 12 weeks gestation) to create a separate measure. Information at age three was replaced with information at age two if missing, and so on. An NS-SeC value was then derived. The same process was used to derive a value for mothers. The dominance approach was then used to determine the highest NS-SeC value between mothers and partners at age three or below. No information was available on full-time or part-time work status, so the dominance approach did not include this but did consider partners' class to dominate mothers' class unless the latter was higher in the ordering of the classes as 1, 2, 3–5, 6, 7 (Bukodi and Goldthorpe 2013). Finally, partners' NS-SeC at age eight was taken as the base variable, and then replaced with values from the measure using the dominance approach where values were missing. The distribution of the parental social-class variable is given in Figure B1 below; the proportions in each category found using LSYPE data are given in the notes, for comparative purposes.

Figure B1. Distribution of Parental Social Class (Reduced Method)



Notes:
Missing values: 1862
Proportions found in LSYPE: Higher managerial (16%; N=1267); Lower managerial (29%; N=2364); Intermediate (7%; N=572); Small employers (9%; N=746); Lower supervisory (14%; N=966); Semi routine (13%; N=980); Routine (12%; 773)

Constructing Parental Education

Mothers and their partners were asked for information on their highest level of education at child ages 13, 8, 5, and 32 and 18 weeks gestation. Each variable was recoded according to the seven ordered categories of parental education given in Bukodi and Goldthorpe (2013). Following the approach taken to measuring class, information was taken from as close to children's age 10 as possible. Age eight information was therefore used as the base variable, replaced with information at age 13 where this was missing, and then at age five and so on (for each parent). Following this, a combined measure of parental education was created, which involved allocating cases to each of the categories listed in Table B1 below (Bukodi and Goldthorpe 2013). This approach required an assumption to be made regarding missing values where educational information was only available for one parent; the assumption applied was that the value of the missing parent is equal to the modal value for partners corresponding to the valid category. See Table B1 notes for the proportions found for the same variable in LSYPE.

Table B1. Distribution of Parental Education

	%	N
1. Neither parent has any qualification	2	268
2. One parent has secondary or lower qualification; other parent has no qualification	7	976
3. Both parents have secondary or lower qualification	39	5302
4. One parent has higher secondary or lower tertiary qualification; other parent has lower qualification	22	3027
5. Both parents have higher secondary or lower tertiary qualification	7	955
6. One parent has degree-level qualification; other parent has lower qualification	14	1884
7. Both parents have degree-level qualifications	10	1316
Missing	--	1717
Total		

Notes:

Proportions found in LSYPE: 1. (10%; N=973); 2. (11%; N=868); 3. (38%; N=2534); 4. (19%; N=1428); 5. (4%; N=345); 6. (11%; N=915); 7. (7%; N=605).

Constructing Parental Status

For the construction of the parental status variable, a similar approach was taken to that of social class described above; that is, prioritising information taken from surveys when the child was aged eight for partners, and replacing missing values with those from previous waves (the same was done for mothers, starting with information on SOC codes available at age three). SOC90 codes were used in place of SOC2000 codes.[17] These SOC codes were then used to determine the social status of each parent using the Chan–Goldthorpe (CG) scale and the CAMSIS scale.[18] The dominance approach was then used, taking the highest value between mothers and partners to determine the parental status score. Table B2 below gives the means and standard deviations of normalised versions of each measure, and also presents those found in LSYPE for comparison, which are very similar.

Table B2. Means and Standard Deviations of Mothers', Fathers' and Parental CG Status Scores (Variables Normalised with range 0–1)

	CG Status Scores			CAMSIS Status Scores		
	Mothers	Fathers	Parental	Mothers	Fathers	Parental
ALSPAC	0.56 (0.26)	0.44 (0.35)	0.62 (0.28)	0.45 (0.18)	0.46 (0.19)	0.52 (0.18)
LSYPE	0.54 (0.25)	0.42 (0.34)	0.58 (0.28)	0.41 (0.19)	0.46 (0.18)	0.51 (0.17)

Notes:

Sample sizes for each measure (CG and CAMSIS N are identical):
ALSPAC: Mothers N=12632; Fathers N=13014; Parental N=13583; Total parental CG status missing values: 1862
LSYPE: Mothers N=6944; Fathers N=6055; Parental N=7668

[17] This is because SOC90 codes are required for conversion to social status scores using the Chan–Goldthorpe approach, and are also most reliable when using the CAMSIS approach.

[18] CAMSIS variables were constructed primarily to determine how comparable they are with those in LSYPE, but were not used to examine relationships with cognitive ability measures in the main document (we expect to use CG status scores in analyses).

The CG status score, derived using the dominance approach, is the measure which was used to derive the parental status quintiles presented above. The distribution of this measure, given in quintiles, is presented in Table B3.

Table B3. Distribution of Parental CG Status Scores (Quintiles)

	Parental CG Status	
	%	N
1st Quintile	23	3099
2nd Quintile	17	2336
3rd Quintile	20	2722
4th Quintile	21	2905
5th Quintile	19	2521
Missing	--	1862
Total	100	15445

Constructing Parental Income

ALSPAC provides information on family 'take-home' income at various child ages. This is given in either weekly or monthly amounts, in various different bands, and is asked of either the mother or the partner or both, depending on the wave. Table B4 summarises the availability of information on income across all waves of ALSPAC.

Table B4. Availability of Information on Family Income in ALSPAC

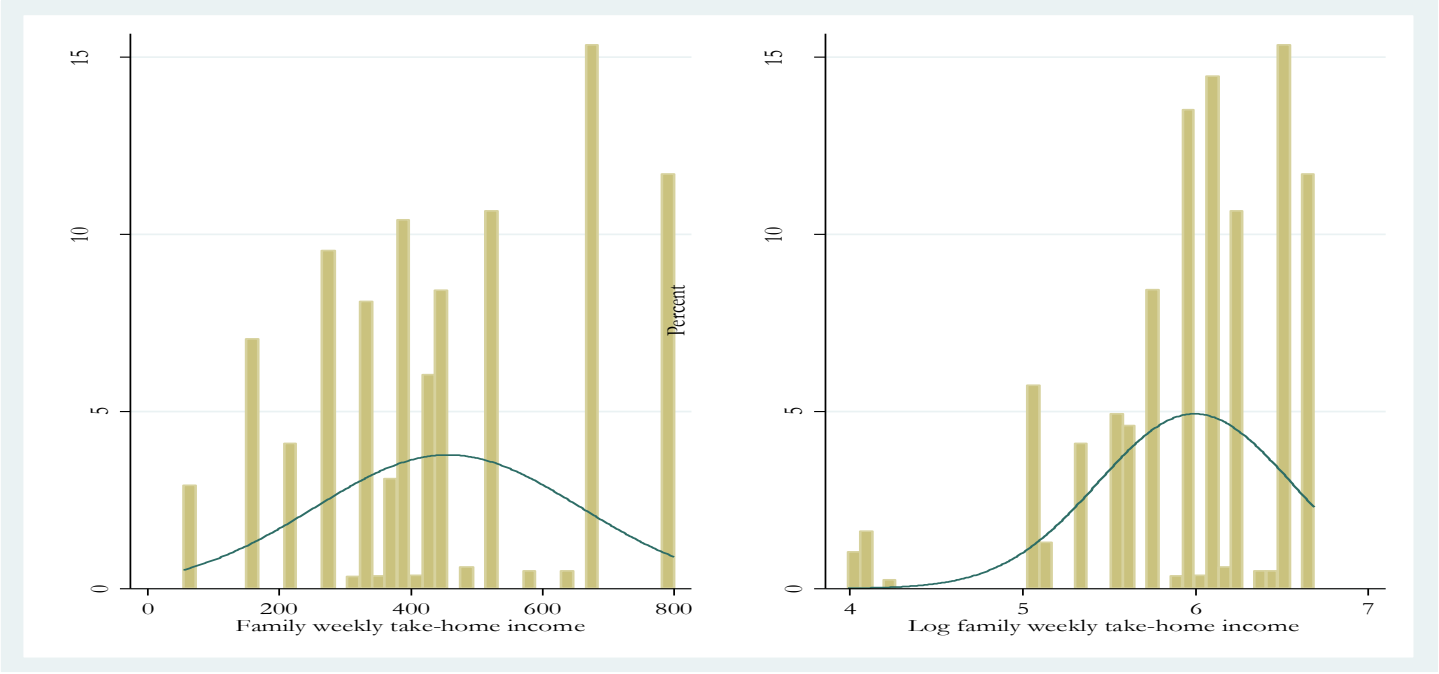
Question wording	**Categories**		**Asked at child ages**					
			2y 9m	3y 11m	7y 1m	8y 1m	11y 2m	~19y
Average 'take-home' family income each week (including social benefits, etc.)	<100 100-199 200-299 300-399 400+ DK		Mother	Mother	Mother & Father	Mother & Father		
Average 'take-home' family income each week (including social benefits, etc.)	<120 120-189 190-239 240-289 290-359 360-429	430-479 480-559 560-799 800+ DK					Mother & Father	
Average 'take-home' family income each **month** (including all earnings, social benefits, tax credits, etc.)	<899 900-1149 1150-1549 1550-1849 1850-2099 2100-2399	2400-2799 2800-3399 3400-4000 4001+ DK						Mother

Since variables were not coded in the same way across waves it is not possible to simply replace missing values with information from earlier (or later) time points (e.g. the top income category at age 11 is 800+, whereas the top category at ages 2–8 is 400+). Information from the variable asked at children's age 11 is used as the base variable, as this is closest to the age used to derive information in the other datasets we consider in this study and it also provides more fine-grained categories (10 as opposed to five in the age eight and earlier measures). Information on income is asked of both parents at this age, so the two measures are combined, prioritising answers given by partners as males are more likely to be in work and the assumption is that they are therefore more likely to provide reliable estimates. For each case, banded values were then replaced with mid-point values.

Separately, the same approach was used to create measures combining information from both parent questionnaires at ages eight and seven. The mid-point values given at age eight (questionnaires administered in 2001) and age seven (questionnaires administered in 2000) were replaced with these values adjusted to 2004 prices (age 11 questionnaires were administered in 2004).[19] Finally, information from questionnaires administered at children's age 19 were used; first, mid-points were taken from each band, then these were adjusted from monthly to weekly amounts (/4), and finally these values were deflated from 2012 prices to 2004 prices. Measures from questionnaires administered at children's ages two and three were not used because parents with young children not yet of school age are likely to be in a considerably different financial situation; these measures were therefore considered to provide unreliable proxy information.

The base variable (age 11) was replaced with values from other waves where cases had missing information to derive the final weekly take-home family income measure. This final variable is made up of 29 unique income values. 5847 cases have missing information. Figure B2 presents the percentile distribution of this variable, before and after log transformation. The logged variable is negatively skewed due to the large number of cases in the highest income categories; unlike LSYPE, ALSPAC does not provide a finer-grained breakdown of incomes in the highest band.

Figure B2. Histogram of Weekly Take-Home Family Income



Notes:
Missing values: 5847

The income variable from LSYPE is comprised of 91 categories and displays a very different distribution.[20] The ALSPAC variable has a range of 54–800, whereas the LSYPE has a range of 4.5–7693. Despite differences in the overall distribution, however, the mean income values are broadly comparable: mean gross weekly income in LSYPE is £567.59, compared with mean take-home weekly income in ALSPAC which is £455.85 (both amounts in 2004 prices); assuming a 20% rate of tax,[21] mean net weekly income in LSYPE would therefore be equal to £454.07.

[19] Inflation calculator found at:
http://www.bankofengland.co.uk/education/Pages/resources/inflationtools/calculator/flash/default.aspx
[20] The variable in LSYPE also asks for combined information on both parents' incomes, as opposed to family income.
[21] Tax rates for incomes up to 31,400 in the year 2004/05 were 22% (incomes between £1–2,020 were taxed at 10%). The mean weekly income in LSYPE (£567.59) amounts to an annual income below the highest threshold (~£29,500), so an approximate 20% rate was assumed for this calculation. Source:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/418669/Table-a2.pdf

Constructing Educational Attainment

The ALSPAC data has been linked to the NPD in order to gain information about individuals' educational attainment. Data from the NPD, which provides details of all examinations taken and grades achieved up to and including Key Stage 5, was used to determine individuals' highest qualification attained. The distribution of this variable is given in Table B5 below, with the proportions found using LSYPE also presented for comparison.

Table B5. Distribution of Respondents' Educational Attainment Up To and Including Key Stage 5

	ALSPAC		LSYPE	
	%	N	%	N
1. No qualifications	4	510	2	91
2. Below O-level, NVQ1	15	1735	15	775
3. 1–4 O-level passes, NVQ2	21	2523	16	943
4. 5+ O-level passes or 1 A-level pass, NVQ3	22	2684	28	2187
5. 2+ A-level passes	38	4623	39	3672
Missing		3361		
Total	100	15445	100	7668

A number of other attainment variables were also created. The first determines simply whether the respondent passed the 2+ A-level achievement threshold; the percentage passing this threshold is the same as given in Table B5 above: 38%. The second determines whether the respondent made the transition to further academic education; i.e. the A-level transition. This measure uses a combination of information from the NPD files as well as from the child-completed questionnaires at ages 17.5 and 18. To construct this measure, those who had achieved 2+ A-levels (according to the NPD data) were coded as having made the transition (1), with others coded as not (0). Then, cases with a value of 0 were recoded to having made the A-level transition if they were studying for AS or A-levels or had achieved either of these qualifications at ages 17.5 or 18, according to the information given in their questionnaires. Finally, further information from the NPD on respondents' number of AS/A-level entries was used to recode cases still taking a value of 0 to having made the A-level transition if they had 1 or more entries at this level. This resulted in a change for 831 cases.

The third variable constructed determined whether cases had made the transition to Key Stage 5 at all, having opted for either the academic or vocational route. This involved starting with the A-level transition variable, and then recoding cases taking a value of 0 to having made the FE transition if there was any information available on these respondents in the Key Stage 5 file (respondents who did not transition to Key Stage 5 at all would not be included). This resulted in a change for a further 1883 cases. Table B6 presents the distribution of each of these measures, with the proportions found using LSYPE data also given for comparison.

Table B6. Distribution of Respondents' Transitions

	ALSPAC		LSYPE	
	%	N	%	N
Passed 2+ A-level threshold				
No	62	7443	61	3996
Yes	38	4623	39	3672
Transition to A-level				
No	55	6612	46	2749
Yes	45	5454	54	4919
Transition to Key Stage 5				
No	39	4729	36	1976
Yes	61	7337	64	5692

There are some notable differences using ALSPAC and LSYPE data; the LSYPE sample has a higher failure rate. For ALSPAC respondents, 84% of those who made the transition to academic FE successfully completed their study (attaining 2 or more A-levels), compared with 75% of LSYPE respondents.

Finally, a variable was created to assess performance at the lower secondary level (i.e. how many A*–C GCSEs were attained). Table B7 summarises this measure, alongside the distribution from the same measure in LSYPE, which is broadly similar.

Table B7. Performance at Lower Secondary Level (Number of A*–C GCSEs Attained)

	ALSPAC		**LSYPE**	
	%	N	%	N
0	19	2241	18	918
0.5	1	76	1	31
1	7	783	6	366
1.5	1	80	1	39
2	4	529	4	260
2.5	1	85	1	59
3	4	443	3	223
3.5	1	118	1	56
4	4	444	5	311
4.5	1	139	1	91
5	4	425	4	274
5.5	1	157	1	80
6	4	489	3	304
6.5	2	203	1	110
7	5	538	4	333
7.5	3	299	2	141
8	5	636	5	414
8.5	4	453	2	207
9	7	885	6	538
9.5	5	642	5	412
10	8	969	9	809
10.5	4	430	5	418
11	3	402	6	515
11.5	2	192	2	207
12	1	149	2	196
12.5	1	83	1	86
13	1	99	1	99
13.5	0	24	1	55
14	0	42	1	49
14.5	0	7	OM	OM
15	0	7	OM	OM
15.5	0	2	OM	OM
16	0	4	OM	OM
16.5	0	0	OM	OM
17	0	1	OM	OM
19	0	0	OM	OM
Missing	--	3361	--	3
Total	100	15445	100	7668

Notes: Values omitted to preserve anonymity.

Note that it is not possible to assess the transition to HE using ALSPAC data. There is information on qualifications attained at age 20 (which is the latest possible age for which attainment information is available) but most individuals do not start tertiary-level education until age 18–19, so are very unlikely to have completed a degree by the age of 20. Further, only ~20% of the initial ALSPAC sample have valid information at this wave.

Appendix C: Multivariate Analyses: Supplementary Material

Table C1. Sensitivity Analysis: Adjustments to Cognitive Ability Reference Group (Average Marginal Effects)

	KS2emX2						WISC-2						WISC-11					
	Reference group						Reference group						Reference group					
	Bottom			Top			Bottom			Top			Bottom			Top		
	ˇCI	Est	ˆCI	ˇCI	Est	ˆCI	ˇCI	Est	ˆCI	ˇCI	Est	ˆCI	ˇCI	Est	ˆCI	ˇCI	Est	ˆCI
1st				[-.68]	-.64*	[-.59]				[-.54]	-.50*	[-.45]				[-.58]	-.54*	[-.49]
2nd	[.08]	.12*	[.17]	[-.55]	-.51*	[-.47]	[.13]	.17*	[.21]	[-.37]	-.33*	[-.29]	[.13]	.17*	[.22]	[-.41]	-.37*	[-.32]
3rd	[.30]	.34*	[.39]	[-.33]	-.29*	[-.25]	[.19]	.23*	[.28]	[-.31]	-.27*	[-.22]	[.25]	.29*	[.33]	[-.29]	-.25*	[-.21]
4th	[.45]	.49*	[.54]	[-.18]	-.14*	[-.11]	[.31]	.35*	[.39]	[-.19]	-.15*	[-.11]	[.34]	.39*	[.43]	[-.19]	-.15*	[-.11]
5th	[.59]	.64*	[.68]				[.45]	.50*	[.54]				[.49]	.54*	[.58]			
N	4,644						4,644						4,644					

Notes:
* p<0.05

Table C2. Sensitivity Analysis: Coding Variations I (Average Marginal Effects)

	KS2emX2	WISC-2	WISC-11
Parental class (5 as ref)			
4. Semi-routine	0.01	0.01	0.01
3. 3+4+5	0.03	0.04	0.04
2. Lower managerial	0.05	0.06*	0.06*
1. Higher managerial	0.06	0.07*	0.07*
Parental status			
Interval scale	0.12*	0.14*	0.13*
Parental education (1. No quals as ref)			
2.	-0.01	0.01	-0.00
3.	0.12	0.13	0.12
4.	0.18	0.21*	0.18
5.	0.27*	0.32*	0.29*
6.	0.31*	0.36*	0.33*
7. Both parents have degrees	0.36*	0.43*	0.39*
Self-employed			
0–1	-0.02	-0.04	-0.05
Gender (male)			
Female	0.06*	0.09*	0.09*
Cognitive ability (3rd as ref)			
Bottom	-0.34*	-0.23*	-0.29*
2nd	-0.22*	-0.06*	-0.11*
4th	0.15*	0.12*	0.10*
Top	0.29*	0.26*	0.24*
N	4,644	4,644	4,644

Notes:
* p<0.05

Table C3. Sensitivity Analysis: Coding Variations II (Average Marginal Effects)

	KS2emX2	WISC-2	WISC-11
Parental class (5 as ref)			
4. Semi-routine	0.01	0.01	0.01
3. 3+4+5	0.03	0.04	0.04
2. Lower managerial	0.06*	0.06*	0.06*
1. Higher managerial	0.06*	0.07*	0.08*
Parental status (3rd as ref)			
Bottom	-0.08*	-0.09*	-0.08*
2nd	-0.05*	-0.05*	-0.05*
4th	-0.01	0.00	0.00
Top	0.03	0.04	0.03
Parental education (1. No quals as ref)			
2.	-0.00	0.01	0.00
3.	0.12	0.14	0.12
4.	0.19	0.21*	0.19
5.	0.27*	0.32*	0.30*
6.	0.32*	0.37*	0.34*
7. Both parents have degrees	0.37*	0.44*	0.40*
Self-employed			
0–1	-0.02	-0.04	-0.05
Gender (male)			
Female	0.06*	0.09*	0.09*
Cognitive ability (3rd as ref)			
Bottom	-0.34*	-0.23*	-0.29*
2nd	-0.22*	-0.06*	-0.12*
4th	0.15*	0.11*	0.10*
Top	0.29*	0.26*	0.24*
N	4,644	4,644	4,644

Notes:
* p<0.05

Table C4. Sensitivity Analysis: Coding Variations III (Average Marginal Effects)

	KS2emX2	WISC-2	WISC-11
Parental class (5 as ref)			
4. Semi-routine	0.01	0.01	0.01
3. 3+4+5	0.03	0.03	0.04
2. Lower managerial	0.04	0.05	0.05
1. Higher managerial	0.05	0.06	0.06*
Parental status			
0–1	0.13*	0.15*	0.13*
Parental education			
0–1	0.22*	0.25*	0.24*
Parental income			
Linear (min=54; max=800)	0.0002*	0.0002*	0.0002*
Self-employed			
0–1	-0.01	-0.03	-0.04
Gender (male)			
Female	0.06*	0.09*	0.08*
Cognitive ability (3rd as ref)			
Bottom	-0.34*	-0.23*	-0.29*
2nd	-0.22*	-0.07*	-0.12*
4th	0.15*	0.11*	0.09*
Top	0.29*	0.26*	0.24*
N	4,644	4,644	4,644

Table C5. Sensitivity Analysis: Coding Variations IV (Average Marginal Effects)

	KS2emX2	WISC-2	WISC-11
Parental class (5 as ref)			
4. Semi-routine	0.01	0.01	0.01
3. 3+4+5	0.03	0.03	0.03
2. Lower managerial	0.04	0.05	0.05
1. Higher managerial	0.05	0.06*	0.06*
Parental status			
0–1	0.13*	0.15*	0.13*
Parental education			
0–1	0.22*	0.26*	0.24*
Parental income			
Bottom	-0.06*	-0.08*	-0.08*
2nd	-0.02	-0.03	-0.03
4th	0.03	0.04	0.03
Top	0.03	0.04	0.04
Self-employed			
0–1	-0.01	-0.03	-0.04
Gender (male)			
Female	0.06*	0.09*	0.08*
Cognitive ability (3rd as ref)			
Bottom	-0.34*	-0.23*	-0.29*
2nd	-0.22*	-0.06*	-0.12*
4th	0.15*	0.11*	0.09*
Top	0.29*	0.26*	0.24*
N	4,644	4,644	4,644

Table C6. Table 27 LSYPE Estimates with Confidence Intervals

	M0			M1			M2			M3			M4			M5		
	CI	Est	CI	CI	Est	CI	CI	Est	CI	CI	Est	CI	CI	Est	CI	CI	Est	CI
Parental class (5)																		
4. Semi-routine	[-.04]	.02	[.07]	[-.03]	.02	[.07]	[-.03]	.01	[.06]	[-.04]	.02	[.07]	[-.03]	.02	[.07]	[-.03]	.01	[.06]
3. 3+4+5	[-.01]	.04	[.08]	[-.04]	.00	[.05]	[-.04]	.01	[.05]	[-.02]	.03	[.08]	[-.04]	.00	[.05]	[-.04]	.00	[.05]
2. Lower managerial	[.01]	.06*	[.12]	[-.02]	.03	[.07]	[-.01]	.03	[.08]	[-.01]	.05	[.10]	[-.02]	.02	[.07]	[-.02]	.03	[.07]
1. Higher managerial	[.05]	.12*	[.18]	[.00]	.06*	[.11]	[.01]	.06*	[.12]	[.03]	.09*	[.16]	[-.01]	.05	[.10]	[-.00]	.05	[.11]
Parental status																		
0–1	[.20]	.27*	[.33]	[.08]	.13*	[.18]	[.08]	.14*	[.19]	[.19]	.25*	[.32]	[.07]	.13*	[.18]	[.08]	.13*	[.19]
Parental education																		
0–1	[.29]	.33*	[.37]	[.12]	.16*	[.20]	[.12]	.16*	[.20]	[.28]	.32*	[.36]	[.11]	.15*	[.19]	[.12]	.16*	[.20]
Parental income																		
0–1										[.21]	.45*	[.68]	[.01]	.19*	[.38]	[.02]	.20*	[.38]
Self employed (no)																		
Yes	[.02]	.06*	[.11]	[.02]	.06*	[.09]	[.01]	.05*	[.09]	[.01]	.06*	[.10]	[.02]	.05*	[.09]	[.01]	.05*	[.09]
Gender (male)																		
Female	[.06]	.08*	[.11]	[.05]	.07*	[.09]	[.05]	.07*	[.09]	[.06]	.09*	[.11]	[.05]	.07*	[.09]	[.05]	.07*	[.09]
Cognitive ability																		
z-scores				[.22]	.23*	[.24]							[.22]	.23*	[.24]			
Cognitive ability (3rd)																		
Bottom							[-.30]	-.27*	[-.23]							[-.30]	-.27*	[-.23]
2nd							[-.17]	-.13*	[-.09]							[-.17]	-.13*	[-.09]
4th							[.15]	.20*	[.24]							[.15]	.19*	[.24]
Top							[.39]	.44*	[.48]							[.39]	.43*	[.48]
N	5,868			5,868			5,868			5,868			5,868			5,868		

Table C8. Table 30 LSYPE Estimates with Confidence Intervals

	M1			M2			M3			M4		
	CI	Est	CI	CI	Est	CI	CI	Est	CI	CI	Est	CI
Cohort (BCS70)												
LSYPE	[0.87]	0.99	[1.12]	[0.77]	1.00*	[1.24]	[1.04]	1.22*	[1.40]	[0.96]	1.23*	[1.50]
Parental class (5)												
4. Semi-routine	[-0.26]	-0.00	[0.26]	[-0.26]	-0.01	[0.25]	[-0.26]	-0.00	[0.26]	[-0.27]	-0.01	[0.25]
3. 3+4+5	[-0.15]	0.08	[0.30]	[-0.13]	0.09	[0.32]	[-0.16]	0.07	[0.29]	[-0.14]	0.08	[0.31]
2. Lower managerial	[-0.04]	0.21	[0.45]	[-0.01]	0.23	[0.47]	[-0.08]	0.17	[0.42]	[-0.05]	0.20	[0.44]
1. Higher managerial	[0.13]	0.41*	[0.68]	[0.17]	0.44*	[0.71]	[0.07]	0.35*	[0.63]	[0.10]	0.38*	[0.65]
Parental status												
0–1	[0.36]	0.64*	[0.92]	[0.39]	0.67*	[0.95]	[0.31]	0.59*	[0.87]	[0.33]	0.62*	[0.90]
Parental education												
0–1	[0.84]	1.05*	[1.26]	[0.89]	1.10*	[1.31]	[0.78]	1.00*	[1.21]	[0.83]	1.04*	[1.25]
Parental income												
0–1							[0.28]	0.66*	[1.03]	[0.31]	0.68*	[1.05]
Self employed (no)												
Yes	[0.03]	0.21*	[0.39]	[0.00]	0.18*	[0.37]	[0.02]	0.20*	[0.38]	[-0.01]	0.17	[0.36]
Gender (male)												
Female	[0.21]	0.32*	[0.43]	[0.21]	0.32*	[0.43]	[0.21]	0.32*	[0.43]	[0.21]	0.32*	[0.43]
Cognitive ability												
z-scores	[0.74]	0.84*	[0.94]				[0.71]	0.82*	[0.92]			
Cognitive ability*Cohort												
z-score*LSYPE	[0.55]	0.69*	[0.83]				[0.57]	0.71*	[0.85]			
Cognitive ability (3rd)												
Bottom				[-1.61]	-1.17*	[-0.73]				[-1.59]	-1.14*	[-0.70]
2nd				[-0.66]	-0.35*	[-0.03]				[-0.65]	-0.33*	[-0.02]
4th				[0.22]	0.47*	[0.72]				[0.19]	0.45*	[0.70]
Top				[0.94]	1.18*	[1.42]				[0.91]	1.15*	[1.39]
Cognitive ability*Cohort												
Bottom*LSYPE				[-1.15]	-0.65*	[-0.14]				[-1.19]	-0.68*	[-0.17]
2nd*LSYPE				[-0.71]	-0.34	[0.03]				[-0.73]	-0.36	[0.02]
4th*LSYPE				[0.10	0.41*	[0.73]				[0.12]	0.44*	[0.75]
Top*LSYPE				[0.60]	0.92*	[1.25]				[0.63]	0.95*	[1.28]
Combined sample N		9,832			9,832			9,832			9,832	

Appendix D: Constructing Alternative Cognitive Ability Measures in LSYPE

Table D1 presents the results of the PCAs run in constructing the measures KS2emX1 and KS2emX2 using LSYPE data. The steps followed before running the PCAs are identical to those used to construct the corresponding measures using the ALSPAC data (see Section 3.1). (KS2emX1 N=7,278; KS2emX2 N=7,513.)

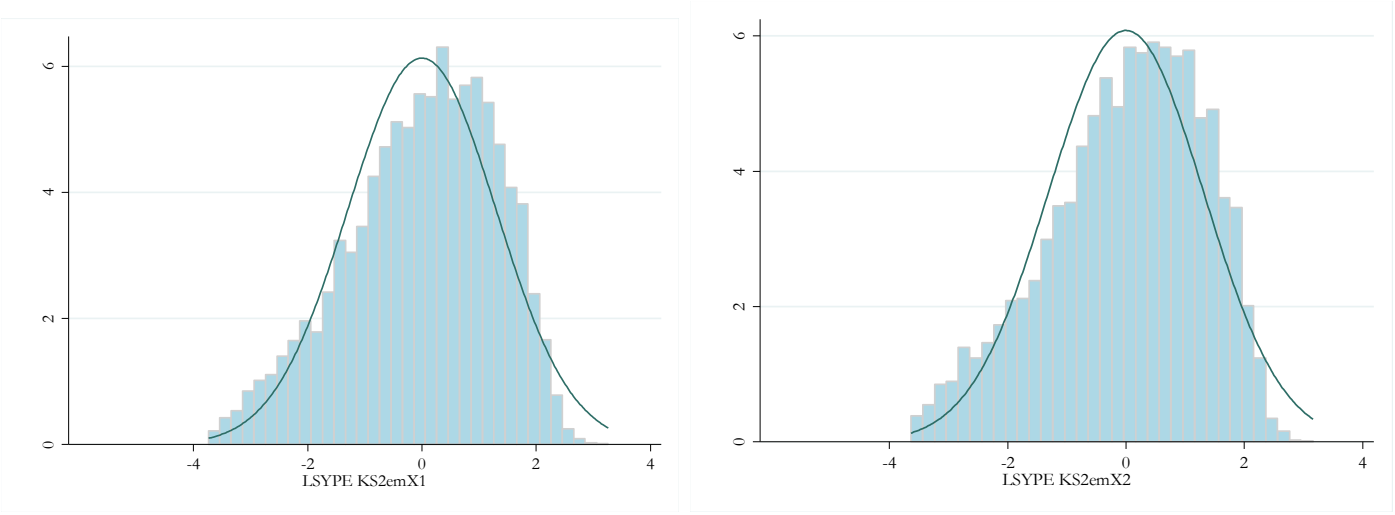
Table D1. PCA to Derive Alternative Cognitive Ability Measures in LSYPE

	PCA					New variable		
	Eigenvalue	Loading			% of variance	Min	Max	Mean (sd)
		English	Maths	Science				
KS2emX1	1.69	0.71	0.71	--	0.85	<-3.56	>2.60	0.00 (1.30)
KS2emX2	1.72	0.71	0.71	--	0.86	<-3.55	>2.60	0.00 (1.31)

Notes:
Precise minimum and maximum values have been omitted to preserve anonymity.

Figure D1 displays the percentile distributions of the KS2emX1 and KS2emX2 measures.

Figure D1. Percentile Distributions of KS2emX1 and KS2emX2 in LSYPE



Appendix E

ALSPAC Study description

ALSPAC recruited 14,541 pregnant women resident in Avon, UK with expected dates of delivery 1st April 1991 to 31st December 1992. 14,541 is the initial number of pregnancies for which the mother enrolled in the ALSPAC study and had either returned at least one questionnaire or attended a "Children in Focus" clinic by 19/07/99. Of these initial pregnancies, there was a total of 14,676 fetuses, resulting in 14,062 live births and 13,988 children who were alive at 1 year of age.

When the oldest children were approximately 7 years of age, an attempt was made to bolster the initial sample with eligible cases who had failed to join the study originally. As a result, when considering variables collected from the age of seven onwards (and potentially abstracted from obstetric notes) there are data available for more than the 14,541 pregnancies mentioned above.

The number of new pregnancies not in the initial sample (known as Phase I enrolment) that are currently represented on the built files and reflecting enrolment status at the age of 18 is 706 (452 and 254 recruited during Phases II and III respectively), resulting in an additional 713 children being enrolled. The phases of enrolment are described in more detail in the ALSPAC cohort profile paper which should be used for referencing purposes.

The total sample size for analyses using any data collected after the age of seven is therefore 15,247 pregnancies, resulting in 15,458 fetuses. Of this total sample of 15,458 fetuses, 14,775 were live births and 14,701 were alive at 1 year of age.

A 10% sample of the ALSPAC cohort, known as the Children in Focus (CiF) group, attended clinics at the University of Bristol at various time intervals between 4 to 61 months of age. The CiF group were chosen at random from the last 6 months of ALSPAC births (1432 families attended at least one clinic). Excluded were those mothers who had moved out of the area or were lost to follow-up, and those partaking in another study of infant development in Avon.

ALSPAC data dictionary

The ALSPAC website contains details of all the data that is available through a fully searchable data dictionary: http://www.bris.ac.uk/alspac/researchers/data-access/data-dictionary.

Ethical approval

Ethical approval for the study was obtained from the ALSPAC Ethics and Law Committee and the Local Research Ethics Committees.

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