Socioeconomic inequalities in vocabulary and their implications for educational attainment and mental health in adolescence

Appendices

Appendix 1: Supplementary material for Chapter 3

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Section 1: Comparison of analytical samples to full cohorts

Table 1: Comparison of BCS analysis sample (pre-registered self-report outcome) to the full BCS cohort

	% (analytical sample; N=11,640)	% (whole cohort; N=17,196)	% NA (whole cohort)
Demographic variables			
Sex (female)	48.21%	48.14%	.06%
Ethnicity (White UK)	96.22%	92.61%	3.39%
Ethnicity (Minority)	3.78%	4.19%	
Socioeconomic variables			
Language used in home (English)	97.63%	96.39%	.27%
Language used in home (other than English)	2.37%	3.34%	
Occupation (Professional & Managerial)	20.95%	20.47%	1.01%
Occupation (skilled manual and skilled non-manual)	61.75%	59.47%	
Occupation (semi-skilled/unskilled)	16.33%	17.75%	
Occupation (unemployed)	0.97%	1.3%	
Parental education (Degree +)	13.7	13.24%	1.99%
Parental education (Certificate of education)	1.66%	1.64%	
Parent education (SRN (state registered nurse)	1.67%	1.74%	
Parent education (A levels)	7.88%	7.54%	
Parent education (O level)	21.18%	20.59%	
Parent education (Vocational qualification)	13.2%	12.83%	
Parent education: no qualifications	40.71%	40.43%	

Table 2: Comparison of MCS analysis sample (pre-registered self-report outcome) to the full MCS cohort

	%(analytical sample; N=14,754)	% (whole cohort(N=19,243)	% NA (whole cohort)
Demographic variables			
Sex (female)	48.93%	47.87%	1.44%
Ethnicity (White)	88.61%	85.5%	2.07%
Ethnicity (mixed)	2.91%	3.07%	
Ethnicity (Indian)	1.78%	1.76%	
Ethnicity (Pakistani/Bangladeshi)	3.47%	3.83%	
Ethnicity (Black/Black British)	2.22%	2.57%	
Ethnicity (Other(incl Chinese)	1%	1.2%	
Socioeconomic variables			
Main language in home (English)	90.20%	73.55%	18.36%
Main language in home (English and another language)	7.86%	6.48%	
Main language in home (only another language)	1.94%	1.61%	
Occupation (NS-SEC Higher managerial)	46.21%	41.74%	2.82%
Occupation (NS-SEC intermediate occupations)	18.68%	17.98%	
Occupation (NS-SEC Routine& Manual occupations	26.17%	25.10%	
Unemployed	8.95%	12.35%	
Parent education (higher degree)	7.64%	6.95%	4.11%
Parent education (first degree)	19.15%	17.12%	
Parent education (diploma in higher education)	12.69%	11.77%	
Parent education (A levels)	10.05%	9.5%	
Parent education (O levels/GCSE grades A-C)	33.05%	31.87%	
Parent education (GCSE grades D-G)	7.36%	7.57%	
Parent education (none of these/other incl overseas)	10.07%	11.11%	
Income(lowest quintile)	17.34%	19.24%	1.78%
Income (second quintile)	18.87%	19.37%	
Income (third quintile)	20.05%	19.45%	
Income (fourth quintile)	21.60%	19.86%	
Income (highest quintile)	22.14%	20.31%	

Section 2: Main analyses tables: full models with controls

Table 3: Analysis of BCS data with age 16 internalising symptoms (Malaise Inventory) as the outcome variable (N= 11,640)

Variable	Model 1 Coef[95% CI] *p value* ***Partial R^2***	Model 2 Coef[95% CI] *p value* ***Partial R^2***	Model 3 Coef[95% CI] *p value* ***Partial R^2***
Birthweight (g)	-.02[-.05;.01], *p=.13* ***0.0004***	-.02[-.05;.01], *p=.25* ***0.0002***	-.02[-.05;.01], *p=.26* ***0.0002***
Gestational age (days)	.00[-.03;.03], *p=.97* ***0***	.00[-.03;.03], *p=.99* ***0***	.00[-.03;.03], *p=.99* ***0***
Sex (female)	.31[.25;.37]**, *p=.00* ***0.0236***	.32[.26;.38]**, *p=.00* ***0.025***	.32[.26;.38]*, *p=.00* ***0.0247***
Ethnicity (minority) [a]	.06[-.10;.21], *p=.47* ***0***	.05[-.11;.20], *p=.54* ***0***	.05[-.11;.20], *p=.56* ***0***
Language used in home (other than English) [b]	-.01[-.18;.17], *p=.95* ***0***	.01[-.17;.19], *p=.94* ***0***	.01[-.17;.19], *p=.95* ***0***
Occupation (skilled manual/skilled non-manual) [c]	.02[-.05;.08], *p=.63* ***0.0001***	.00[-.06;.07], *p=.96* ***0.0001***	.00[-.06;.07], *p=.96* ***0.0001***
Occupation (semi-skilled/unskilled)	.02[-.07;.11], *p=.71*	-.01[-.10;.08], *p=.85*	-.01[-.10;.08], *p=.84*
Occupation (unemployed)	.12[-.18;.42], *p=.42*	.10[-.21;.40], *p=.52*	.10[-.21;.40], *p=.53*
Parental education [d] (Certificate of education)	.07[-.11;.26], *p=.43* ***0.0003***	.07[-.12;.25], *p=.48* ***0.0002***	.07[-.12;.25], *p=.48* ***0.0002***
Parent education (SRN (state registered nurse)	-.01[-.20;.18], *p=.94*	-.01[-.20;.18], *p=.92*	-.01[-.20;.18], *p=.91*
Parent education (A levels)	.02[-.09;.12], *p=.76*	.01[-.09;.11], *p=.83*	.01[-.09;.11], *p=.83*
Parent education (O level)	.03[-.06;.12], *p=.48*	.02[-.07;.11], *p=.62*	.02[-.07;.11], *p=.62*
Parent education (Vocational qualification)	-.02[-.13;.09], *p=.73*	-.03[-.14;.08], *p=.59*	-.03[-.14;.08], *p=.59*
Parent education: no qualifications	.04[-.04;.13], *p=.32*	.02[-.06;.10], *p=.60*	.02[-.06;.11], *p=61*
Teen mum (yes)		.10[.01;.19]* , *p=.03* ***0.0007***	.10[.01;.19]*, *p=.03* ***0.0007***
Marital status (not partnered)		.01[-.12;.14], *p=.92* ***0***	.01[-.12;.14], *p=.92* ***0***
Maternal depression (CM age 5)		.02[-.01;.05], *p=.29* ***0.0001***	.02[-.01;.05], *p=.29* ***0.0001***
Age 5 CM externalising difficulties		.04[.01;.07]*, *p=.01*	.04[.01;.07]*, *p=.01*

		0.0014	***0.0013***
Age 5 CM internalising difficulties		.05[.02;.08]**, *p=.00*	.05[.02;.08]**, *p=.00*
		0.0025	***0.0025***
Age of CM at time of language test (months)			.00[-.03;.03], *p=.82*
			0
Age 5 vocabulary score			.00[-.03;.03], *p=.94*
			0
R^2	0.0263	0.0331	0.0332

[a] ethnicity reference group = European UK, [b]language used in the home reference group = English, [c] occupation reference group = professional & managerial, [d]parent education reference group = degree+. * p <.05, ** p <.01.

Table 4: post-hoc analysis of BCS data with self-reported internalising symptoms as the outcome variable, vocabulary predictor added to model with biological and SES controls (*N=11640)*

Variable	Coef[95% CI], ***Partial R^2***
Birthweight (g)	-.02[-.05;.01], *p= .15*
	0.0003
Gestational age (days)	.00[-.03;.03], *p=.98*
	0
Sex (female)	.31[.25;.37]**, *p=.00*
	0.0231
Ethnicity (minority) [a]	.05[-.11;.20], *p=.53*
	0
Language used in home (other than English) [b]	-.01[-.19;.17], *p=.90*
	0
Occupation (skilled manual/skilled non-manual) [c]	.01[-.05;.08], *p=.67*
	0.00001
Occupation (semi-skilled/unskilled)	.01[-.08;.10]. *p=.78*
Occupation (unemployed)	.12[-.19;.42], *p=.44*
Parental education [d] (Certificate of education)	.07[-.11;.26], *p=.43*
	0.0003
Parent education (SRN (state registered nurse)	-.01[-.20;.18], *p=.92*
Parent education (A levels)	.01[-.09;.12], *p=.78*
Parent education (O level)	.03[-.06;.12], *p=.51*

Parent education (Vocational qualification)	-.02[-.14;.09], *p*=.68
Parent education: no qualifications	.04[-.05;.12], *p*= .41
Age of CM at time of vocabulary test (months)	.00[-.03;.03], *p*= .85 ***0***
Age 5 vocabulary score	-.01[-.04;.02], *p*=.42 ***0***
R^2	0.0264

[a] ethnicity reference group = European UK, [b]language used in the home reference group = English, [c] occupation reference group = professional & managerial, [d]parent education reference group = degree+. * *p* <.05, ** *p* <.01.

Table 5: Analysis of MCS data with age 14 internalising symptoms (moods and feelings questionnaire) as the outcome variable (N= 14,754)

Variable	Model 1 Coef[95% CI] ***Partial R^2***	Model 2 Coef[95% CI] ***Partial R^2***	Model 3 Coef[95% CI] ***Partial R^2***
Birthweight (g)	.01[-.03;.04] *p*=.74 ***0***	.00[-.03;.04] *p*=.83 ***0***	.00[-.03;.04] *p*=.81 ***0***
Gestational age (days)	.00[-.01;.02] *p*=.67 ***0***	.01[-.01;.03] *p*=.49 ***0***	.01[-.01;.03] *p*=.49 ***0***
Sex (female)	.54[.50;.58]** *p*<.001 ***.0718***	.54[.50;.58]** *p*<.001 ***.0735***	.54[.50;.58]** *p*<.001 ***.0728***
Ethnicity (mixed)[a]	.03[-.07;.14] *p*=.53 ***.0012***	.02[-.09;.12] *p*=.78 ***.0011***	.02[-.09;.12] *p*=.76 ***.0008***
Ethnicity (Indian)	-.11[-.27;.04] *p*=.15	-.11[-.27;.04] *p*=.15	-.11[-.27;.04] *p*=.15
Ethnicity (Pakistani/Bangladeshi)	-.25[-.38;-.12] *p*<.001	-.24[-.37;-.11]** *p*<.001	-.21[-.34;-.08]** *p*<.001
Ethnicity (Black)	-.14[-.27;-.01]* *p*=.04	-.14[-.27;-.01]* *p*=.03	-.12[-.25;.01] *p*=.06
Ethnicity (Other)	-.12[-.32;.08] *p*=.24	-.13[-.33;.07] *p*=.20	-.11[-.31;.09] *p*=.28
Main language in home (English and another language)[b]	-.02[-.12;.08] *p*=.70 ***0***	-.01[-.11;.09] *p*=.86 ***0***	.01[-.09;.11] *p*=.83 ***0***
Main language in home (only another language)	-.04[-.20;.12] *p*=.63	-.03[-.19;.14] *p*=.76	.01[-.16;.17] *p*=.93
Occupation (NS-SEC intermediate occupations)[c]	.01[-.05;.06] *p*=.79 ***.0001***	.00[-.05;.06] *p*=.87 ***0***	.01[-.05;.07] *p*=.76 ***0***
Occupation (NS-SEC Routine& Manual occupations	.03[-.03;.10] *p*=.27	.01[-.05;.08] *p*=.64	.02[-.04;.08] *p*=.49
Unemployed	.07[-.02;.16] *p*=.11	.02[-.07;.11] *p*=.68	.03[-.06;.13] *p*=.46

Parent education (first degree)[d]	-.06[-.13;.02] *p*=.15 ***.0001***	-.05[-.13;.02] *p*=.16 ***.0001***	-.05[-.13;.02] *p*=.18 ***.0001***
Parent education (diploma in higher education)	-.05[-.13;.04] *p*=.27	-.06[-.14;.03] *p*=.20	-.05[-.13;.04] *p*=.30
Parent education (a levels)	-.05[-.14;.04] *p*=.29	-.05[-.14;.03] *p*=.23	-.04[-.13;.05] *p*=.37
Parental education (o levels/GCSE grades A-C	-.06[-.15;.02] *p*=.15	-.08[-.16;.01] *p*=.07	-.06[-.14;.03] *p*=.17
Parental education (GCSE grades D-G	-.00[-.12;.12] *p*=.96	-.04[-.16;.08] *p*=.53	-.02[-.13;.10] *p*=.79
Parental education (none of these/other incl overseas)	-.04[-.15;.07] *p*=.45	-.08[-.19;.03] *p*=.13	-.05[-.16;.05] *p*=.33
Income (second quintile)[e]	.02[-.05;.08] *p*=.66 ***.0013***	.03[-.04;.10] *p*=.40 ***.0005***	.03[-.04;.10] *p*=.41 ***.0006***
Income (third quintile)	-.06[-.13;.01] *p*=.10	-.02[-.09;.05] *p*=.54	-.03[-.10;.04] *p*=.43
Income (fourth quintile)	-.08[-.15;-.00]* *p*=.04	-.03[-.11;.05] *p*=.46	-.04[-.11;.04] *p*=.34
Income (highest quintile)	-.12[-.20;-.05]** *p*<.001	-.07[-.14;.01] *p*=.10	-.08[-.15;.00] *p*=.05
Total net wealth	-.02[-.04;-.00]* *p*=.04 ***.0004***	-.02[-.04;-.00]* *p*=.04 ***.0004***	-.02[-.04;-.00]* *p*=.03 ***.0004***
Teen mum (yes)		.01[-.12;.14] *p*=.88 ***0***	.01[-.12;.14] *p*=.88 ***0***
Marital status (not partnered)		.07[.02;.13]* *p*=.01 ***.001***	.07[.02;.13]** *p*<.001 ***.001***
Maternal depression (CM age 5)		.07[.04;.09]** *p*<.001 ***.0037***	.07[.04;.09]** *p*<.001 ***.0038***
Age 5 CM externalising difficulties		.04[.02;.07]** *p*<.001 ***.0015***	.05[.02;.07]** *p*<.001 ***.0016***
Age 5 CM internalising difficulties		.02[-.00;.04] *p*=.11 ***.0002***	.02[-.00;.04] *p*=.07 ***.0003***
Age of CM at time of taking vocabulary test (months)			.01[-.01;.03] *p*=.33 ***0***
Age 5 vocabulary score			.05[.02;.07]** *p*<.001 ***.0017***
R^2	0.0783	0.0875	0.0893

[a] ethnicity reference group = white, [b] Main language used in home reference group = only English, [c] NS-SEC reference group = higher managerial, administrative and professional occupations, [d] parent education reference group = higher degree, [e] Income quintile reference group = lowest quintile. * p <.05, ** p <.01.

Section 3: Sensitivity analysis 1, BCS self-reported mental health: White, English-speaking subsample (N=10,725)

Rationale

As a sensitivity check, we carried out the BCS1970 analysis described in Chapter 3, on a subsample of the cohort. This subsample was comprised of only White, English-speaking cohort members, giving a final sample of 10,725 cohort members.

Measures

Details of the predictor, outcome and control variables can be found in Chapter 3. The same variables were used in this analysis.

Results

Descriptive statistics (means ± SD and 95% CI for continuous variables; proportions (%) for categorical variables) for each analysis can be found in table 6.

No relationship between vocabulary and mental health before including the control variables was observed (β= -.03 [-.06; .01]).

Table 7 reports pooled estimates for individual predictors in each model in relation to age 16 internalising symptoms. Compared to a model with no predictors, SES variables significantly improve the model fit, (Dm(12, 1228.95)= 10.17, p<.001). Compared to a model with only SES at birth variables, a model that also included childhood controls was significantly different, (Dm(5, 427.99)=6.62, p<.001). Compared to a model with all childhood variables, adding receptive vocabulary scores in model 3 did not significantly improve the model fit, (Dm(2, 120.68)=.13, p=.883). Adding quadratic and cubic terms to the vocabulary predictor did not significantly improve the model fit, (Dm(2, 221.59)= .33, p=.719).

These results suggest that adding vocabulary scores does not improve the model fit, indicating that age five vocabulary size does not predict any unique variance in age 16 mental health in this cohort. The partial R^2 value of the vocabulary predictor further supports this. The cubic term did not improve the model fit, suggesting the absence of non-linear relationships between age 5 vocabulary and age 16 mental health.

Tables

Table 6: Mean (SD), proportions (%) and 95% confidence intervals for BCS self-reported age 16 mental health: White, English-speaking subsample (N=10,725)

	Mean (SD) or % [95%CI]
Mental health	
Age 16 self-reported internalising symptoms	3.75(2.22)[3.71;3.79]
Age 16 parent-reported internalising symptoms	1.93(1.89)[1.90;1.97]
Vocabulary	
Age 5 vocabulary score (EPVT)	35.78(10.49)[35.58;35.98]
Age of CM at the time of vocabulary test (months)	60.9(1.26)[60.87; 60.92]
Biological Risk Variables	
Birthweight (g)	3339.54(514.99)[3329.79;3349.29]
Gestational age (days)	282.05(16.42)[281.74;282.05]
Sex (female)	48.07%
Socioeconomic variables	
Occupation (Professional & Managerial)	21.11%
Occupation (skilled manual and skilled non-manual)	62.59%
Occupation (semi-skilled/unskilled)	15.4%
Occupation (unemployed)	0.9%
Parental education (Degree +)	13.92%
Parental education (Certificate of education)	1.67%
Parent education (SRN (state registered nurse)	1.6%
Parent education (A levels)	8.1%
Parent education (O level)	21.45%
Parent education (Vocational qualification)	13.31%
Parent education: no qualifications	39.96%
Childhood psychosocial variables	
Teen mum (yes)	8.73%
Marital status (not partnered)	4.75%
Maternal depression (CM age 5)	4.26(3.57)[4.19;4.33]
Age 5 CM externalising difficulties	1.79(1.63)[1.75;1.82]
Age 5 CM internalising difficulties	1.51(1.5)[1.48;1.54]

Table 7: Analysis of BCS data with age 16 depressive symptoms as the outcome variable: White, English-speaking subsample (N=10,725)

Variable	Model 1 Coef[95% CI] ***Partial R^2***	Model 2 Coef[95% CI] ***Partial R^2***	Model 3 Coef[95% CI] ***Partial R^2***
Birthweight (g)	-.02[-.05;.01], *p=.13* ***0.0003***	-.01[-.04;.02], *p=.33* ***0.0001***	-.01[-.04;.02], *p=.32* ***0.0001***
Gestational age (days)	.02[-.02;.05], *p=.34* ***0.0002***	.01[-.02;.05], *p=.38* ***0.0002***	.01[-.02;.05], *p=.38* ***0.0002***
Sex (female)	.29[.24;.34]**, *p=.00* ***0.0205***	.31[.26;.36]**, *p=.00* ***0.0228***	.31[.26;.36]**, *p=.00* ***0.0227***

Occupation (skilled manual/skilled non-manual) [c]	.02[-.06;.09], *p=.66* ***0***	-.00[-.07;.07], *p=.96* ***0***	-.00[-.07;.07], *p=.97* ***0***
Occupation (semi-skilled/unskilled)	.01[-.09;.12], *p=.77*	-.02[-.13;.09], *p=.71*	-.02[-.12;.09], *p=.73*
Occupation (unemployed)	.02[-.25;.30], *p=.73*	-.01[-.28;.27], *p=.92*	-.01[-.28;.27], *p=.92*
Parental education [d] (Certificate of education)	.06[-.12;.23], *p=.58* ***0***	.05[-.13;.23], *p=.65* ***0***	.05[-.13;.23], *p=.65* ***0***
Parent education (SRN (state registered nurse)	-.00[-.18;.18], *p=.93*	-.01[-.19;.17], *p=.87*	-.01[-.19;.17], *p=.88*
Parent education (A levels)	.03[-.09;.15], *p=.67*	.02[-.10;.14], *p=.78*	.02[-.10;.14], *p=.77*
Parent education (O level)	.02[-.07;.12], *p=.64*	.01[-.08;.10], *p=.86*	.01[-.08;.11], *p=.85*
Parent education (Vocational qualification)	-.00[-.11;.11], *p=.90*	-.01[-.13;.10], *p=.70*	-.01[-.13;.10], *p=.73*
Parent education: no qualifications	.03[-.07;.13], *p=.46*	.00[-.10;.10], *p=.90*	.01[-.10;.11], *p=.85*
Teen mum (yes)		.13[.03;.23]*, *p=.01* ***0.0012***	.13[.03;.23]*, *p=.01* ***0.0012***
Marital status (not partnered)		.01[-.11;.13], *p=.78* ***0***	.01[-.11;.13], *p=.78* ***0***
Maternal depression (CM age 5)		.01[-.01;.04], *p=.43* ***0.0001***	.01[-.01;.04], *p=.42* ***0.0001***
Age 5 CM externalising difficulties		.06[.02;.09]**, *p=.00* ***0.003***	.06[.02;.10]**, *p=.00* ***0.0031***
Age 5 CM internalising difficulties		.04[.02;.07]*, *p=.02* ***0.0017***	.04[.02;.07]*, *p=.02* ***0.0017***
Age of CM when took vocabulary test (months)			.00[-.02;.03], *p=.83* ***0***
Age 5 vocabulary score			.01[-.03;.04], *p=.72* ***0.0001***
R^2	0.0222	0.0306	0.0308

[a] ethnicity reference group = white, [b] Main language used in home reference group = only English, [c] occupation reference group = professional & managerial, [d] parent education reference group = higher degree, [e] Income quintile reference group = lowest quintile. * p <.05, ** p <.01.

Section 4: Sensitivity analysis 2, MCS self-reported mental health: White, English-speaking subsample (N=10,758)

Rationale

As a sensitivity check, we carried out the MCS analysis described in Chapter 3, on a subsample of the cohort. This subsample was comprised of only White, English-speaking cohort members. This gave us a final sample of 10,758 cohort members. The main MCS analysis controlled for additional indicators of SES (income and wealth). However, such measures are not available for the BCS cohort; therefore, in this sensitivity analysis, we do not control for income and wealth, to match the BCS sensitivity analysis.

Measures

Details of the predictor, outcome and control variables can be found in Chapter 3. The same variables were used in this analysis, although wealth and income were removed to match the BCS control variables.

Results

Descriptive statistics (means ± SD and 95% CI for continuous variables; proportions (%) for categorical variables) for each analysis can be found in table 8.

No relationship between vocabulary and mental health before including the control variables was observed (β= 0 [-.02; .03]).

Compared to a model with no predictors, sociodemographic variables significantly improve the model fit, (Dm(12, 1376.006)= 45.26, p<.001). Compared to a model with only sociodemographic variables, a model that also included childhood psychosocial controls was significantly different, (Dm(5, 622.082)=13.21, p<.001). Compared to a model with all childhood variables, adding expressive vocabulary scores in model 3 was significantly different, (Dm(2, 427.86)=3.58, p=.029). Adding quadratic and cubic terms to the vocabulary predictor did not significantly improve the model fit, (Dm(2, 463.61)= 1.24, p=.29) (Table 9).

Although age 5 vocabulary was a significant predictor of age 14 mental health in this subsample, adding the vocabulary predictor to the model did not significantly improve the model fit. This differs from the main pre-registered analysis.

Tables

Table 8: Mean (SD), proportions (%) and 95% confidence intervals for MCS self-reported age 14 mental health: White, English-speaking subsample (N=10,758)

	Mean (SD) or % [95%CI]
Mental Health	
Age 14 self-reported internalising symptoms	5.72(5.96)[5.6;5.83]
Age 14 parent-reported internalising symptoms	1.96(2.12)[1.92;2.00]
Vocabulary	
Age 5 vocabulary (naming vocabulary)	111.08(14.27)[110.81;111.35]
Age of CM at time of vocabulary test (months)	62.49(2.89)[62.43;62.54]
Biological risk variables	
Birthweight (g)	3367.14(616.81)[3355.48;3378.80]
Gestational age (days)	276.42(13.24)[276.17;276.67]
Sex (female)	49.05%
Sociodemographic variables	
Occupation (NS-SEC Higher managerial)	49.01%
Occupation (NS-SEC intermediate occupations)	18.69%
Occupation (NS-SEC Routine& Manual occupations	25.41%
Unemployed	6.89%
Parent education (higher degree)	7.05%
Parent education (first degree)	19.97%
Parent education (diploma in higher education)	13.59%
Parent education (A levels)	10.38%
Parent education (O levels/GCSE grades A-C)	34.42%
Parent education (GCSE grades D-G)	7.36%
Parent education(none of these/ other incl overseas)	7.23%
Childhood psychosocial controls	
Teen mum (yes)	4.08%
Marital status (not partnered)	33.16%
Maternal depression (CM age 5)	2.95(3.61)[2.88;3.02]
Age 5 CM externalising difficulties	1.19(1.53)[1.17;1.22]
Age 5 CM internalising difficulties	1.28(1.49)[1.25;1.31]

Means, SDs, proportions and 95% CIs are sample weighted. Proportions are excluding missing values.

Table 9: Analysis of MCS data with age 14 internalising symptoms as the outcome variable: White, English-speaking subsample (N=10,758)

Variable	Model 1 Coef[95% CI] ***Partial R^2***	Model 2 Coef[95% CI] ***Partial R^2***	Model 3 Coef[95% CI] ***Partial R^2***
Birthweight (g)	.03 [-.03;.08] *p*=.31 ***.0006***	.03[-.03;.08] *p*=.29 ***.0006***	.03[-.02;.08] *p*=.28 ***.0007***
Gestational age (days)	-.01[-.04;.03] *p*=.68 ***0***	-.01[-.04;.03] *p*=.72 ***0***	-.01[-.04;.03] *p*=.71 ***0***
Sex (female)	.55[.50;.59]**	.55[.51;.60]**	.55[.51;.59]**

	p<.001 ***.0744***	*p*<.001 ***.0758***	*p*<.001 ***.0754***
Occupation (NS-SEC intermediate occupations)[a]	.03[-.03;.09] *p*=.34 ***.0028***	.02[-.04;.08] *p*=.49 ***.0008***	.03[-.04;.09] *p*=.42 ***.001***
Occupation (NS-SEC Routine& Manual occupations	.10[.03;.16]** *p*<.001	.06[-.01;.13] *p*=.08	.07[-.00;.13] *p*=.05
Unemployed	.23[.13;.33]** *p*<.001	.14[.03;.24]* *p*=.01	.15[.04;.26]* *p*=.01
Parent education (first degree)[b]	-.05[-.13;.04] *p*=.30 ***.0004***	-.04[-.13;.04] *p*=.31 ***0***	-.04[-.13;.04] *p*=.35 ***0***
Parent education (diploma in higher education)	.00[-.09;.10] *p*=.96	-.01[-.10;.09] *p*=.88	-.00[-.10;.09] *p*=.99
Parent education (a levels)	.01[-.09;.12] *p*=.82	-.00[-.11;.10] *p*=.96	.01[-.10;.11] *p*=.88
Parent education (O levels/GCSE grades A-C	-.00[-.10;.09] *p*=.95	-.03[-.12;.07] *p*=.56	-.01[-.11;.08] *p*=.76
Parent education (GCSE grades D-G)	.06[-.06;.18] *p*=.35	.01[-.11;.13] *p*=.91	.02[-.10;.14] *p*=.70
Parent education (none of these/other incl overseas)		-.02[-.15;.10] *p*=.72	-.00[-.13;.12] *p*=.96
Teen mum (yes)		.00[-.12;.13] *p*=.99 ***0***	.00[-.13;.13] *p*=.99 ***0***
Marital status (not partnered)		.08[.02;.13]** *p*<.001 ***.0011***	.08[.03;.13]** *p*<.001 ***.0012***
Maternal depression (CM age 5)		.07[.05;.10]** *p*<.001 ***.0044***	.07[.05;.10]** *p*<.001 ***.0045***
Age 5 CM externalising difficulties		.04[.02;.06]** *p*<.001 ***.0013***	.04[.02;.07]** *p*<.001 ***.0014***
Age 5 CM internalising difficulties		.01[-.01;.04] *p*=.34 ***.0001***	.01[-.01;.04] *p*=.30 ***.0001***
Age of CM at time of vocabulary test (months)			.01[-.01;.03] *p*=.37 ***0***
Age 5 vocabulary score			.03[.00;.05]* *p*=.02 ***.0006***
R^2	0.0802	0.0896	0.0904

[a] NS-SEC reference group = higher managerial, administrative and professional occupations, [b] parent education reference group = higher degree. * p <.05, ** p <.01.

Section 5: Supplementary analysis 1: BCS parent-reported adolescent internalising symptoms as the outcome variable (N=11640)

Rationale

There are multiple potential reporters for adolescent mental health. Rates of agreement between parent and self-reported symptoms of adolescent internalising symptoms are known to be low (Rescorla et al, 2013). Self-reported symptoms were considered as our main pre-registered analysis, due to the unique positioning of individuals to report on how they are feeling. However, we acknowledge that there are multiple reporters of mental health and we therefore report parent-reported symptoms of adolescent internalising symptoms as a supplementary analysis. This was not a pre-registered analysis.

Measures

Details of the predictor and control variables can be found in Chapter 3. The same variables were used in this analysis.

Outcome variable: Parent reported internalising symptoms (age 16)

When cohort members were aged 16, their parents completed the Rutter "A" scale (Rutter et al, 1970) as a measure of their mental health. This indicates behavioural difficulties a child may have (Rutter, 1967; Rutter et al, 1970). A high score on this scale indicates problems in behavioural adjustment. Scores on the neurotic subscale were totalled and used as the measure of parent-reported depressive symptoms. For our sample, there was an alpha coefficient of 0.64.

Results

Descriptive statistics (means ± SD and 95% CI for continuous variables; proportions (%) for categorical variables) for each analysis can be found in table 1 of Chapter 3 file.

There was a significant negative relationship between age 5 vocabulary size and parent-reported age 16 mental health, before control variables were added (-.12[-.14; -.10]).

Table 10 reports pooled estimates for individual predictors in each model in relation to parent reported age 16 mental health, when vocabulary is considered as a continuous predictor. Compared to a model with no predictors, sociodemographic variables significantly improved the model fit, (Dm(14, 3149.80)= 13.24, p<.001). Compared to a model with only sociodemographic variables, a model that also included childhood controls was significantly

different, (Dm(5, 668.18)=63.21, p<.001). Compared to a model with all childhood variables, adding receptive vocabulary scores in model 3 accounted for significantly more variance in the outcome, (Dm(2, 223.3)=12.37, p<.001). A model with quadratic and cubic terms added to the vocabulary predictor was not a significantly better fit to the data, (Dm(2, 306.47)= 2.67, p=.071).

The results of this supplementary analysis suggest that lower vocabulary scores in childhood were predictive of more parent reported mental health symptoms in adolescence.

Tables

Table 10: Analysis of BCS data with parent-reported age 16 internalising symptoms as the outcome variable (N=11,640)

Variable	Model 1 Coef[95% CI] ***Partial R^2***	Model 2 Coef[95% CI] ***Partial R^2***	Model 3 Coef[95% CI] ***Partial R^2***
Birthweight (g)	-.04[-.06;-.01]**, *p=.00* ***0.0013***	-.03[-.05;-.00]*, *p=.05* ***0.0005***	-.02[-.05;.00], *p=.12* ***0.0003***
Gestational age (days)	.00[-.02;.03], *p=.88* ***0***	.00[-.02;.03], *p=.84* ***0***	.00[-.02;.03], *p=.89* ***0***
Sex (female)	.24[.19;.28]**, *p=.00* ***0.014***	.27[.22;.31]**, *p=.00* ***0.0182***	.25[.21;.30]**, *p=.00* ***0.0165***
Ethnicity (minority) [a]	.10[-.04;.24], *p=.12* ***0.0002***	.06[-.08;.19], *p=.35* ***0***	.02[-.12;.16], *p=.70* ***0***
Language used in home (other than English) [b]	.04[-.12;.20], *p=.67* ***0***	.07[-.09;.22], *p=.41* ***0***	.03[-.12;.19], *p=.72* ***0***
Occupation (skilled manual/skilled non-manual) [c]	.06[-.00;.12], *p=.05* ***0.0009***	.02[-.04;.08], *p=.61* ***0***	.01[-.05;.07], *p=.77* ***0***
Occupation (semi-skilled/unskilled)	.12[.04;.20]*, *p=.01*	.03[-.05;.12], *p=.53*	.02[-.07;.10], *p=85*
Occupation (unemployed)	.13[-.11;.36], *p=.24*	.04[-.20;.27], *p=.70*	.01[-.22;.25], *p=84*
Parental education [d] (Certificate of education)	.18[.01;.34]*, *p=.03* ***0.0032***	.14[-.03;.31], *p=.06* ***0.0008***	.13[-.04;.30], *p=.07* ***0.0004***
Parent education (SRN (state registered nurse)	.10[-.06;.27], *p=.19*	.09[-.07;.25], *p=23*	.08[-.08;.24], *p=.31*
Parent education (A levels)	.11[.01;.21]*, *p=.02*	.10[.00;.19]*, *p=.04*	.09[-.00;.19]*, *p=.05*
Parent education (O level)	.10[.02;.18]**, *p=*.00	.08[.01;.15]*, *p=.03*	.06[-.01;.14], *p=.07*
Parent education (Vocational qualification)	.13[.04;.21]** *p=.00*	.08[-.01;.16], *p=.06*	.06[-.02;.14], *p=.13*

Parent education: no qualifications	.20[.12;.27]** *p=.00*	.11[.03;.19]**, *p=.00*	.08[.00;.16]*, *p=.01*
Teen mum (yes)		.07[-.00;.15] ***0.0004***	.06[-.02;.14], *p=.15* ***0.0002***
Marital status (not partnered)		.09[-.02;.19] ***0.0003***	.08[-.02;.19], *p=.09* ***0.0003***
Maternal depression (CM age 5)		.14[.11;.17]** *p=.00* ***0.0175***	.14[.11;.17]**, *p=.00* ***0.0168***
Age 5 CM externalising difficulties		.10[.07;.12]** *p=.00* ***0.0088***	.09[.06;.12]**, *p=.00* ***0.0075***
Age 5 CM internalising difficulties		.13[.11;.16]** *p=*.00 ***0.0183***	.14[.12;.16]**, *p=.00* ***0.0189***
Age of CM when took vocabulary test (months)			.03[.01;.05]**, *p=.02* ***0.0008***
Age 5 vocabulary score			-.06[-.08;-.03]**, *p=.00* ***0.0028***
R^2	0.0257	0.0921	0.0954

[a] ethnicity reference group = European UK, [b] language used in the home reference group = English, [c] occupation reference group = professional & managerial, [d] parent education reference group = degree+. * p <.05, ** p <.01.

Section 6: Sensitivity analysis 3: BCS parent-reported internalising symptoms: White, English-speaking sub-sample (N=10,725)

Rationale

As a sensitivity check, we carried out the BCS parent-reported analysis, on a subsample of the cohort. This subsample was comprised of only White, English-speaking cohort members, giving a final sample of 10,725 cohort members.

Measures

Details of the predictor and control variables can be found in Chapter 3. The same variables were used in this analysis.

Outcome variable: Parent reported internalising symptoms (age 16)

When cohort members were aged 16, their parents completed the Rutter "A" scale (Rutter et al, 1970) as a measure of their mental health. This indicates behavioural difficulties a child may have (Rutter, 1967; Rutter et al, 1970). A high score on this scale indicates

problems in behavioural adjustment. Scores on the neurotic subscale were totalled and used as the measure of parent-reported depressive symptoms.

Controls

The control variables were identical to those outlined in Chapter 3.

Results

Descriptive statistics (means ± SD and 95% CI for continuous variables; proportions (%) for categorical variables) for each analysis can be found in table 6, section 4.

There was a significant negative relationship between age 5 vocabulary size and parent-reported age 16 mental health, before control variables were added (-.12[-.15; -.09]).

Table 11 reports pooled estimates for individual predictors in each model in relation to parent reported age 16 mental health, when vocabulary is considered as a continuous predictor. Compared to a model with no predictors, sociodemographic variables significantly improved the model fit, (Dm(12, 3420.78)= 15.98, p<.001). Compared to a model with only sociodemographic variables, a model that also included childhood controls was significantly different, (Dm(5, 676.46)=61.54, p<.001). Compared to a model with all childhood variables, adding receptive vocabulary scores in model 3 accounted for significantly more variance in the outcome, (Dm(2, 243.66)=12.67, p<.001). A model with quadratic and cubic terms added to the vocabulary predictor was a significantly better fit to the data, (Dm(2, 246.79)= 2.43, p=.09).

The results of this supplementary analysis support the parent-reported analysis on all ethnicities and languages spoken in the home, suggesting that lower vocabulary scores in childhood were predictive of more parent reported mental health symptoms in adolescence.

Tables

Table 11: Analysis of BCS data with age 16 parent-reported depressive symptoms as the outcome variable: White, English-speaking sample (N=10,725)

Variable	Model 1 Coef[95% CI] ***Partial R^2***	Model 2 Coef[95% CI] ***Partial R^2***	Model 3 Coef[95% CI] ***Partial R^2***
Birthweight (g)	-.04[-.07;-.02]**, *p*= .00 ***0.0017***	-.03[-.05;-.00]*, *p=.04* ***0.0007***	-.02[-.05;.00], *p=.08* ***0.0005***
Gestational age (days)	.01[-.02;.03], *p*= .75 ***0***	.01[-.02;.03], *p=.73* ***0***	.00[-.02;.03], *p=.77* ***0***
Sex (female)	.24[.19;.29]**,	.27[.22;.32]** ,	.26[.21;.30]**,

	p=.00	*p=.00*	*p=.00*
	0.0145	***0.0186***	***0.0167***
Occupation (skilled manual/skilled non-manual) [c]	.07[.00;.13]* , *p=* .03	.03[-.04;.09], *p=.34*	.02[-.04;.08], *p=.45*
	0.001	***0***	***0***
Occupation (semi-skilled/unskilled)	.13[.04;.22]* , *p=.01*	.05[-.04;.14], *p=.28*	.03[-.06;.12], *p=.49*
Occupation (unemployed)	.15[-.08;.38] , *p=.22*	.09[-.13;.31], *p=.45*	.07[-.15;.29], *p=.57*
Parental education [d] (Certificate of education)	.15[-.02;.33] , *p=.09*	.15[-.01;.31], *p=.16*	.15[-.01;.31], *p=.16*
	0.0036	***0.0012***	***0.0006***
Parent education (SRN (state registered nurse)	.09[-.09;.28], *p=.31*	.08[-.10;.26], *p=.40*	.06[-.11;.24], *p=.51*
Parent education (A levels)	.10[.00;.19], *p=.05*	.08[-.02;.18], *p=.09*	.08[-.02;.18], *p=.11*
Parent education (O level)	.10[.02;.17]* , *p=.02*	.07[-.01;.14], *p=.08*	.06[-.02;.13], *p=.14*
Parent education (Vocational qualification)	.15[.06;.24]** , *p=.00*	.10[.02;.19]* , *p=.04*	.07[-.01;.15], *p=.10*
Parent education: no qualifications	.20[.13;.28]**, *p=.00*	.12[.05;.19]**, *p=.00*	.09[.02;.16]*, *p=.03*
Teen mum (yes)		.06[-.02;.14], *p=.19*	.05[-.04;.13], *p=.30*
		0.0002	***0.0001***
Marital status (not partnered)		.08[-.04;.20], *p=.14*	.08[-.04;.20], *p=.15*
		0.0002	***0.0002***
Maternal depression (CM age 5)		.13[.11;.16]**, *p=.00*	.13[.10;.16]**, *p=.00*
		0.0162	***0.0154***
Age 5 CM externalising difficulties		.10[.07;.12]**, *p=.00*	.09[.07;.11]**, *p=.00*
		0.0088	***0.0074***
Age 5 CM internalising difficulties		.15[.12;.17]**, *p=.00*	.15[.13;.17]** , *p=.00*
		0.0221	***0.0227***
Age of CM when took vocabulary test (months)			.03[.00;.05]*, *p=* .02
			0.0007
Age 5 vocabulary score			-.06[-.08;-.03]**, *p=.00*
			0.0032
R^2	0.0267	0.0948	0.0983

[a] ethnicity reference group = white, [b] Main language used in home reference group = only English, [c] occupation reference group = professional & managerial, [d] parent education reference group = higher degree, [e] Income quintile reference group = lowest quintile. * p <.05, ** p <.01.

Section 7: Supplementary analysis 2: MCS parent-reported internalising symptoms as the outcome variable (N=14,754)

Rationale

There are multiple potential reporters for adolescent mental health. Rates of agreement between parent and self-reported symptoms of adolescent internalising symptoms are known to be low (Rescorla et al, 2013). Self-reported symptoms were considered as our main pre-registered analysis, due to the unique positioning of individuals to report on how they are feeling. However, we acknowledge that there are multiple reporters of mental health and we therefore report parent-reported symptoms of adolescent internalising symptoms as a supplementary analysis. This was not a pre-registered analysis.

Measures

Details of the predictor and control variables can be found in Chapter 3. The same variables were used in this analysis.

Outcome variable: Parent reported internalising symptoms (age 14)

When cohort members were aged 14, their parents completed the SDQ as a measure of their adolescent's mental health (Goodman, 1997). This is a short behavioural screening tool, used with children aged 3-16. We used total scores from the emotional items subscale in our analysis as the outcome variable of parent-reported mental health. For our sample, the alpha coefficient was 0.72.

Results

Descriptive statistics (means ± SD and 95% CI for continuous variables; proportions (%) for categorical variables) for each analysis can be found in table 2 of Chapter 3.

There was a significant negative relationship between age 5 vocabulary size and parent-reported age 14 mental health, before control variables were added (-.12[-.14; -.10]).

Table 12 reports pooled estimates for individual predictors in each model in relation to parent reported age 16 mental health, when vocabulary is considered as a continuous predictor. Compared to a model with no predictors, sociodemographic variables significantly improved the model fit, (Dm(24, 4099.5)= 27.63, p<.001; see table 6, supplementary file section 9). Compared to a model with only sociodemographic variables, a model that also included childhood controls was significantly different, (Dm(5, 643.26)=213.69, p<.001). Compared to a model with all childhood variables, adding expressive vocabulary scores in model 3 accounted for significantly more variance in the outcome, (Dm(2, 365.16)=5.25,

p=.005). We examined a model with quadratic and cubic terms which did not improve the model fit, (Dm(2, 307.94)= 1.06, *p*=.347.

The results of this supplementary analysis suggest that lower vocabulary scores in childhood were predictive of more parent reported mental health symptoms in adolescence.

Tables

Table 12: Analysis of MCS data with parent-reported age 14 internalising symptoms as the outcome variable (N=14,754)

Variable	Model 1 Coef[95% CI] ***Partial R^2***	Model 2 Coef[95% CI] ***Partial R^2***	Model 3 Coef[95% CI] ***Partial R^2***
Birthweight (g)	.01[-.03;.04] *p*=.67 ***0***	-.00[-.03;.03] *p*=.97 ***0***	-.00[-.03;.03] *p*=.98 ***0***
Gestational age (days)	-.05 [-.07;-.03]** *p*<.001 ***0***	-.04[-.06;-.02]** *p*<.001 ***.0014***	-.04[-.06;-.02]** *p*<.001 ***.0014***
Sex (female)	.28[.25;.32]** *p*<.001 ***.0216***	.28[.25;.32]** *p*<.001 ***.0239***	.29[.25;.32]** *p*<.001 ***.0243***
Ethnicity (mixed)[a]	-.03[-.15;.08] *p*=.60 ***.0002***	-.06[-.17;.05] *p*=.27 ***.0002***	-.06[-.17;.05] *p*=.26 ***.0003***
Ethnicity (Indian)	-.10[-.26;.06] *p*=.22	-.12[-.28;.03] *p*=.12	-.12[-.28;.03] *p*=.11
Ethnicity (Pakistani/Bangladeshi)	.01[-.12;.14] *p*=.88	-.07[-.19;.06] *p*=.28	-.09[-.21;.04] *p*=.16
Ethnicity (Black)	-.09[-.23;.05] *p*=.20	-.09[-.22;.05] *p*=.21	-.10[-.23;.04] *p*=.15
Ethnicity (Other)	.08[-.11;.27] *p*=.41	-.01[-.20;.17] *p*=.90	-.03[-.21;.16] *p*=.78
Main language in home (English and another language)[b]	-.01[-.11;.09] *p*=.81 ***0***	-.01[-.11;.08] *p*=.79 ***0***	-.03[-.12;.07] *p*=.58 ***0***
Main language in home (only another language)	.07[-.08;.22] *p*=.35	.05[-.10;.19] *p*=.52	.03[-.12;.17] *p*=.73
Occupation (NS-SEC intermediate occupations)[c]	.02[-.04;.07] *p*=.54 ***.0021***	.02[-.03;.07] *p*=.47 ***.0002***	.02[-.04;.07] *p*=.54 ***.0001***
Occupation (NS-SEC Routine& Manual occupations	.07[.01;.12* *p*=.02	.02[-.04;.07] *p*=.54	.01[-.04;.06] *p*=.66
Unemployed	.21[.12;.31]** *p*<.001	.08[-.01;.17] *p*=.08	.07[-.02;.16] *p*=.13
Parent education (first degree)[d]	.01[-.06;.09] *p*=.70 ***.0034***	.01[-.06;.08] *p*=.79 ***.0012***	.01[-.06;.08] *p*=.84 ***.0009***
Parent education (diploma in higher education)	.11[.03;.19]* *p*=.01	.09[.01;.16]* *p*=.03	.08[.00;.16]* *p*=.04

Parent education (a levels)	.08[-.02;.17] *p*=.10	.07[-.03;.16] *p*=.16	.06[-.03;.15] *p*=.22
Parent education (o levels/GCSE grades A-C	.12[.04;.20]** *p*<.001	.10[.02;.18]* *p*=.01	.09[.01;.16]* *p*=.03
Parental education (GCSE grades D-G)	.23[.11;.34]** *p*<.001	.14[.03;.25]* *p*=.01	.13[.02;.24]* *p*=.02
Parental education (none of these/other incl overseas)	.25[.15;.35]** *p*<.001	.13[.03;.23]* *p*=.01	.11[.01;.21]* *p*=.03
Income (second quintile)[e]	-.06[-.12;.01] *p*=.08 ***.0039***	-.04[-.10;.02] *p*=.18 ***.0015***	-.04[-.10;.02] *p*=.18 ***.0013***
Income (third quintile)	-.16[-.22;-.09]** *p*<.001	-.10[-.16;-.03]** *p*<.001	-.10[-.16;-.03]** *p*<.001
Income (fourth quintile)	-.19[-.26;-.12]** *p*<.001	-.12[-.19;-.05]** *p*<.001	-.11[-.18;-.04]** *p*<.001
Income (highest quintile)	-.24[-.32;-.16] *p*<.001	-.15[-.23;-.07]** *p*<.001	-.14[-.22;-.07]** *p*<.001
Total net wealth	-.00[-.02;.01] *p*=.67 ***0***	-.00[-.02;.01] *p*=.67 ***0***	-.00[-.02;.01] *p*=.71 ***0***
Teen mum (yes)		-.03[-.13;.06] *p*=.51 ***0***	-.03[-.13;.06] *p*=.51 ***0***
Marital status (not partnered)		.03[-.01;.07] *p*=.12 ***.0002***	.03[-.01;.07] *p*=.12 ***.0002***
Maternal depression (CM age 5)		.10[.08;.13]** *p*<.001 ***.0102***	.10[.08;.13]** *p*<.001 ***.0101***
Age 5 CM externalising difficulties		.10[.08;.12]** *p*<.001 ***.0093***	.10[.08;.12]** *p*<.001 ***.009***
Age 5 CM internalising difficulties		.24[.22;.27]** *p*<.001 ***.054***	.24[.22;.26]** p<.001 ***.0533***
Age of CM at time of vocabulary test (months)			-.01[-.03;.01] *p*=.42 ***0***
Age 5 vocabulary score			-.03[-.05;-.01]** *p*<.001 ***.0008***
R^2	0.061	0.1641	0.1649

[a] ethnicity reference group = white, [b] Main language used in home reference group = only English, [c] NS-SEC reference group = higher managerial, administrative and professional occupations, [d] parent education reference group = higher degree, [e] Income quintile reference group = lowest quintile. * p <.05, ** p <.01.

Section 8: Sensitivity analysis 4: MCS parent-reported age 14 internalising symptoms: White, English speaking sub-sample (N=10,758)

Rationale

As a sensitivity check, we carried out the MCS analysis described in Chapter 3, on a subsample of the cohort. This subsample was comprised of only White, English-speaking cohort members. This gave us a final sample of 10,758 cohort members. The main MCS analysis controlled for additional indicators of SES (income and wealth). However, such measures are not available for the BCS cohort; therefore, in this sensitivity analysis, we do not control for income and wealth, to match the BCS sensitivity analysis.

Measures

Details of the predictor and control variables can be found in Chapter 3. The same variables were used in this analysis, although wealth and income were removed to match the BCS analysis controls.

Outcome variable: Adolescent Mental Health

When cohort members were aged 14, their parents completed the SDQ as a measure of their adolescent's mental health (Goodman, 1997). This is a short behavioural screening tool, used with children aged 3-16 We used total scores from the emotional items subscale in our analysis as the outcome variable of parent-reported mental health. Higher scores indicated more symptoms (poorer mental health).

Results

Descriptive statistics (means ± SD and 95% CI for continuous variables; proportions (%) for categorical variables) can be found in section 5, table 8.

No relationship between vocabulary and mental health before including the control variables was observed (β=-.12 [-.14; -0.1]).

Compared to a model with no predictors, sociodemographic variables significantly improve the model fit, (Dm(12, 1383.46)= 34.44, p<.001). Compared to a model with only sociodemographic variables, a model that also included childhood psychosocial controls was significantly different, (Dm(5, 683.21)= 182.67, p<.001). Compared to a model with all childhood variables, adding expressive vocabulary scores in model 3 accounted for significantly more variance in the outcome, (Dm(2, 320.33)= 7.09, p=.001). Adding

quadratic and cubic terms to the vocabulary predictor did not significantly improve the model fit, (Dm(2, 341.41)= 0.84, *p*=.434) (Table 13).

Results from this supplementary analysis are very similar to that of the parent-reported analysis with all ethnicities, languages and including Northern Ireland, which allowed for a more representative sample and additional controls. This would suggest that differences found between the two cohorts are a result of cross-cohort differences, rather than the MCS sample and controls being more extensive than that of the BCS analysis.

Tables

Table 13: Analysis of MCS data with parent-reported age 14 internalising symptoms as the outcome variable, White, English-speaking subsample (N=10,758)

Variable	Model 1 Coef[95% CI] ***Partial R^2***	Model 2 Coef[95% CI] ***Partial R^2***	Model 3 Coef[95% CI] ***Partial R^2***
Birthweight (g)	.03[-.02;.08] *p*=.25 ***.0008***	.01[-.04;.06] *p*=.60 ***.0002***	.01[-.04;.06] *p*=.62 ***.0002***
Gestational age (days)	-.05[-.09;-.02]** *p*<.001 ***.0022***	-.03[-.07;-.00]* *p*=.03 ***.0009***	-.03[-.07;-.00]* *p*=.03 ***.0009***
Sex (female)	.31[.26;.35]** *p*<.001 ***.0247***	.30[.26;.34]** *p*<.001 ***.0266***	.30[.26;.34]** *p*<.001 ***.027***
Occupation (NS-SEC intermediate occupations)[a]	.03[-.03;.09] *p*=.29 ***.0077***	.03[-.03;.09] *p*=.29 ***.0013***	.03[-.03;.08] *p*=.38 ***.001***
Occupation (NS-SEC Routine& Manual occupations	.13[.07;.19]** *p*<.001	.04[-.01;.10] *p*=.12	.03[-.02;.09] *p*=.23
Unemployed	.39[.27;.50]** *p*<.001	.17[.05;.29]** *p*<.001	.15[.04;.27]* *p*=.01
Parent education (first degree)[b]	.04[-.05;.12] *p*=.43 ***.0079***	.03[-.06;.11] *p*=.54 ***.0038***	.02[-.06;.11] *p*=.60 ***.0029***
Parent education (diploma in higher education)	.18[.09;.27]** *p*<.001	.15[.06;.24]** *p*<.001	.14[.05;.23]** *p*<.001
Parent education (a levels)	.17[.08;.27]** *p*<.001	.14[.05;.23]** *p*<.001	.12[.03;.21]* *p*=.01
Parent education (O levels/GCSE grades A-C	.23[.14;.32]** *p*<.001	.18[.09;.26]** *p*<.001	.16[.07;.25] *p*<.001
Parent education (GCSE grades D-G	.34[.22;.45]** *p*<.001	.21[.09;.32]** *p*<.001	.18[.07;.30]** *p*<.001
Parent education (none of these/other incl overseas)		.20[.08;.33]** *p*<.001	.18[.05;.30]* *p*=.01
Teen mum (yes)		.01[-.11;.14]	.01[-.11;.14]

		p=.84 ***0*** .04[-.01;.09] *p*=.12 ***.0002*** .12[.09;.14]** *p*<.001 ***.0137*** .10[.07;.12]** *p*<.001 ***.009*** .25[.23;.28]** *p*<.001 ***.0618***	*p*=.84 ***0*** .04[-.01;.09] *p*=.15 ***.0002*** .12[.09;.14]** *p*<.001 ***.0135*** .10[.07;.12]** *p*<.001 ***.0086*** .25[.23;.27]** *p*<.001 ***.0612***
Marital status (not partnered)			
Maternal depression (CM age 5)			
Age 5 CM externalising difficulties			
Age 5 CM internalising difficulties			
Age of CM at time of taking vocabulary test (months)			-.01[-.03;.01] *p*=.44 ***0***
Age 5 vocabulary score			-.04[-.07;-.02]** *p*<.001 ***.0017***
R^2	0.0603	0.1761	0.1777

[a] NS-SEC reference group = higher managerial, administrative and professional occupations, [b] parent education reference group = higher degree, * p <.05, ** p <.01.

Section 9: Supplementary analysis 3: BCS age 34 internalising symptoms as the outcome variable (N=11,640)

Rationale

Schoon et al (2010) used BCS data and dichotomised the vocabulary predictor, whereby those scoring 1 standard deviation below the mean were taken to have poor language ability. We extended their analyses; instead of dichotomising vocabulary , we entered this as a continuous predictor. This was to capture the effects of vocabulary size across the whole continuum, rather than exclusively in a clinical sample, as well as allowing for a direct comparison between adolescent and adulthood mental health in the same cohort.

We included singleton cohort members of all ethnicities and all languages and had a final sample of 11,640 cohort members. 93% of the sample were of a white ethnicity and 97% of cohort members spoke only English in the home.

Measures

Details of the predictor and control variables can be found in Chapter 3. The same variables were used in this analysis.

Outcome variable: Adulthood Mental Health (age 34)

Total scores on a shortened 9-item version of the Malaise Inventory (Rutter et al, 1970) were used as a measure of mental health at age 34 in the BCS. This measures symptoms of psychological distress or depression. Scores ranged from 0-9, with higher scores indicating higher severity of depression. For our sample, there was an alpha coefficient of 0.76.

Results

Descriptive statistics (means ± SD and 95% CI for continuous variables; proportions (%) for categorical variables) for each analysis can be found in table 14.

There was a significant negative relationship between age 5 vocabulary size and age 34 mental health, before control variables were added (-.11[-.14; -.09]).

Table 15 reports pooled estimates for individual predictors in each model in relation to age 34 mental health, when vocabulary is considered as a continuous predictor. Compared to a model with no predictors, sociodemographic variables significantly improved the model fit, (Dm(14, 2035.75)= 10.84, p<.001). Compared to a model with only sociodemographic variables, a model that also included childhood controls was significantly different, (Dm(5, 516.74)=14.55, p<.001). Compared to a model with all childhood variables, adding expressive vocabulary scores in model 3 accounted for significantly more variance in the outcome, (Dm(2, 313.330)=14.04, p<.001). A model with quadratic and cubic terms added to the vocabulary predictor did not significantly improve the model fit, (Dm(2, 693.13)= 2.35, p=.096).

These results suggest that adding vocabulary scores significantly improves the model fit, indicating that age five vocabulary size explains some unique variance in age 34 mental health.

Tables

Table 14: Means (SD), proportions (%) and 95% confidence intervals for BCS analysis sample, age 34 internalising symptoms as the outcome variable (N=11,640)

	Mean (SD) or % [95%CI]
Mental health	

Age 34 self-reported internalising symptoms	1.69(1.90)[1.65;1.72]
Vocabulary	
Age 5 vocabulary score (EPVT)	35.32(10.81)[35.12; 35.51]
Age of CM at the time of vocabulary test (months)	60.92(1.28)[60.89;60.94]
Biological Risk Variables	
Birthweight (g)	3331.09(517.01)[3321.70;3340.48]
Gestational age (days)	281.86(16.44)[281.56; 282.16]
Sex (female)	48.21%
Ethnicity (White UK)	96.22%
Ethnicity (Minority)	3.78%
Socioeconomic variables	
Language used in home (other than English)	2.37%
Occupation (Professional & Managerial)	20.95%
Occupation (skilled manual and skilled non-manual)	61.75%
Occupation (semi-skilled/unskilled)	16.33%
Occupation (unemployed)	0.97%
Parental education (Degree +)	13.7
Parental education (Certificate of education)	1.66%
Parent education (SRN (state registered nurse)	1.67%
Parent education (A levels)	7.88%
Parent education (O level)	21.18%
Parent education (Vocational qualification)	13.2%
Parent education: no qualifications	40.71%
Childhood psychosocial variables	
Teen mum (yes)	8.85%
Marital status (not partnered)	5.37%
Maternal depression (CM age 5)	4.32(3.63) [4.25;4.39]
Age 5 CM externalising difficulties	1.8(1.65) [1.77; 1.83]
Age 5 CM internalising difficulties	1.5(1.5) [1.48; 1.53]

Table 15: Analysis of BCS data with age 34 internalising symptoms as the outcome variable (N=11,640)

Variable	Model 1 Coef[95% CI] ***Partial R^2***	Model 2 Coef[95% CI] ***Partial R^2***	Model 3 Coef[95% CI] ***Partial R^2***
Birthweight (g)	-.02[-.04;.01], *p=.16* ***0.0002***	-.01[-.03;.01], *p=.44* ***0***	-.00[-.03;.02], *p=.72* ***0***
Gestational age (days)	.00[-.02;.03], *p=.71* ***0***	.00[-.02;.03], *p=.71* ***0***	.00[-.02;.03], *p=.79* ***0***
Sex (female)	.24[.20;.29]**, *p=.00* ***0.0148***	.26[.22;.31]**, *p=.00* ***0.0168***	.25[.20;.29]**, *p=.00* ***0.0148***
Ethnicity (minority) [a]	.01[-.14;.17], *p=.88* ***0***	-.03[-.18;.13], *p=.73* ***0***	-.07[-.22;.09], *p=.41* ***0.0001***
Language used in home (other than English) [b]	-.06[-.24;.12], *p=.50*	-.04[-.22;.14], *p=.65*	-.08[-.26;.10], *p=.38*

	0	***0***	***0.0001***
Occupation (skilled manual/skilled non-manual) [c]	.06[-.00;.13], *p=.06*	.03[-.03;.10], *p=.29*	.03[-.04;.09], *p=.41*
	0.0005	***0.0002***	***0.0003***
Occupation (semi-skilled/unskilled)	.08[-.02;.18], *p=.13*	.02[-.08;.12], *p=.73*	-.00[-.10;.10], *p=.95*
Occupation (unemployed)	-.04[-.28;.19], *p=.72*	-.13[-.37;.11], *p=.28*	-.14[-.38;.10], *p=.24*
Parental education [d] (Certificate of education)	.12[-.07;.31], *p=.20*	.11[-.08;.29], *p=.26*	.11[-.08;.29], *p=.27*
	0.006	***0.0034***	***0.0021***
Parent education (SRN (state registered nurse)	.07[-.10;.24], *p=.40*	.07[-.11;.24], *p=.45*	.05[-.12;.22], *p=.55*
Parent education (A levels)	.05[-.05;.15], *p=.32*	.04[-.06;.14], *p=.42*	.04[-.06;.13], *p=.48*
Parent education (O level)	.04[-.04;.11], *p=.36*	.02[-.06;.09], *p=.66*	.00[-.07;.08], *p=.91*
Parent education (Vocational qualification)	.15[.05;.24]**, *p=.00*	.11[.02;.21]* , *p=.02*	.09[-.00;.19]*, *p=.05*
Parent education: no qualifications	.21[.13;.30]**, *p=.00*	.16[.07;.24]**, *p=.00*	.12[.03;.21]*, *p=.01*
Teen mum (yes)		.05[-.05;.14], *p=.32*	.04[-.06;.13], *p=.45*
		0.0001	***0.0001***
Marital status (not partnered)		.12[.00;.23]*, *p=.05*	.11[-.00;.23]*, *p=.05*
		0.0006	***0.0005***
Maternal depression (CM age 5)		.09[.06;.11]**, *p=.00*	.08[.06;.11]**, *p=.00*
		0.0064	***0.0059***
Age 5 CM externalising difficulties		.06[.03;.09]**, *p=.00*	.05[.02;.08]**, *p=.00*
		0.0031	***0.0023***
Age 5 CM internalising difficulties		.04[.01;.06]** , *p=.00*	.04[.01;.06]**, *p=.00*
		0.0011	***0.0013***
Age of CM when they took the vocabulary test (months)			.00[-.02;.02], *p=.87*
			0
Age 5 vocabulary score			-.07[-.09;-.04]**, *p=.00*
			0.0037
R^2	0.0257	0.0435	0.0471

[a] ethnicity reference group = white, [b] Main language used in home reference group = only English, [c] occupation reference group = professional & managerial, [d] parent education reference group = higher degree, [e] Income quintile reference group = lowest quintile. * p <.05, ** p <.01.

Section 10: Sensitivity analysis 5: BCS self-reported complete-case analysis for the vocabulary predictor and internalising symptoms outcome (N=4,132)

Rationale

In our main analyses, we chose to impute the outcome variable (adolescent internalising symptoms) and analyse complete cases in terms of the vocabulary measure. This was to reduce bias of estimates in our regression modelling. However, there is some debate around whether or not the outcome variable should be imputed (Lang & Little, 2016; van Ginkel, Linting, Rippe, & van der Voort, 2019; Von Hippel, 2007). Therefore, we completed a sensitivity analysis where we considered those with complete cases for the outcome variable, to see if this introduced bias into our estimates. Considering complete cases for the vocabulary and internalising symptoms measures gave us a final sample of 4,132 cohort members. We restricted this sensitivity check to self-reported symptoms only, as these were our main pre-registered analyses.

Measures

Details of the predictor, outcome and control variables can be found in Chapter 3. The same variables were used in this analysis.

Results

No relationship between vocabulary and mental health before including the control variables was observed (β= -.03 [-.06; .00]).

Table 16 reports pooled estimates for individual predictors in each model in relation to age 16 internalising symptoms. Compared to a model with no predictors, SES variables significantly improve the model fit, (Dm(14, 661512)= 8.28, p<.001). Compared to a model with only SES at birth variables, a model that also included childhood controls was significantly different, (Dm(5, 2450982)=4.85, p<.001). Compared to a model with all childhood variables, adding receptive vocabulary scores in model 3 did not significantly improve the model fit, (Dm(2, 172291.4)=.04, p=.964). Adding quadratic and cubic terms to the vocabulary predictor did not significantly improve the model fit, (Dm(2, 777287252)= .12, p=.889).

These results support the findings of the main pre-registered BCS analysis, by suggesting that adding vocabulary scores did not improve the model fit, indicating that age five vocabulary size does not predict any unique variance in age 16 internalising mental health in this cohort. The main pattern of results, that there was no relationship between age 5 vocabulary and adolescent self-reported internalising symptoms, remained.

Tables

Table 16: Analysis of BCS data with age 16 internalising symptoms as the outcome variable, complete case analysis for the vocabulary predictor and internalising symptoms outcome (N=4,132)

Variable	Model 1 Coef[95% CI], *p value* ***Partial R^2***	Model 2 Coef[95% CI], *p value* ***Partial R^2***	Model 3 Coef[95% CI], *p value* ***Partial R^2***
Birthweight (g)	-.02[-.05;.02], *p=.33* ***0***	-.01[-.04;.02], *p=.54* ***0***	-.01[-.04;.02], *p=.54* ***0***
Gestational age (days)	-.00[-.04;.03], *p=.84* ***0***	-.00[-.04;.03], *p=.84* ***0***	-.00[-.04;.03], *p=.84* ***0***
Sex (female)	.33[.27;.40]** , *p=.00* ***0.0267***	.35[.29;.41]**, *p=.00* ***0.0285***	.35[.29;.41]**, *p=.00* ***0.0281***
Ethnicity (minority) [a]	.09[-.13;.31], *p=.42* ***0***	.07[-.15;.30], *p=.52* ***0***	.08[-.15;.30], *p=.51* ***0***
Language used in home (other than English) [b]	.02[-.19;.24], *p=.82* ***0***	.05[-.16;.27], *p=.62* ***0***	.05[-.16;.27], *p=.62* ***0***
Occupation (skilled manual/skilled non-manual) [c]	.04[-.04;.12], *p=.36* ***0***	.02[-.06;.10], *p=.63* ***0***	.02[-.06;.10], *p=.62* ***0***
Occupation (semi-skilled/unskilled)	-.02[-.14;.09], *p=69*	-.06[-.18;.06], *p=.34*	-.06[-.18;.06], *p=.35*
Occupation (unemployed)	.13[-.20;.45], *p=.44*	.10[-.22;.42], *p=.55*	.10[-.22;.43], *p=.54*
Parental education [d] (Certificate of education)	.01[-.20;.22], *p=.93* ***0***	.01[-.20;.21], *p=.95* ***0***	.01[-.20;.21], *p=.95* ***0***
Parent education (SRN (state registered nurse)	-.02[-.24;.19], *p=.85*	-.02[-.23;.20], *p=.86*	-.02[-.23;.20], *p=.87*
Parent education (A levels)	.00[-.12;.12], *p=. 99*	.00[-.12;.13], *p=.97*	.00[-.12;.13], *p=.97*
Parent education (O level)	.01[-.09;.11], *p=.85*	.00[-.10;.10], *p=.98*	.00[-.10;.10], *p=.98*
Parent education (Vocational qualification)	-.07[-.19;.05], *p=.28*	-.07[-.19;.05], *p=.25*	-.07[-.19;.05], *p=.25*
Parent education: no qualifications	.00[-.10;.10], *p=.98*	-.02[-.12;.08], *p=.69*	-.02[-.12;.08], *p=.71*
Teen mum (yes)		.09[-.03;.21], *p=.15* ***0.0003***	.09[-.03;.21], *p=.15* ***0.0003***
Marital status (not partnered)		.05[-.11;.21], *p=.55* ***0***	.05[-.11;.21], *p=.55* ***0***
Maternal depression (CM age 5)		.02[-.01;.05], *p=.23*	.02[-.01;.05], *p=.23*

		0.0001	***0.0001***
Age 5 CM externalising difficulties		.05[.02;.08]**, *p=.00*	.05[.02;.09]**, *p=.00*
		0.0024	***0.0024***
Age 5 CM internalising difficulties		.05[.02;.08]**, *p=.00*	.05[.02;.08]**, *p=.00*
		0.0021	***0.0021***
Age of CM at time of vocabulary test (months)			-.00[-.03;.03], *p=.81*
			0
Age 5 vocabulary score			.00[-.03;.03], *p=.91*
			0
R^2	0.0266	0.0334	0.0329

[a] ethnicity reference group = European UK, [b]language used in the home reference group = English, [c] occupation reference group = professional & managerial, [d]parent education reference group = degree+. * p <.05, ** p <.01.

Section 11: Sensitivity analysis 6, MCS self-reported complete case analysis for the vocabulary predictor and internalising symptoms outcome (N=10,310)

Rationale

In our main analyses, we chose to impute the outcome variable (adolescent internalising symptoms) and analyse complete cases in terms of the vocabulary measure. This was to reduce bias of estimates in our regression modelling. However, there is some debate around whether or not the outcome variable should be imputed (Lang & Little, 2016; van Ginkel et al., 2019; Von Hippel, 2007). Therefore, we completed a sensitivity analysis where we considered those with complete cases for the outcome variable, to see if this introduced bias into our estimates. Considering complete cases for the vocabulary and internalising symptoms measures gave us a final sample of 4,132 cohort members. We restricted this sensitivity check to self-reported symptoms only, as these were our main pre-registered analyses.

Measures

Details of the predictor, outcome and control variables can be found in Chapter 3. The same variables were used in this analysis.

Results

A significant *positive* relationship between vocabulary size and self-reported mental health difficulties was observed in an unadjusted model (β= .04 [.01; .06]).

Table 17 reports pooled estimates for individual predictors in each model in relation to age 14 internalising symptoms. Compared to a model with no predictors, SES variables significantly improve the model fit, (Dm(24, 9353.34)= 36.1, p<.001). Compared to a model with only SES at birth variables, a model that also included childhood controls was significantly different, (Dm(5, 3092.76)=18.84, p<.001). Compared to a model with all childhood variables, adding expressive vocabulary scores in model 3 significantly improved the model fit, (Dm(2, 10239.04)=12.3, p=<.001). Adding quadratic and cubic terms to the vocabulary predictor did not significantly improve the model fit, (Dm(2, 10229.54)= .89, p=.409).

These results support the findings of the main pre-registered MCS analysis, as adding age 5 expressive vocabulary scores improved the model fit, indicating they play a unique role in predicting age 14 internalising symptoms. Results found that age 5 vocabulary scores were significantly positively related to age 14 self-reported internalising symptoms, in line with the main pre-registered analysis. The main pattern of results, that there was a positive relationship between age 5 vocabulary and adolescent self-reported internalising symptoms, remained.

Tables

Table 17: Analysis of MCS data with age 14 internalising symptoms as the outcome variable: complete case analysis for the vocabulary predictor and internalising symptoms outcome (N=10,310)

Variable	Model 1 Coef[95% CI], *p value* ***Partial R^2***	Model 2 Coef[95% CI], *p value* ***Partial R^2***	Model 3 Coef[95% CI], *p value* ***Partial R^2***
Birthweight (g)	.00[-.03;.04] *p*=.90 ***0***	.00[-.03;.04] *p*=.94 ***0***	.00[-.03;.04] *p*=.93 ***0***
Gestational age (days)	.00[-.01;.02] *p*=.63 ***0***	.01[-.01;.03] *p*=.51 ***0***	.01[-.01;.03] *p*=.50 ***0***
Sex (female)	.54[.50;.58]** *p*<.001 ***.0726***	.55[.51;.58]** *p*<.001 ***.074***	.55[.51;.58]** *p*<.001 ***.0736***
Ethnicity (mixed)[a]	.03[-.08;.15] *p*=.59 ***.002***	.01[-.11;.13] *p*=.87 ***.002***	.01[-.11;.12] *p*=.89 ***.0015***
Ethnicity (Indian)	-.14[-.31;.02] *p*=.09	-.15[-.31;.02] *p*=.08	-.15[-.31;.02] *p*=.08
Ethnicity (Pakistani/Bangladeshi)	-.31[-.45;-.17]** *p*<.001	-.31[-.45;-.17]** *p*<.001	-.28[-.42;-.14]**

			p<.001
Ethnicity (Black)	-.21[-.35;-.07]** *p*<.001	-.22[-.36;-.08]** *p*<.001	-.20[-.34;-.06]* *p*=.01
Ethnicity (Other)	-.13[-.33;.07] *p*=.19	-.15[-.35;.05] *p*=.13	-.12[-.32;.07] *p*=.22
Main language in home (English and another language)[b]	-.01[-.12;.09] *p*=.82 ***0***	-.00[-.10;.10] *p*=1.00 ***0***	.02[-.08;.12] *p*=.68 ***0***
Main language in home (only another language)	-.03[-.20;.14] *p*=.71	-.02[-.19;.16] *p*=.85	.02[-.16;.19] *p*=.85
Occupation (NS-SEC intermediate occupations)[c]	-.00[-.06;.05] *p*=.92 ***.0002***	-.00[-.06;.05] *p*=.89 ***0***	.00[-.06;.06] *p*=.98 ***0***
Occupation (NS-SEC Routine& Manual occupations	.03[-.03;.09] *p*=.33	.01[-.05;.07] *p*=.71	.02[-.04;.08] *p*=.56
Unemployed	.10[-.00;.20] *p*=.06	.04[-.06;.14] *p*=.39	.06[-.04;.16] *p*=.25
Parent education (first degree)[d]	-.07[-.14;.01] *p*=.09 ***.0001***	-.06[-.14;.01] *p*=.11 ***0***	-.06[-.13;.02] *p*=.13 ***0***
Parent education (diploma in higher education)	-.06[-.14;.03] *p*=.18	-.06[-.15;.02] *p*=.14	-.05[-.14;.03] *p*=.24
Parent education (a levels)	-.06[-.15;.04] *p*=.24	-.06[-.15;.03] *p*=.20	-.05[-.14;.05] *p*=.33
Parental education (o levels/GCSE grades A-C	-.07[-.15;.01] *p*=.09	-.08[-.16;-.00] *p*=.05	-.06[-.15;.02] *p*=.13
Parental education (GCSE grades D-G	.01[-.10;.12] *p*=.91	-.03[-.14;.08] *p*=.54	-.01[-.12;.10] *p*=.86
Parental education (none of these/other incl overseas)	-.05[-.16;.06] *p*=.39	-.09[-.19;.02] *p*=.13	-.05[-.16;.06] *p*=.34
Income (second quintile)[e]	.02[-.05;.09] *p*=.57 ***.0017***	.04[-.04;.11] *p*=.34 ***.0007***	.03[-.04;.11] *p*=.35 ***.0009***
Income (third quintile)	-.07[-.15;.00] *p*=.06	-.03[-.11;.04] *p*=.38	-.04[-.12;.04] *p*=.29
Income (fourth quintile)	-.09[-.16;-.01]* *p*=.04	-.04[-.12;.04] *p*=.36	-.05[-.13;.04] *p*=.27
Income (highest quintile)	-.14[-.23;-.06]** *p*<.001	-.08[-.17;.00] *p*=.05	-.10[-.18;-.01]* *p*=.03
Total net wealth	-.02[-.04;-.00]* *p*=.04 ***.0006***	-.02[-.04;-.00]* *p*=.04 ***.0006***	-.02[-.04;-.00]* *p*=.03 ***.0006***
Teen mum (yes)		-.03[-.15;.09] *p*=.64 ***0***	-.03[-.15;.09] *p*=.64 ***0***
Marital status (not partnered)		.08[.03;.13]** *p*<.001 ***.0011***	.08[.03;.13]** *p*<.001 ***.0011***
Maternal depression (CM age 5)		.07[.05;.09]** *p*<.001 ***.0041***	.07[.05;.09]** *p*<.001 ***.0042***
Age 5 CM externalising difficulties		.05[.02;.07]** *p*<.001 ***.0017***	.05[.03;.07]** *p*<.001 ***.0019***

Age 5 CM internalising difficulties		.02[-.00;.04] *p*=.09 ***.0002***	.02[-.00;.04] *p*=.06 ***.0003***
Age of CM at time of taking vocabulary test (months)			.01[-.01;.03] *p*=.24 ***0***
Age 5 vocabulary score			.05[.03;.08]** *p*<.001 ***.0019***
R^2	0.0814	0.091	0.093

[a] ethnicity reference group = white, [b] Main language used in home reference group = only English, [c] NS-SEC reference group = higher managerial, administrative and professional occupations, [d] parent education reference group = higher degree, [e] Income quintile reference group = lowest quintile. * p <.05, ** p <.01.

Section 12: Exploratory analyses: model comparisons and analyses tables (details in Chapter 3)

Exploratory analyses model comparisons

1. BCS binary vocabulary

When considering a model with no controls, the relationship between age 5 vocabulary as a binary predictor and age 16 mental health was not significant (β=.-.05[-.03;.12]). Coefficients and 95% CIs for all models can be found in table 16. Compared to a model with no predictors, biological and SES variables significantly improved the model fit, (Dm(14, 1535.46)=11.35 *p*<.001) and the subsequent model adding in mother and childhood psychosocial controls was also an improvement (Dm(5, 356.46)=5.16, *p*<.001). Adding the age 5 binary indicator of DLD did not significantly improve the model fit, (Dm(2, 118.01)=0.19, *p*=.824).

2. MCS binary vocabulary

When considering a model with no controls, the relationship between age 5 vocabulary as a binary predictor and age 14 mental health was not significant (β=.-.05[-.11;.01]). Coefficients and 95% CIs for all models can be found in table 17. Compared to a model with no predictors, biological and SES variables significantly improved the model fit, (Dm(24, 4312.52)=36.69, *p*<.001). Compared to a model with only biological and SES variables, a model that also included mother and childhood psychosocial controls was significantly different, (Dm(5, 429.41)=14.43, *p*<.001). Compared to a model with all childhood variables, adding expressive vocabulary scores in model 3 did not significantly improve the model fit, (Dm(2, 452.78)=2.35, *p*=.096).

3. BCS binary internalising symptoms as the outcome

Odds Ratios and 95% CIs for all models can be found in table 18. Compared to a model with only biological and SES variables, a model that also included mother and childhood psychosocial controls was significantly different, (Dm(5, 437.31)=5.91, p<.001). Compared to a model with all childhood variables, adding receptive vocabulary scores in model 3 did not significantly improve the model fit, (Dm(2, 144.44)=.17, p=.842).

4. MCS binary internalising symptoms as the outcome

Odds Ratios and 95% CIs for all models can be found in table 19. Compared to a model with only biological and SES variables, a model that also included mother and childhood psychosocial controls was significantly different, (Dm(5, 177.54)=2.64, p =.025). Compared to a model with all childhood variables, adding expressive vocabulary scores in model 3 did not significantly improve the model fit, (Dm(2, 70.29)=2.3, p =.107).

Exploratory analyses tables

Table 18: Analysis of BCS data with vocabulary considered as a binary predictor, split at 1SD below the mean (N= 11,640)

Variable	Model 1 Coef[95% CI], *p value* ***Partial R^2***	Model 2 Coef[95% CI], *p value* ***Partial R^2***	Model 3 Coef[95% CI], *p value* ***Partial R^2***
Birthweight (g)	-.02[-.05;.01], *p=.23* ***0.0002***	-.01[-.04;.02], *p=.40* ***0.0001***	-.01[-.04;.02], *p=.39* ***0.0001***
Gestational age (days)	-.00[-.04;.03], *p=.89* ***0***	-.00[-.04;.03], *p=.88* ***0.0001***	-.00[-.04;.03], *p=.89* ***0.0001***
Sex (female)	.31[.26;.36]**, *p=.00* ***0.0238***	.32[.27;.37]**, *p=.00* ***0.0252***	.32[.27;.38]**, *p=.00* ***0.0253***
Ethnicity (minority) [a]	.06[-.09;.22], *p=.43* ***0.0001***	.05[-.10;.21], *p=.51* ***0***	.06[-.10;.21], *p=.47* ***0***
Language used in home (other than English) [b]	.02[-.15;.19], *p=.82* ***0***	.03[-.14;.21], *p=.69* ***0***	.04[-.13;.21], *p=.65* ***0***
Occupation (skilled manual/skilled non-manual) [c]	.03[-.05;.10], *p=.48* ***0.0002***	.01[-.06;.08], *p=.74* ***0.0002***	.01[-.06;.08], *p=.74* ***0.0002***
Occupation (semi-skilled/unskilled)	.01[-.09;.11], *p=.89*	-.02[-.12;.08], *p=.71*	-.02[-.12;.09], *p=.74*

Occupation (unemployed)	.15[-.07;.37], *p=.18*	.12[-.11;.35], *p=.29*	.12[-.10;.35], *p=.28*
Parent education [d] (Certificate of education)	.07[-.10;.24], *p=.45* ***0.0002***	.06[-.11;.23], *p=.51* ***0.0002***	.06[-.11;.23], *p=.51* ***0.0002***
Parent education (SRN (state registered nurse)	-.02[-.20;.16], *p=.84*	-.02[-.20;.16], *p=.81*	-.02[-.20;.16], *p=.82*
Parent education (A levels)	.03[-.07;.13], *p=.57*	.02[-.07;.12], *p=.63*	.02[-.07;.12], *p=.63*
Parent education (O level)	.03[-.05;.11], *p=.49*	.02[-.07;.11], *p=.64*	.02[-.06;.11], *p=.64*
Parent education (Vocational qualification)	-.02[-.12;.08], *p=.66*	-.03[-.14;.07], *p=.53*	-.03[-.13;.07], *p=.54*
Parent education: no qualifications	.04[-.05;.13], *p=.38*	.02[-.07;.11], *p=.68*	.02[-.07;.11], *p=.63*
Teen mum (yes)		.09[-.01;.19], *p=.09* ***0.0005***	.09[-.01;.19], *p=.08* ***0.0005***
Marital status (not partnered)		.03[-.09;.15], *p=.60* ***0***	.03[-.09;.15], *p=.58* ***0***
Maternal depression (CM age 5)		.02 [-.01;.04], *p=.29* ***0.0001***	.02[-.01;.04], *p=.28* ***0.0001***
Age 5 CM externalising difficulties		.04[.01;.08]*, *p=.02* ***0.0014***	.04[.01;.08]*, *p=.02* ***0.0014***
Age 5 CM internalising difficulties		.05[.03;.08]**, *p=.00* ***0.0027***	.05[.03;.08]**, *p=.00* ***0.0027***
Age of CM when took vocabulary test (months)			.00[-.03;.03], *p=.83* ***0***
Age 5 vocabulary score (poor language) [e]			-.02[-.10;.05], *p=.54* ***0***
R^2	0.0261	0.0331	0.0333

[a] ethnicity reference group = European UK, [b] language used in the home reference group = English, [c] occupation reference group = professional & managerial, [d] parent education reference group = degree+, [e] Vocabulary score reference group = normal language. * p <.05, ** p <.01.

Table 19: Analysis of MCS data with vocabulary considered as a binary predictor (N=14,754)

Variable	Model 1 Coef[95% CI], *p value* ***Partial R^2***	Model 2 Coef[95% CI], *p value* ***Partial R^2***	Model 3 Coef[95% CI], *p value* ***Partial R^2***
Birthweight (g)	.01[-.03;.04] *p*=.74 ***0***	.00[-.03;.04] *p*=.83 ***0***	.00[-.03;.04] *p*=.83 ***0***
Gestational age (days)	.00[-.01;.02] *p*=.67 ***0***	.01[-.01;.03] *p*=.49 ***0***	.01[-.01;.03] *p*=.48 ***0***
Sex (female)	.54[.50;.58]** *p*<.001	.54[.50;.58]** *p*<.001	.54[.50;.58]** *p*<.001

	.0718	***.0735***	***.0731***
Ethnicity (mixed)[a]	.03[-.07;.14]	.02[-.09;.12]	.01[-.09;.12]
	p=.53	*p*=.78	*p*=.78
	.0012	***.0011***	***.001***
Ethnicity (Indian)	-.11[-.27;.04]	-.11[-.27;.04]	-.11[-.27;.04]
	p=.15	*p*=.15	*p*=.15
Ethnicity (Pakistani/Bangladeshi)	-.25[-.38;-.12]**	-.24[-.37;-.11]	-.23[-.36;-.10]**
	p<.001	*p*<.001	*p*<.001
Ethnicity (Black)	-.14[-.27;-.01]*	-.14[-.27;-.01]*	-.14[-.27;-.01]*
	p=.04	*p*=.03	*p*=.04
Ethnicity (Other)	-.12[-.32;.08]	-.13[-.33;.07]	-.12[-.32;.08]
	p=.24	*p*=.20	*p*=.23
Main language in home (English and another language)[b]	-.02[-.12;.08]	-.01[-.11;.09]	-.00[-.11;.10]
	p=.70	*p*=.86	*p*=.93
	0	***0***	***0***
Main language in home (only another language)	-.04[-.20;.12]	-.03[-.19;.14]	-.02[-.18;.14]
	p=.63	*p*=.76	*p*=.81
Occupation (NS-SEC intermediate occupations)[c]	.01[-.05;.06]	.00[-.05;.06]	.00[-.05;.06]
	p=.79	*p*=.87	*p*=.86
	.0001	***0***	***0***
Occupation (NS-SEC Routine& Manual occupations	.03[-.03;.10]	.01[-.05;.08]	.02[-.05;.08]
	p=.27	*p*=.64	*p*=.63
Unemployed	.07[-.02;.16]	.02[-.07;.11]	.02[-.07;.12]
	p=.11	*p*=.68	*p*=.63
Parent education (first degree)[d]	-.06[-.13;.02]	-.05[-.13;.02]	-.05[-.13;.02]
	p=.15	*p*=.16	*p*=.17
	.0001	***.0001***	***.0001***
Parent education (diploma in higher education)	-.05[-.13;.04]	-.06[-.14;.03]	-.05[-.14;.03]
	p=.27	*p*=.20	*p*=.22
Parent education (a levels)	-.05[-.14;.04]	-.05[-.14;.03]	-.05[-.14;.04]
	p=.29	*p*=.23	*p*=.25
Parent education (o levels/GCSE grades A-C	-.06[-.15;.02]	-.08[-.16;.01]	-.07[-.16;.01]
	p=.15	*p*=.07	*p*=.09
Parent education (GCSE grades D-G	-.00[-.12;.12]	-.04[-.16;.08]	-.03[-.15;.09]
	p=.96	*p*=.53	*p*=.58
Parent education(none of these/other incl overseas)	-.04[-.15;.07]	-.08[-.19;.03]	-.08[-.18;.03]
	p=.45	*p*=.13	*p*=.17
Income (second quintile)[e]	.02 [-.05;.08]	.03[-.04;.10]	.03[-.04;.10]
	p=.66	*p*=.40	*p*=.39
	.0013	***.0005***	***.0005***
Income (third quintile)	-.06[-.13;.01]	-.02[-.09;.05]	-.02[-.09;.05]
	p=.10	*p*=.54	*p*=.52
Income (fourth quintile)	-.08[-.15;-.00]*	-.03[-.11;.05]	-.03[-.11;.05]
	p=.04	*p*=.46	*p*=.45
Income (highest quintile)	-.12[-.20;-.05]	-.07[-.14;.01]	-.07[-.14;.01]
	p<.001	*p*=.10	*p*=.09
Total net wealth	-.02[-.04;-.00]*	-.02[-.04;-.00]*	-.02[-.04;-.00]*
	p<.04	*p*=.04	*p*=.03
	.0004	***.0004***	***.0004***
Teen mum (yes)		.01[-.12;.14]	.01[-.12;.14]
		p=.88	*p*=.90
		0	***0***

Marital status (not partnered)		.07[.02;.13]* *p*=.01 ***.001***	.07[.02;.13]* *p*=.01 ***.001***
Maternal depression (CM age 5)		.07[.04;.09]** *p*<.001 ***.0037***	.07[.04;.09]** *p*<.001 ***.0038***
Age 5 CM externalising difficulties		.04[.02;.07]** *p*<.001 ***.0015***	.04[.02;.07]** *p*<.001 ***.0015***
Age 5 CM internalising difficulties		.02[-.00;.04] *p*=.11 ***.0002***	.02[-.00;.04] *p*=.09 ***.0002***
Age of CM at time of vocabulary test (months)			.02[-.00;.03] *p*=.10 ***.0002***
Age 5 vocabulary score (poor language)[e]			-.04[-.09;.02] *p*=.22 ***.0001***
R^2	0.0783	0.0875	0.0878

[a] ethnicity reference group = white, [b] Main language used in home reference group = only English, [c] NS-SEC reference group = higher managerial, administrative and professional occupations, [d] parent education reference group = higher degree, ,[e] Income quintile reference group = lowest quintile, [f]vocabulary reference group= normal language. * p <.05, ** p <.01.

Table 20: Analysis of BCS data with age 16 mental health considered as a binary outcome (N= 11,640)

Variable	Model 1, *p value* OR[95% CI]	Model 2, *p value* OR[95% CI]	Model 3, *p value* OR[95% CI]
Birthweight (g)	.96[.91;1.01], *p=.14*	.97[.92;1.02] *p=.26*	.97[.92;1.02], *p=.26*
Gestational age (days)	1.01[.95;1.08], *p=. 65*	1.01[.95;1.08], *p=.67*	1.01[.95;1.08], *p=.66*
Sex (female)	1.61[1.45;1.78]**, *p=.00*	1.65[1.48;1.83]**, *p=.00*	1.65[1.48;1.84]**, *p=.00*
Ethnicity (Minority) [a]	1.12[.82;1.52], *p=.49*	1.10[.81;1.50], *p=.55*	1.10[.82;1.48], *p=.53*
Language used in home (other than English) [b]	1.05[.74;1.47], *p=.80*	1.07[.76;1.51], *p=.70*	1.07[.75;1.52], *p=.70*
Occupation (skilled manual/skilled non-manual) [c]	1.02[.88;1.19], *p=.80*	.99[.85;1.16], *p=.92*	.99[.85;1.16], *p=.92*
Occupation (semi-skilled/unskilled)	1.02[.83;1.24], *p=.87*	.97[.79;1.19], *p=.76*	.97[.79;1.20], *p=.77*
Occupation (unemployed)	1.13[.67;1.88], *p=.65*	1.08[.65;1.79], *p=.78*	1.07[.65;1.78], *p=.79*
Parental education [d] (Certificate of education)	1.33[.90;1.96], *p=.16*	1.31[.89;1.94], *p=.18*	1.31[.89;1.94], *p=.18*
Parent education (SRN (state registered nurse)	.94[.62;1.42], *p=.75*	.93[.62;1.41], *p=.74*	.93[.62;1.41], *p=.73*
Parent education (A levels)	1.10[.87;1.38], *p=.44*	1.09[.86;1.37], *p=.48*	1.09[.86;1.37], *p=.48*
Parent education (O level)	1.05[.87;1.27], *p=.59*	1.03[.86;1.25], *p=.74*	1.03[.85;1.25], *p=.73*

Parent education (Vocational qualification)	.96[.78;1.19], *p=.74*	.95[.77;1.17], *p=.61*	.95[.76;1.17], *p=.62*
Parent education: no qualifications	1.12[.91;1.37], *p=.28*	1.08[.88;1.32], *p=.47*	1.08[.88;1.33], *p=.47*
Teen mum (yes)		1.23[1.01;1.50]*, *p=.05*	1.23[1.00;1.50]*, *p=.05*
Marital status (not partnered)		1.01[.77;1.32], *p=.96*	1.01[.77;1.32], *p=.96*
Maternal depression (CM age 5)		1.03[.97;1.10], *p=.38*	1.03[.97;1.10], *p=.38*
Age 5 CM externalising difficulties		1.08[1.01;1.15]*, *p=.04*	1.08[1.01;1.15]*, *p=.04*
Age 5 CM internalising difficulties		1.10[1.04;1.16]**, *p=.00*	1.10[1.04;1.16]**, *p=.00*
Age of CM when took vocabulary test (months)			1.01[.96;1.06], *p=.73*
Age 5 vocabulary score			1.00[.93;1.08], *p=.95*

[a] ethnicity reference group = European UK, [b] language used in the home reference group = English, [c] occupation reference group = professional & managerial, [d] parent education reference group = degree+. * $p < .05$, ** $p < .01$.

Table 21: Analysis of MCS data with internalising symptoms as a binary outcome variable (N= 14,754)

Variable	Model 1, *p value* OR[95% CI]	Model 2, *p value* OR[95% CI]	Model 3, *p value* OR[95% CI]
Birthweight (g)	.98[.82;1.16] *p*=.78	.97[.82;1.15] *p*=.75	.97[.81;1.16] *p*=.76
Gestational age (days)	1.01[.95;1.07] *p*=.81	1.01[.95;1.08] *p*=.67	1.01[.95;1.08] *p*=.66
Sex (female)	3.64 [3.19;4.15]** *p*<.001	3.76[3.29;4.29]** *p*<.001	3.74[3.28;4.27]** *p*<.001
Ethnicity (mixed)[a]	1.09[.80;1.49] *p*=.59	1.05[.77;1.43] *p*=.76	1.05[.77;1.44] *p*=.76
Ethnicity (Indian)	.72[.43;1.21] *p*=.22	.72[.42;1.21] *p*=.21	.72[.42;1.21] *p*=.21
Ethnicity (Pakistani/Bangladeshi)	.46[.30;.71]** *p*<.001	.47[.30;.73]** *p*<.001	.51[.33;.80]** *p*<.001
Ethnicity (Black)	.64[.42;.99] *p*=.05	.64[.42;.98]* *p*=.04	.67[.43;1.02] *p*=.06
Ethnicity (Other)	.70[.36;1.36] *p*=.29	.70[.36;1.36] *p*=.29	.74[.38;1.45] *p*=.39
Main language in home (English and another language)[b]	1.07[.78;1.45] *p*=.69	1.11[.82;1.52] *p*=.50	1.18[.87;1.62] *p*=.29
Main language in home (only another language)	.85[.50;1.44] *p*=.54	.89[.52;1.50] *p*=.65	.99[.58;1.69] *p*.96
Occupation (NS-SEC intermediate occupations)[c]	1.00[.83;1.20] *p*=1	.99[.82;1.19] *p*=.89	1.00[.83;1.20] *p*=1.00
Occupation (NS-SEC Routine& Manual occupations	1.06[.87;1.29] *p*=.57	1.00[.82;1.22] *p*=.99	1.02[.84;1.24] *p*=.85
Unemployed	1.17[.91;1.52] *p*=.23	1.02[.79;1.33] *p*=.86	1.07[.82;1.39] *p*=.63

Parent education (first degree)[d]	.97[.75;1.25] *p*=.81	.97[.75;1.26] *p*=.83	.98[.76;1.27] *p*=.88
Parent education (diploma in higher education)	.98[.74;1.29] *p*=.88	.96[.73;1.27] *p*=.78	.99[.75;1.31] *p*=.94
Parent education (a levels)	1.00[.76;1.33] *p*=.98	.99[.75;1.32] *p*=.95	1.03[.77;1.37] *p*=.85
Parental education (o levels/GCSE grades A-C	.92[.70;1.22] *p*=.56	.88[.66;1.17] *p*=.37	.93[.70;1.23] *p*=.60
Highest level of parental education (GCSE grades D-G	1.14[.80;1.62] *p*=.47	1.04[.73;1.47] *p*=.85	1.11[.77;1.59] *p*=.58
Parent education (none of these/other incl overseas	1.00[.71;1.41] *p*=.99	.90[.64;1.28] *p*=.57	.98[.69;1.39] *p*=.91
Income (second quintile)[e]	1.07[.88;1.29] *p*=.49	1.12[.93;1.36] *p*=.24	1.12[.92;1.36] *p*=.25
Income (third quintile)	.88[.72;1.08] *p*=.23	.98[.79;1.21] *p*=.85	.96[.78;1.18] *p*=.70
Income (fourth quintile)	.82[.65;1.04] *p*=.10	.93[.73;1.18] *p*=.56	.91[.72;1.15] *p*=.43
Income (highest quintile)	.71[.55;.91]* *p*=.01	.82[.63;1.06] *p*=.13	.79[.62;1.02] *p*=.08
Total net wealth	.91[.81;1.04] *p*=.16	.92[.82;1.03] *p*=.17	.92[.81;1.03] *p*=.16
Teen mum (yes)		1.09[.76;1.56] *p*=.64	1.09[.76;1.55] *p*=.65
Marital status (not partnered)		1.23[1.07;1.43]* *p*=.01	1.24 [1.07;1.44] *p*<.001
Maternal depression (CM age 5)		1.14[1.07;1.21]** *p*<.001	1.14[1.07;1.22]** *p*<.001
Age 5 CM externalising difficulties		1.13[1.05;1.20]** *p*<.001	1.13[1.06;1.21]** *p*<.001
Age 5 CM internalising difficulties		1.02[.96;1.09] *p*=.47	1.03[.97;1.10] *p*=.34
Age of CM at time of taking vocabulary test (months)			1.05[.99;1.11] *p*=.14
Age 5 vocabulary score			1.16 [1.07;1.25]** *p*<.001

[a] ethnicity reference group = white, [b] Main language used in home reference group = only English, [c] NS-SEC reference group = higher managerial, administrative and professional occupations, [d] parent education reference group = higher degree, [e] Income quintile reference group = lowest quintile. * p <.05, ** p <.01.

Section 13: Sensitivity analysis 7: Analyses with vocabulary as a binary predictor, dichotomised at 1.5 SD below the mean

In our manuscript, we chose to dichotomise the vocabulary predictor at 1SD below the mean in line with the methodology of Schoon et al (2010), as we were aiming to extend their analysis of binary childhood vocabulary predicting adulthood mental health. However,

we acknowledge that some researchers dichotomise the vocabulary predictor at 1.5SD below the mean (Norbury et al, 2016). We therefore also conducted these exploratory analyses using this cut off in addition to that reported in the manuscript, as a sensitivity check.

In the BCS sample, 1114 cohort members (10%) had vocabulary scores 1.5 SD below the mean (10526 were above this cut off). When using this cut off, before adding any control variables, there was no relationship between age 5 binary vocabulary and age 16 internalising symptoms (β=.03[-.08;.14]. Results showed that compared to a model with no predictors, biological and SES variables significantly improved the model fit, (Dm(14, 1326.89)=10.74 p<.001) and the subsequent model adding in mother and childhood psychosocial controls was also an improvement (Dm(5, 280.67)=4.53, p<.001). Adding the age 5 binary indicator of DLD did not significantly improve the model fit, (Dm(2, 100.58)=0.21, p=.807). The pattern of results when using this cut off is in line with the findings when the 1SD below the mean cut off was used.

In the MCS sample, 1204 cohort members (8%) had vocabulary scores 1.5 SD below the mean (13550 cohort members were above this cut off). When using this cut off, before adding any control variables, there was a significant negative relationship between age 5 binary vocabulary and age 14 internalising symptoms (β=-.14[-.24;.-.05]). Results showed that compared to a model with no predictors, biological and SES variables significantly improved the model fit, (Dm(24, 4312.52)=36.94 p<.001) and the subsequent model adding in mother and childhood psychosocial controls was also an improvement (Dm(5, 429.41)=14.43, p<.001). Adding the age 5 binary indicator of DLD significantly improved the model fit, (Dm(2, 331.61)=9.93, p<.001). When using this more stringent cut off point, the findings revealed that those with language delay (scoring 1.5 SD below the mean on the vocabulary measure) had lower mental health scores than those with typical language development (β=-.14[-.24;.-.05]), indicating that those with larger vocabulary sizes had poorer mental health in adolescence.

Tables

Table 22: Analysis of BCS data with vocabulary considered as a binary predictor (1.5SD below the mean; N= 11,640)

Variable	Model 1 Coef[95% CI], *p value* ***Partial R^2***	Model 2 Coef[95% CI], *p value* ***Partial R^2***	Model 3 Coef[95% CI], *p value* ***Partial R^2***
Birthweight (g)	-.02[-.05;.01], *p=.22* ***0.0002***	-.01[-.04;.02], *p=.41* ***0.0001***	-.01[-.04;.02], *p=.39* ***0.0001***

Gestational age (days)	-.00[-.04;.03], *p=.95* ***0.0001***	-.00[-.04;.03], *p=.94* ***0.0001***	-.00[-.04;.03], *p=.95* ***0.0001***
Sex (female)	.31[.26;.37]**, *p=.00* ***0.0243***	.33[.27;.39]**, *p=.00* ***0.0259***	.33[.27;.39]**, *p=.00* ***0.026***
Ethnicity (minority) [a]	.06[-.10;.22], *p=.44* ***0.0001***	.05[-.10;.21], *p=.51* ***0***	.06[-.10;.21], *p=.49* ***0.0001***
Language used in home (other than English) [b]	-.02[-.19;.15], *p=.81* ***0***	-.01[-.17;.16], *p=.93* ***0***	-.00[-.17;.17], *p=.99* ***0***
Occupation (skilled manual/skilled non-manual) [c]	.02[-.05;.08], *p=.59* ***0.0001***	.00[-.06;.07], *p=.93* ***0.0001***	.00[-.06;.07], *p=.93* ***0.0001***
Occupation (semi-skilled/unskilled)	.00[-.09;.10], *p=.93*	-.02[-.12;.07], *p=.64*	-.02[-.12;.08], *p=.67*
Occupation (unemployed)	.12[-.11;.36], *p=.30*	.10[-.14;.34], *p=.43*	.10[-.15;.34], *p=.43*
Parent education [d] (Certificate of education)	.04[-.15;.22], *p=.68* ***0.0002***	.03[-.15;.22], *p=.74* ***0.0001***	.03[-.15;.22], *p=.74* ***0.0002***
Parent education (SRN (state registered nurse)	-.00[-.19;.19], *p=.97*	-.01[-.20;.18], *p=.94*	-.01[-.20;.18], *p=.94*
Parent education (A levels)	.03[-.08;.14], *p=.59*	.02[-.08;.13], *p=.65*	.03[-.08;.13], *p=.65*
Parent education (O level)	.03[-.06;.12], *p=.47*	.02[-.07;.11], *p=.62*	.02[-.07;.11], *p=.61*
Parent education (Vocational qualification)	-.02[-.14;.10], *p=.75*	-.03[-.15;.09], *p=.62*	-.03[-.15;.09], *p=.63*
Parent education: no qualifications	.04[-.05;.12], *p=.38*	.02[-.07;.10], *p=.70*	.02[-.06;.10], *p=.65*
Teen mum (yes)		.10[-.02;.22], *p=.10* ***0.0007***	.10[-.02;.22], *p=.09* ***0.0007***
Marital status (not partnered)		.01[-.12;.14], *p=.83* ***0***	.02[-.12;.15], *p=.82* ***0***
Maternal depression (CM age 5)		.02[-.02;.05], *p=.33* ***0.0002***	.02[-.02;.05], *p=.32* ***0.0002***
Age 5 CM externalising difficulties		.04[.01;.08]*, *p=.01* ***0.0015***	.04[.01;.08]*, *p=.01* ***0.0016***
Age 5 CM internalising difficulties		.05[.02;.08]**, *p=.00* ***0.0028***	.05[.02;.08]**, *p=.00* ***0.0028***
Age of CM when took vocabulary test (months)			.01[-.03;.04], *p=.72* ***0***
Age 5 vocabulary score (poor vocabulary) [e]			-.03[-.15;.08], *p=.59* ***0.0001***
R^2	0.0263	0.034	0.0342

[a] ethnicity reference group = European UK, [b] language used in the home reference group = English, [c] occupation reference group = professional & managerial, [d] parent education reference group = degree+, [e] Vocabulary score reference group = normal vocabulary . * p <.05, ** p <.01.

Table 23: Analysis of MCS data with vocabulary considered as a binary predictor (1.5SD below the mean; N= 14,754)

Variable	Model 1 Coef[95% CI], *p value* ***Partial R^2***	Model 2 Coef[95% CI], *p value* ***Partial R^2***	Model 3 Coef[95% CI], *p value* ***Partial R^2***
Birthweight (g)	.01[-.03;.04] *p*=.74 ***0***	.00[-.03;.04] *p*=.83 ***0***	.00[-.03;.04] *p*=.81 ***0***
Gestational age (days)	.00[-.01;.02] *p*=.67 ***0***	.01[-.01;.03] *p*=.49 ***0***	.01[-.01;.03] *p*=.47 ***0***
Sex (female)	.54[.50;.58]** *p*<.001 ***.0718***	.54[.50;.58]** *p*<.001 ***.0735***	.54[.50;.58]** *p*=.001 ***.0728***
Ethnicity (mixed)[a]	.03[-.07;.14] *p*=.53 ***.0012***	.02[-.09;.12] *p*=.78 ***.0011***	.01[-.09;.12] *p*=.81 ***.0009***
Ethnicity (Indian)	-.11[-.27;.04] *p*=.15	-.11[-.27;.04] *p*=.15	-.12[-.27;.04] *p*=.14
Ethnicity (Pakistani/Bangladeshi)	-.25[-.38;-.12]** *p*<.001	-.24[-.37;-.11] *p*<.001	-.22[-.35;-.09] *p*<.001
Ethnicity (Black)	-.14[-.27;-.01]* *p*=.04	-.14[-.27;-.01]* *p*=.03	-.13[-.26;-.00]* *p*=.04
Ethnicity (Other)	-.12[-.32;.08] *p*=.24	-.13[-.33;.07] *p*=.20	-.11[-.31;.09] *p*=.26
Main language in home (English and another language)[b]	-.02[-.12;.08] *p*=.70 ***0***	-.01[-.11;.09] *p*=.86 ***0***	.00[-.10;.10] *p*=.99 ***0***
Main language in home (only another language)	-.04[-.20;.12] *p*=.63	-.03[-.19;.14] *p*=.76	-.00[-.17;.16] *p*=.97
Occupation (NS-SEC intermediate occupations)[c]	.01[-.05;.06] *p*=.79 ***.0001***	.00[-.05;.06] *p*=.87 ***0***	.01[-.05;.06] *p*=.84 ***0***
Occupation (NS-SEC Routine& Manual occupations	.03[-.03;.10] *p*=.27	.01[-.05;.08] *p*=.64	.02[-.05;.08] *p*=.63
Unemployed	.07[-.02;.16] *p*=.11	.02[-.07;.11] *p*=.68	.03[-.07;.12] *p*=.56
Parent education (first degree)[d]	-.06[-.13;.02] *p*=.15 ***.0001***	-.05[-.13;.02] *p*=.16 ***.0001***	-.05[-.13;.02] *p*=.18 ***.0001***
Parent education (diploma in higher education)	-.05[-.13;.04] *p*=.27	-.06[-.14;.03] *p*=.20	-.05[-.14;.03] *p*=.23
Parent education (a levels)	-.05[-.14;.04] *p*=.29	-.05[-.14;.03] *p*=.23	-.05[-.14;.04] *p*=.25
Parent education (o levels/GCSE grades A-C	-.06[-.15;.02] *p*=.15	-.08[-.16;.01] *p*=.07	-.07[-.16;.01] *p*=.09
Parent education (GCSE grades D-G	-.00[-.12;.12] *p*=.96	-.04[-.16;.08] *p*=.53	-.03[-.15;.09] *p*=.62

Parent education(none of these/other incl overseas)	-.04[-.15;.07] *p*=.45	-.08[-.19;.03] *p*=.13	-.07[-.18;.04] *p*=.21
Income (second quintile)[e]	.02 [-.05;.08] *p*=.66 ***.0013***	.03[-.04;.10] *p*=.40 ***.0005***	.03[-.04;.10] *p*=.38 ***.0005***
Income (third quintile)	-.06[-.13;.01] *p*=.10	-.02[-.09;.05] *p*=.54	-.02[-.09;.05] *p*=.53
Income (fourth quintile)	-.08[-.15;-.00]* *p*=.04	-.03[-.11;.05] *p*=.46	-.03[-.11;.05] *p*=.45
Income (highest quintile)	-.12[-.20;-.05] *p*<.001	-.07[-.14;.01] *p*=.10	-.07[-.14;.01] *p*=.09
Total net wealth	-.02[-.04;-.00]* *p*<.04 ***.0004***	-.02[-.04;-.00]* *p*=.04 ***.0004***	-.02[-.04;-.00] *p*=.03 ***.0004***
Teen mum (yes)		.01[-.12;.14] *p*=.88 ***0***	.01[-.12;.14] *p*=.90 ***0***
Marital status (not partnered)		.07[.02;.13]* *p*=.01 ***.001***	.07[.02;.12]* *p*=.01 ***.001***
Maternal depression (CM age 5)		.07[.04;.09]** *p*<.001 ***.0037***	.07[.04;.09]** *p*<.001 ***.0038***
Age 5 CM externalising difficulties		.04[.02;.07]** *p*<.001 ***.0015***	.04[.02;.07]** *p*<.001 ***.0015***
Age 5 CM internalising difficulties		.02[-.00;.04] *p*=.11 ***.0002***	.02[-.00;.04] *p*=.08 ***.0003***
Age of CM at time of vocabulary test (months)			.01[-.00;.03] *p*=.11 ***.0004***
Age 5 vocabulary score			-.11[-.21;-.02]** *p*=.01 ***.0006***
R^2	0.0783	0.0875	0.0883

[a] ethnicity reference group = white, [b] NS-SEC reference group = higher managerial, administrative and professional occupations, [c] parent education reference group = higher degree, [d] Income quintile reference group = lowest quintile, [e] vocabulary reference group= normal language. * *p* <.05, ** *p* <.01.

Section 14: Sensitivity analysis using a harmonised subset of internalising symptoms items for self-reported analyses

Given the fact that different measures of internalising symptoms were used for the self-reported analysis (BCS= Malaise inventory, MCS=Short Moods and Feelings Questionnaire (SMFQ)), we ran a sensitivity check where we included total scores derived only from a harmonised matched subset of the measures. The SMFQ is a measure comprised entirely of depression items, whereas the malaise inventory also contains anxiety items. These items are

questions about the following constructs: tired, miserable, easily upset and restlessness. When using this harmonised measure, the SMFQ (MCS) has a range of 0-8 and a mean of 2.21(±1.93) and the Malaise Inventory (BCS) has a range of 0-8 and a mean of (2.36(±2.32). Results can be found in tables 24 and 25 below.

As can be seen from these tables, the main finding did not change when using the matched subset of items. therefore, we conclude that the observed relationship in our main self-reported findings is the same when items of depression are used.

Relatedly, When BCS cohort members were aged 16, the version of the malaise inventory administered was 22 out of the total 24 items, with a 3-category response (0=rarely/never; 1= some of the time; 2=most of the time). In our main analyses, we used the items taken from the 9-item version and used a 2-category response (0=no, 1=yes) to correspond with the Malaise inventory at age 34, and the fact that this is how the Malaise Inventory is usually administered. However, for the purpose of this sensitivity analysis, we first re-ran the main analysis using the 3-category response version of the Malaise Inventory to check it against findings when using the 2-category response version. We then conducted the sensitivity check with the matched subset of items listed above with the 3-category response measure to be consistent with the scoring of the SMFQ which is scored in the same way (0=not true, 1=sometimes true; 2=certainly true). As can be seen from table 26, the main finding did not change when using the 9 item 3-category response measure (non-significant relationship between vocabulary and internalising symptoms.)

Table 24: Sensitivity check using harmonised internalising symptoms items (BCS, N=11,640)

Variable	Model 1 Coef[95% CI] *p value*	Model 2 Coef[95% CI] *p value*	Model 3 Coef[95% CI] *p value*
Birthweight (g)	-.01[-.04;.01] p= .337	-.01[-.04;.02] p= .521	-.01[-.04;.02] p= .500
Gestational age (days)	.01[-.02;.04] p= .678	.01[-.02;.04] p= .686	.01[-.02;.04] p= .686
Sex (female)	.33[.28;.38] p<.001 * *	.34[.29;.39] p<.001 * *	.34[.29;.39] p<.001 * *
Ethnicity (minority) [a]	.07[-.08;.22] p= .337	.05[-.10;.20] p= .492	.06[-.09;.20] p= .460
Language used in home (other than English) [b]	-.04[-.21;.13] p= .643	-.02[-.19;.15] p= .799	-.02[-.19;.15] p= .822
Occupation (skilled manual/skilled non-manual) [c]	.02[-.04;.09] p= .501	.01[-.05;.08] p= .743	.01[-.05;.08] p= .730

Occupation (semi-skilled/unskilled)	-.02[-.11;.08] p= .732	-.04[-.13;.05] p= .409	-.04[-.13;.06] p= .435
Occupation (unemployed)	.18[-.08;.44] p= .165	.15[-.10;.41] p= .236	.16[-.10;.41] p= .228
Parental education [d] (Certificate of education)	-.03[-.21;.15] p= .719	-.04[-.22;.14] p= .636	-.04[-.22;.14] p= .639
Parent education (SRN (state registered nurse)	-.08[-.25;.08] p= .326	-.09[-.26;.08] p= .297	-.09[-.26;.08] p= .306
Parent education (A levels)	.01[-.09;.12] p= .807	.01[-.09;.11] p= .856	.01[-.09;.11] p= .850
Parent education (O level)	-.01[-.10;.07] p= .733	-.02[-.11;.06] p= .596	-.02[-.11;.06] p= .605
Parent education (Vocational qualification)	-.06[-.16;.04] p= .221	-.07[-.17;.03] p= .167	-.07[-.17;.03] p= .169
Parent education: no qualifications	-.03[-.11;.05] p= .470	-.05[-.13;.03] p= .233	-.05[-.13;.03] p= .250
Teen mum (yes)		.01[-.09;.11] p= .772	.02[-.09;.12] p= .759
Marital status (not partnered)		.05[-.09;.19] p= .508	.05[-.09;.19] p= .508
Maternal depression (CM age 5)		.01[-.03;.04] p= .665	.01[-.03;.04] p= .661
Age 5 CM externalising difficulties		.03[-.00;.06] p= .052	.03[.00;.06] p= .047 *
Age 5 CM internalising difficulties		.06[.03;.09] p<.001 * *	.06[.03;.09] p<.001 * *
Age of CM at time of vocabulary test (months)			-.01[-.03;.02] p= .586
Age 5 vocabulary score			.00[-.03;.04] p= .753

[a] ethnicity reference group = European UK, [b]language used in the home reference group = English, [c] occupation reference group = professional & managerial, [d]parent education reference group = degree+. * p <.05, ** p <.01.

Table 25: Sensitivity check using harmonised internalising symptoms items (MCS, N=14,574)

Variable	Model 1 Coef[95% CI]	Model 2 Coef[95% CI]	Model 3 Coef[95% CI]
Birthweight (g)	.00[-.03;.03] p= .859	.00[-.03;.03] p= .950	.00[-.03;.03] p= .967
Gestational age (days)	.01[-.01;.03] p= .205	.02[-.01;.04] p= .147	.02[-.01;.04] p= .142
Sex (female)	.51[.47;.54] p<.001 * *	.51[.48;.55] p<.001 * *	.51[.47;.55] p<.001 * *
Ethnicity (mixed)[a]	.06[-.05;.17] p= .272	.05[-.06;.16] p= .407	.05[-.06;.16] p= .395
Ethnicity (Indian)	-.16[-.31;-.00] p= .049 *	-.16[-.32;-.00] p= .044 *	-.16[-.32;-.00] p= .044 *

Ethnicity (Pakistani/Bangladeshi)	-.21[-.34;-.07] p= .002 * *	-.21[-.34;-.07] p= .003 * *	-.18[-.32;-.05] p= .009 * *
Ethnicity (Black)	-.08[-.21;.05] p= .233	-.08[-.21;.05] p= .219	-.06[-.19;.07] p= .342
Ethnicity (Other)	-.13[-.32;.06] p= .175	-.14[-.33;.04] p= .134	-.12[-.31;.07] p= .204
Main language in home (English and another language)[b]	-.03[-.14;.07] p= .558	-.02[-.13;.08] p= .655	-.00[-.11;.10] p= .935
Main language in home (only another language)	-.02[-.18;.14] p= .817	-.01[-.17;.15] p= .886	.02[-.15;.18] p= .831
Occupation (NS-SEC intermediate occupations)[c]	.02[-.04;.07] p= .566	.01[-.04;.07] p= .616	.02[-.04;.08] p= .528
Occupation (NS-SEC Routine& Manual occupations	.01[-.05;.07] p= .756	-.01[-.07;.05] p= .816	-.00[-.06;.06] p= .967
Unemployed	.04[-.06;.15] p= .408	-.00[-.11;.10] p= .994	.01[-.09;.12] p= .807
Parent education (first degree)[d]	-.05[-.12;.03] p= .232	-.04[-.12;.03] p= .261	-.04[-.11;.04] p= .298
Parent education (diploma in higher education)	-.02[-.11;.06] p= .637	-.03[-.11;.06] p= .545	-.02[-.10;.07] p= .695
Parent education (a levels)	-.03[-.12;.06] p= .497	-.04[-.13;.06] p= .446	-.02[-.11;.07] p= .618
Parental education (o levels/GCSE grades A-C	-.04[-.12;.04] p= .328	-.05[-.13;.03] p= .207	-.04[-.12;.05] p= .393
Parental education (GCSE grades D-G	-.01[-.12;.10] p= .918	-.03[-.14;.07] p= .529	-.01[-.12;.10] p= .812
Parental education (none of these/other incl overseas)	-.04[-.15;.07] p= .491	-.07[-.18;.04] p= .186	-.05[-.16;.06] p= .388
Income (second quintile)[e]	-.01[-.08;.06] p= .796	.00[-.07;.07] p= .971	.00[-.07;.07] p= .959
Income (third quintile)	-.05[-.13;.02] p= .163	-.02[-.10;.05] p= .545	-.03[-.11;.05] p= .448
Income (fourth quintile)	-.07[-.14;.01] p= .085	-.03[-.11;.05] p= .461	-.04[-.11;.04] p= .366
Income (highest quintile)	-.12[-.21;-.04] p= .004 * *	-.08[-.17;.01] p= .080	-.09[-.17;.00] p= .050
Total net wealth	-.01[-.03;.01] p= .318	-.01[-.03;.01] p= .306	-.01[-.03;.01] p= .281
Teen mum (yes)		.02[-.10;.13] p= .775	.02[-.10;.13] p= .787
Marital status (not partnered)		.04[-.01;.10] p= .088	.05[-.01;.10] p= .084
Maternal depression (CM age 5)		.06[.04;.09] p<.001 * *	.06[.04;.09] p<.001 * *
Age 5 CM externalising difficulties		.04[.02;.06] p<.001 * *	.04[.02;.07] p<.001 * *
Age 5 CM internalising difficulties		.01[-.01;.04] p= .222	.02[-.01;.04] p= .164
Age of CM at time of taking vocabulary test (months)			.02[-.00;.04] p= .123

Age 5 vocabulary score	.05[.02;.07] p<.001 * *

[a] ethnicity reference group = white, [b] Main language used in home reference group = only English, [c] NS-SEC reference group = higher managerial, administrative and professional occupations, [d]parent education reference group = higher degree, [e]Income quintile reference group = lowest quintile. * p <.05, ** p <.01.

Table 26: Sensitivity check using 3-category response version of Malaise Inventory for BCS sample (N=11,640)

Variable	Model 1 Coef[95% CI] *p value*	Model 2 Coef[95% CI] *p value*	Model 3 Coef[95% CI] *p value*
Birthweight (g)	-.02[-.05;.01] p= .240	-.01[-.04;.02] p= .384	-.01[-.04;.02] p= .433
Gestational age (days)	.01[-.03;.04] p= .748	.00[-.03;.04] p= .773	.00[-.03;.04] p= .795
Sex (female)	.31[.26;.37] p<.001 **	.33[.27;.38] p<.001 **	.32[.27;.38] p<.001 **
Ethnicity (minority) [a]	.07[-.08;.22] p= .353	.05[-.10;.21] p= .480	.04[-.11;.20] p= .570
Language used in home (other than English) [b]	.03[-.16;.22] p= .729	.04[-.15;.23] p= .687	.03[-.16;.21] p= .772
Occupation (skilled manual/skilled non-manual) [c]	.03[-.04;.09] p= .425	.01[-.06;.07] p= .802	.01[-.06;.07] p= .849
Occupation (semi-skilled/unskilled)	.04[-.05;.13] p= .399	.00[-.09;.09] p= .972	-.00[-.09;.09] p= .930
Occupation (unemployed)	.08[-.18;.34] p= .555	.03[-.23;.30] p= .796	.03[-.23;.30] p= .810
Parental education [d] (Certificate of education)	.02[-.16;.20] p= .826	.02[-.16;.19] p= .866	.01[-.16;.19] p= .868
Parent education (SRN (state registered nurse)	-.06[-.24;.12] p= .491	-.07[-.25;.11] p= .456	-.07[-.25;.11] p= .432
Parent education (A levels)	.03[-.08;.14] p= .551	.03[-.08;.13] p= .633	.02[-.08;.13] p= .650
Parent education (O level)	.01[-.07;.09] p= .840	-.00[-.09;.08] p= .906	-.01[-.09;.07] p= .837
Parent education (Vocational qualification)	.00[-.09;.10] p= .927	-.01[-.11;.08] p= .773	-.02[-.11;.08] p= .688
Parent education: no qualifications	.05[-.03;.13] p= .247	.01[-.07;.09] p= .729	.00[-.08;.09] p= .920
Teen mum (yes)		.07[-.02;.17] p= .135	.07[-.03;.17] p= .154
Marital status (not partnered)		.01[-.12;.13] p= .931	.00[-.12;.13] p= .946
Maternal depression (CM age 5)		.04[.00;.07] p= .032 *	.04[.00;.07] p= .038 *
Age 5 CM externalising difficulties		.04[-.16;.25] p= .667	.04[-.16;.25] p= .679

Age 5 CM internalising difficulties	.01[-.20;.22] p= .939	.01[-.20;.22] p= .939
Age of CM at time of vocabulary test (months)		-.00[-.03;.03] p= .765
Age 5 vocabulary score		-.02[-.05;.01] p= .225

[a] ethnicity reference group = European UK, [b]language used in the home reference group = English, [c] occupation reference group = professional & managerial, [d]parent education reference group = degree+. * p <.05, ** p <.01.

Section 15: References

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Appendix 2: Supplementary materials for Chapter 4

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Section 1: Supplementary Methods

Confirmatory Factor Analysis of SEC indicators

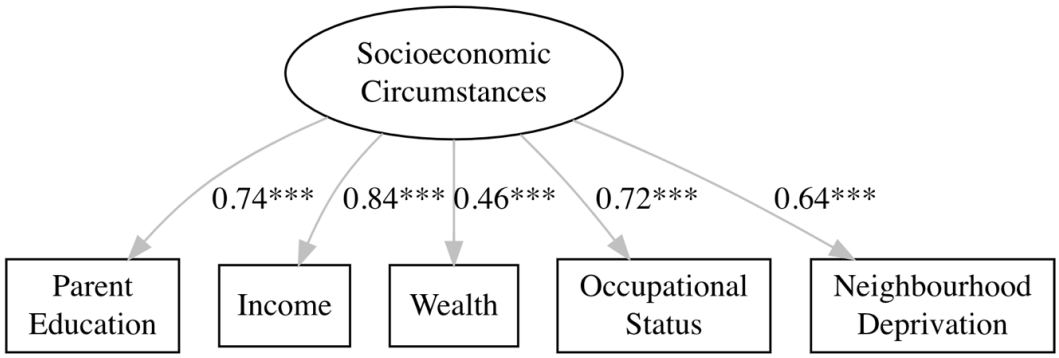
Using the lavaan package in R (Rosseel, 2012), a CFA was conducted to create a latent variable of SES. A robust weighted least squares estimator (WLSMV in the lavaan package) was used. This was due to the fact that maximum likelihood estimators are not currently supported for ordered data in the package. A latent variable factor score was then created for each individual imputed dataset, and regression models, where the factor score was the main predictor, were ran for each imputed dataset. The results of the regression models were then pooled. This procedure was conducted on separate regression models, where vocabulary at ages 3, 5, 11 and 14 were the outcome variables.

The latent variable was made up of highest household education, income, wealth, occupational status and relative neighbourhood deprivation. These variables were added to the CFA model in this order. Factor loadings can be found in Figure S1.

Model fit was examined with the normed χ^2 ^{2} (χ^2/df) statistic (Ullman, 2001), Comparative Fit Index (CFI) (Hu & Bentler, 1999), Root Mean Square Error of Approximation (RMSEA)(MacCallum et al., 1996), Standardized Root Mean Square Residual (SRMR)(Hu & Bentler, 1999) and Tucker Lewis Index (TLI)(Hu & Bentler, 1999). Normed χ^2 statistics between 1 and 2 suggest a good model fit, and between 2 and 3 suggest an acceptable model fit (Carmines & McIver, 1981). CFI and TLI values of >.9 indicate an acceptable fit and >.95 indicate a good model fit (Hu & Bentler, 1999). RMSEA values of 0.01 indicate an excellent model fit, 0.05 indicates a good fit and 0.08 indicates an acceptable model fit (MacCallum et al., 1996). Finally, SRMR values <.08 are indicative of a good fit (Hu & Bentler, 1999). Robust fit indices are reported.

The model converged on 25 imputed datasets. Estimates were pooled across the 25 imputed datasets, using Rubin's rules (Rubin, 1984). The normed χ^2 statistic indicated a poor model fit (normed χ^2 (χ^2/5)) = 22. The remaining fit indices indicated the model was a good fit to the data (RMSEA = 0.045; SRMR = 0.027; CFI = 0.994; TLI= 0.988). Standardised factor loadings indicate that all variables loaded onto the latent construct (see Figure S1).

Fig. S1. Factor Loadings for CFA



Creation of BCS attrition weight

Procedure

1. Generate a response variable, whereby 1=response and 0=missing
2. Compile predictor variables (detailed below). Where data was missing for these, single imputation was used (random imputation, where impute random values sampled from the non-missing values of the variable)
3. Logistic regression, where response variable is the outcome, and predictor variables are variables deemed to predict missingness (detailed below)
4. Obtain predicted probabilities from the logistic regression
5. The weight variable is the inverse of these probabilities (ie predicted value/1
6. Apply a constant to the weight (weight/1.38)

A weight was created for those who were missing at age 5, those who were missing at age 10 and those who were missing at age 16. This is because although some people may have been missing at age 5, they could have returned by age 10, or they may have participated at age 5, but not age 10. These three weights were then combined into one weight variable, where the weight for age 5 response was used, if this was missing, the age 10 weight was used and if both of these were missing, the age 16 weight was used.

The mean of the final weight variable was 0.9, with a standard deviation of 0.16. The range was 0.83 to 3.82.

Predictor variables

The decision on which variables to include as predictors of response were made following the guides to the BCS datasets (Butler et al., 1981; Goodman & Butler, 1986; Institute of Child Health, 1975)

Variables predicting response at the age 5 sweep:

From the birth data:

- Whether the cohort member was born to a teenage mother

- Whether the mother had high parity (defined as ≥5 pregnancies of ≥ 20 weeks of gestation)
- Whether the mother was a heavy smoker (defined as ≥15 a day)
- Marital status of mother at birth of cohort member (0=married, 1=single)
- Gender
- Father's social class
- Mother's social class

Variables predicting response at the age 10 sweep:
From the birth data:

- Gender
- Parents born outside of Britain
- Age mother and father left full time education
- Whether the cohort member was born to a teenage mother
- Whether the mother was a single mother at birth
- Father unemployed
- Whether the cohort member was a twin
- Mother aged 40+ at child's birth

From the age 5 data:

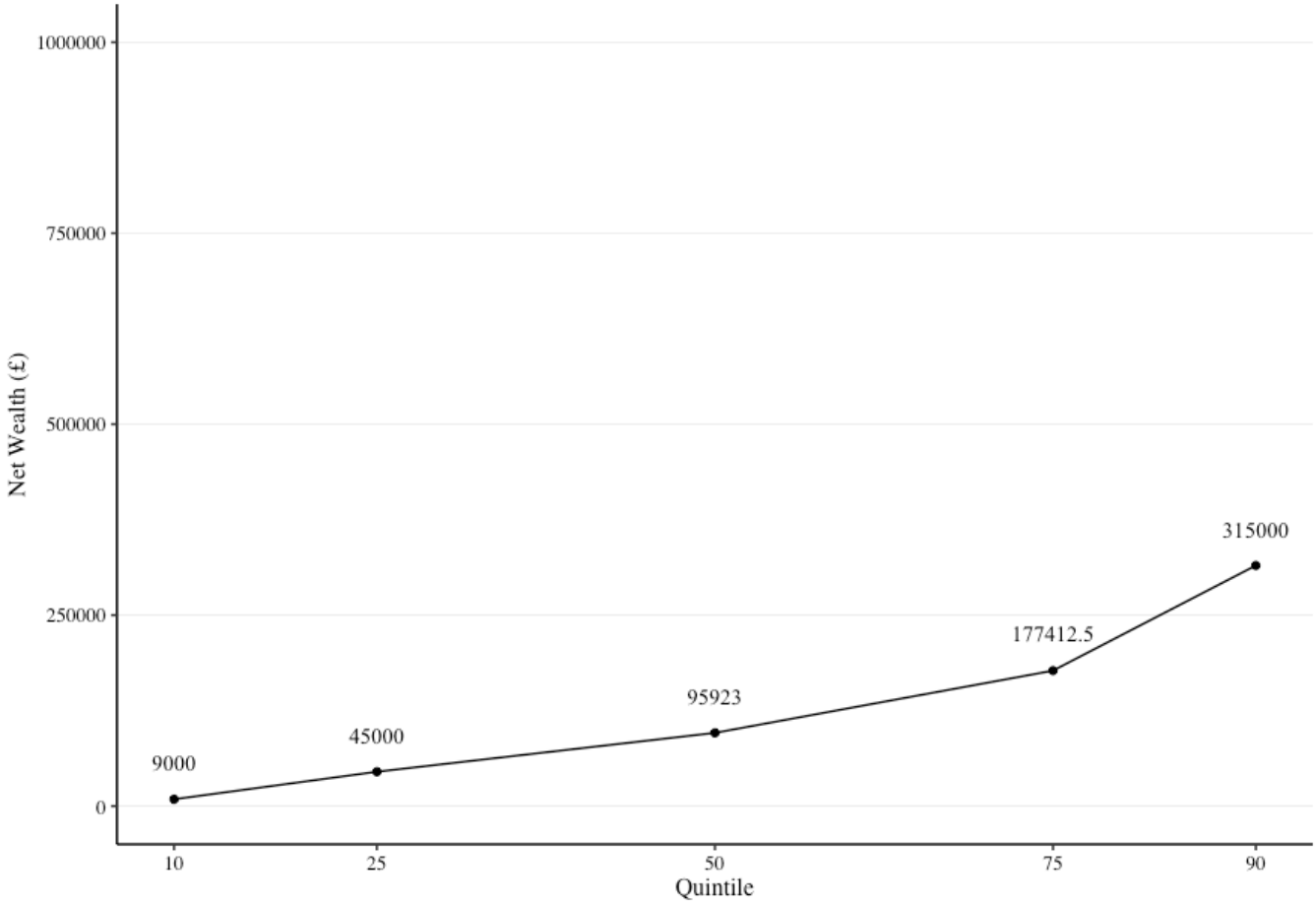
- Child's ethnic group
- Parents with no qualifications
- Separation of mother and cohort member as a baby for 1 month or more
- Father's social class
- Low birthweight (<5lb)
- Family moved 3 or more times since 1970
- Crowded accommodation (>1 person per room = crowded)
- Whether living in private rented accommodation
- Social rating of the neighbourhood (1=poor, 0=not poor)

Variables predicting response at the age 16 sweep:

- Gender
- Father's social class
- Region

Distribution of the total net wealth measure used in analyses

Fig S2. Distribution of Total Net Wealth in MCS5



Section 2: Comparison of analytical and full cohort samples

Table S1: Full cohort sample vs analytical sample: RQ 1-3, MCS2001 cohort sample only

	Analytical Sample Mean (SD) or % [95%CI] *N=17,082*	Whole Cohort Mean (SD) or % [95%CI] *N=19,243*
Language		
Age 3	49.36(±11.38) [49.19,49.53]	49.91(±11.13) [49.73;50.09]
Age 5	54.38(±11.04) [54.21;54.54]	54.67(±10.97) [54.50;54.85]
Age 11	58.51(9.90) [58.36;58.66]	58.81(±9.76) [58.64;58.97]
Age 14	7.01(±2.61) [6.97;7.04]	7.15(±2.63) [7.10; 7.20]
Potential confounders		
gender (male)	50.95%	51.31%
gender (female)	49.05%	48.69%
Ethnicity (White)	85.99%	85.59%
Ethnicity (mixed)	3.33%	3.38%
Ethnicity (Indian)	1.91%	1.88%
Ethnicity (Pakistani/Bangladeshi)	4.48%	4.54%
Ethnicity (Black/Black British)	3.05%	3.18%
Ethnicity (Other, including Chinese)	1.26%	1.43%
Main language in home (English)	88.50%	88.22%
Main language in home (English and another language)	9.01%	9.15%
Main language in home (only another language)	2.49%	2.64%
SES predictors		
Parent education (NVQ level 1)	5.75%	5.92%
Parent education (NVQ level 2)	25.30%	25.53%
Parent education (NVQ level 3)	15.97%	15.95%

Parent education (NVQ level 4)	35.38%	34.45%
Parent education (NVQ level 5)	7.36%	7.11%
Parent education (None of these/overseas qualifications)	10.24%	11.05%
Income (lowest quintile)	21.27%	22.04%
Income (second quintile)	20.42%	20.83%
Income (third quintile)	19.84%	19.68%
Income (fourth quintile)	19.30%	18.84%
Income (highest quintile)	19.17%	18.61%
Occupational status (routine)	22.46%	22.29%
Occupational status (intermediate)	19.75%	18.91%
Occupational status (higher managerial)	38.69%	37.86%
Occupational status (unemployed)	19.09%	20.95%
IMD (most deprived decile)	12.95%	13.27%
IMD (10 - < 20%)	10.84%	11.14%
IMD (20 - < 30%)	10.32%	10.39%
IMD (30 - < 40%)	9.11%	9.18%
IMD (40 - < 50%)	9.72%	9.70%
IMD (50 - < 60%)	9.72%	9.63%
IMD (60 - < 70%)	8.79%	8.77%
IMD (70 - < 80%)	9.01%	8.91%
IMD (80 - < 90%)	9.55%	9.26%
IMD (least deprived decile)	9.98%	9.74%

Note: wealth variable compiled after imputation of house value, mortgage, savings and debts and then split to quintiles, therefore cannot calculate proportions before imputation for full sample. Means (±SD) and proportions for analytical sample are pooled across 25 imputed datasets. All descriptives are sample and attrition weighted.

Table S2: full sample vs analytical sample comparisons for RQ4: cross-cohort comparison

	BCS1970 cohort		MCS2001 cohort	
	Analytical Sample (N=14, 206)	Full Cohort Sample (N=17,196)	Analytical Sample (N=16,033)	Full Cohort Sample (N=19,243)
Language				
Early childhood	34.59(±11.17) [34.40;34.77]	35.27(±10.81) [35.07;35.46]	107.98(±16.13) [107.73; 108.23]	108.42(±15.89) [108.17; 108.67]
Late childhood	12.01(±2.64) [11.97;12.05]	12.06(±2.61) [12.01; 12.10]	12017(±16.80) [119.91;120.43]	120.65(±16.52([120.37;120.93]
Adolescence	41.12(±13.04) [40.90;41.33]	42.46(±12.66) [42.14;42.79]	7.01(±2.61) [6.97;7.05]	7.13(±2.63) [7.08; 7.18]
Potential confounders				
gender(male)	51.12%	51.82%	51.34%	51.36%
gender(female)	48.88%	48.18%	48.66%	48.64%
Ethnicity (white)	94.60%	95.67%	86.04%	85.91%
Ethnicity (minority)	5.40%	4.33%	13.96%	14.09%
English as an additional language (no)	95.77%	96.65%	88.65%	88.59%
English as an additional language (yes)	4.23%	3.35%	11.35%	11.41%
SES predictors				
Parent education (no/low level)	55.84%	53.83%	22.20%	22.29%
parent education (O-levels/GCSEs grades A*-C)	20.43%	21.24%	31.93%	32.00%
parent education(post-16 quals)	7.52%	7.78%	21.55%	21.50%
parent education (university level quals)	16.21%	17.15%	24.31%	24.21%
Occupational status (routine)	17.48%	17.85%	24.83%	24.85%

Occupational status (intermediate)	54.67%	55%	20.80%	20.83%
Occupational status (higher managerial)	27.17%	26.32%	40.87%	40.67%
Occupational status (unemployed)	0.68%	0.82%	13.50%	13.76%

Means (±SD) and proportions for analytical sample are pooled across 25 imputed datasets. All descriptives are sample and attrition weighted (MCS2001 cohort only).

Section 3: preliminary analysis for parent education variable

Rationale

Previous research often uses maternal education as an indicator of parent education. We consider household SES for all of our other indicators. We therefore conducted a preliminary analysis to determine which measure of parent education predicted the most variance in our outcomes (language at ages 3, 5, 11 and 14). We stated in our pre-registration (https://osf.io/482zw/) that we would use the measure of parent education that predicted the most variance in our outcome variables in our main analyses.

Method

Measures

Language ability. At ages 3 and 5, cohort members completed the naming vocabulary subscale of the BAS II. At age 11, cohort members completed the verbal similarities subscale of the BAS II. At age 14, cohort members completed a Word Activity Task. Please refer to Chapter 4 and section 1 of the supplementary file for details.

NVQ. When cohort members were aged 3, highest NVQ level was used (both academic and vocational qualifications derived into NVQ levels 1-5, with level 5 equating to higher qualifications). Highest household NVQ was derived from mother and fathers NVQ levels. We considered highest household, mother's and father's NVQ levels as separate predictors.

Analysis plan

Following multiple imputation (see Chapter 4), we conducted a series of multiple linear regressions: we predicted language at each age with 3 separate regression models, with highest household NVQ level, mother's NVQ level and father's NVQ level as predictors in separate models, in turn. We controlled for gender, ethnicity and whether English was spoken as an additional language in the home.

Results

Table S4 shows results for separate models (one with highest household NVQ level, one with mother's NVQ level and one with father's NVQ level) predicting language at ages 3, 5, 11 and 14. As can be seen from table 1, highest household NVQ consistently predicted the most variance in language at each age. Therefore, we use a measure of highest household NVQ as an indicator of parent's education in our analyses.

Table S3. Partial R2 values for NVQ variables

	Partial R^2 (%)			
	Age 3	Age 5	Age 11	Age 14
Highest household NVQ	6.78	8.64	6.6	7.24
Mother's NVQ	6.71	8.44	5.9	6.87
Father's NVQ	5.46	7.07	5.71	6.46

Models adjusted for gender, ethnicity and whether an additional language was spoken in the home. Partial R^2 values for the confounders only models: age 3= 14.89, age 5= 11.54, age 11= 1.12, age 14= 0.44.

Section 4: Model Comparison Results for Main Analysis

Model comparisons were conducted to determine whether each SES predictor contributed unique variance in language ability at each age; a model with all indicators included simultaneously was compared to a model with each removed in turn). If the five-predictor model was a better fit to the data than the four-predictor model following the removal of an SES indicator, then the SES variable that was dropped can be said to account for significant variance in language ability at that age.

Age 3. Parent education (Dm(5, 4449.02)= 46.73, p<.001), income (Dm(4, 4311.06)= 17.36, p<.001), occupational status (Dm(3, 3601.65)= 17.68, p<.001) and relative neighbourhood deprivation (Dm(9, 8015.91)= 2.61, p=.005) all accounted for significant variance in language ability at age 3. Wealth did not account for significant variance (Dm(4, 357.98)= 1, p=.457).

Age 5. Parent education (Dm(5, 3553.15)= 50.75, p<.001), income (Dm(4, 3378.3)= 13.2, p<.001), occupational status (Dm(3, 2861.34)= 30.24, p<.001) and relative neighbourhood deprivation (Dm(9, 6839)= 3.58, p<.001) all accounted for significant variance in language ability at age 5. Wealth did not account for significant variance (Dm(4, 327.59)= 1.88, p=.114).

Age 11. Parent education (Dm(5, 886.3)= 28.08, p<.001), income (Dm(4, 1105.92)= 7.59, p<.001), occupational status (Dm(3, 811.4)= 15.02, p<.001) and relative neighbourhood deprivation (Dm(9, 2298.22)= 3.14, p<.001) all accounted for significant variance in language ability at age 11. Wealth did not account for significant variance (Dm(4, 290.05)= 2.11, p=.079).

Age 14. Parent education Dm(5, 811.14)= 39.65, p<.001), income (Dm(4, 694.12)= 6.11, p<.001), occupational status (Dm(3, 339.7)= 7.93, p<.001) and wealth (Dm(4, 318.3)= 4.03, p=.003) all accounted for significant variance in language ability at age 14. Relative

neighbourhood deprivation did not account for significant variance (Dm(9, 1706.49)= .81, *p*=.61).

Section 5: AIC Values for Main Analysis

Results.

Regardless of age, a model that included each SES indicator as separate predictors was the "best model" (indicated by the smallest AIC values) and the ΔAIC values for the composite model at all ages were greater than 10, lending no support for the composite factor being as good a fit to the data as the 'all predictors separately' model (see table S4). Thus, it is better to include SES indicators separately when predicting language ability, even when the greater model complexity is taken account of, and there may be a reduction in the predictive accuracy of the model if we reduce the indicators to a composite measure. Compared to individual measures, however, the composite factor was a better fit to the data at all ages (see table S5). Therefore, compared to individual indicators of SES a composite measure is better than any one measure, but including all as separate indicators provides the best fit to the data

Table S4. AIC and ΔAIC values Individual SES predictors compared to composite factor

	Mean AIC [95% CIs]							
Indicator	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC
Parent Education	47348.89[47322.24;47375.53]	236.28	47801.41[47765.71;47837.11]	384.08	50192.3[50135.96;50248.65]	245.59	51279.94[51234.9;51324.98]	111.74
Income	47460.64[47434.98;47486.31]	348.03	47984.35[47946.97;48021.72]	567.02	50351.63[50292.06;50411.19]	404.92	51593.29[51554.79;51631.8]	425.09
Wealth	48418.76[48389.02;48448.5]	1306.15	49054.27[49011.53;49097]	1636.94	50990.43[50929.01;51051.86]	1043.72	52148.77[52105.27;52192.28]	980.57
Occupational Status	47495.28[47469.8;47520.76]	382.67	47899.06[47863.18;47934.93]	481.73	50319.15[50262.31;50375.98]	372.44	51605.87[51569.56;51642.18]	437.67
Neighbourhood Deprivation	48063.46[48037.29;48089.63]	950.85	48645.84[48611.6;48680.08]	1228.51	50790.71[50734.58;50846.83]	844	52089.09[52049.85;52128.34]	920.89
Composite	47112.61[47086.6;47138.62]	AIC*	47417.33[47381.27;47453.39]	AIC*	49946.71[49890.27;50003.15]	AIC*	51168.2[51129.16;51207.24]	AIC*

AIC* = best model; Values are the mean AIC values across 25 imputed datasets; All models adjusted for gender, ethnicity and EAL.

Table S5. AIC and ΔAIC values for a model containing all predictors simultaneously vs a composite factor.

	Mean AIC [95% CIs]							
	Age 3 Language (AIC)	ΔAIC	Age 5 Language (AIC)	ΔAIC	Age 11 Language (AIC)	ΔAIC	Age 14 Language (AIC)	ΔAIC
All predictors (simultaneous)	46937.31[46911.39; 46963.22]	AIC*	47266.77[47230.78;47302.77]	AIC*	49858.14[49803.97;49912.31]	AIC*	51030.88[50988.29;51073.48]	AIC*
Composite Factor	47112.61[47086.6;47138.62]	175.3	47417.33[47381.27;47453.39]	150.56	49946.71[49890.27;50003.15]	88.57	51168.2[51129.16;51207.24]	137.32

AIC* = best model
Values are the mean AIC values across 25 imputed datasets
All models adjusted for gender, ethnicity and EA

Section 6: Coefficients for associations between SEC indicators and vocabulary in the MCS2001 cohort

Table S6: Associations between SEC indicators and vocabulary at ages 3, 5, 11 and 14 in the MCS2001 cohort

		β [95% CIs] *p value*			
	Indicator	Age 3	Age 5	Age 11	Age 14
Parent Education	Parent Education (NVQ1)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Parent Education (NVQ5)	.74[.66;.82] * * * p<.001	.89[.81;.98] * * * p<.001	.80[.70;.90] * * * p<.001	.93[.82;1.03] * * * p<.001
	Parent Education (NVQ2	.20[.13;.26] * * * p<.001	.24[.17;.31] * * * p<.001	.16[.08;.25] * * * p<.001	.15[.06;.24] * * * p<.001
	Parent Education (NVQ3)	.34[.27;.41] * * * p<.001	.37[.29;.44] * * * p<.001	.32[.22;.41] * * * p<.001	.26[.16;.35] * * * p<.001
	Parent Education (NVQ4)	.58[.52;.65] * * * p<.001	.66[.59;.73] * * * p<.001	.55[.46;.64] * * * p<.001	.55[.46;.64] * * * p<.001
	Parent Education (None of these/overseas qualifications)	-.11[-.19;-.04] * * * p<.001	-.09[-.17;-.01] * p= .030	-.07[-.17;.03] p= .170	-.05[-.15;.05] p= .330

Income	Income Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Income Quintile	.16[.12;.20] * * * p<.001	.16[.12;.21] * * * p<.001	.13[.08;.18] * * * p<.001	.13[.07;.19] * * * p<.001
	Income Quintile 3	.40[.35;.44] * * * p<.001	.43[.38;.47] * * * p<.001	.32[.27;.37] * * * p<.001	.28[.22;.34] * * * p<.001
	Income Quintile 4	.56[.52;.61] * * * p<.001	.57[.53;.62] * * * p<.001	.46[.40;.51] * * * p<.001	.45[.39;.51] * * * p<.001
	Income Quintile 5	.67[.62;.71] * * * p<.001	.76[.72;.81] * * * p<.001	.66[.61;.72] * * * p<.001	.69[.63;.75] * * * p<.001
Wealth	Wealth Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Wealth Quintile 2	.03[-.03;.10] p= .310	.02[-.05;.09] p= .490	.03[-.05;.11] p= .420	.02[-.05;.09] p= .570
	Wealth Quintile 3	.09[.02;.16] * * p= .010	.09[.02;.16] * * p= .010	.09[.02;.16] * * p= .010	.10[.02;.17] * * p= .010
	Wealth Quintile 4	.18[.12;.24] * * * p<.001	.20[.13;.26] * * * p<.001	.18[.11;.26] * * * p<.001	.17[.09;.24] * * * p<.001
	Wealth Quintile 5	.33[.27;.40] * * * p<.001	.40[.34;.46] * * * p<.001	.37[.29;.46] * * * p<.001	.41[.35;.48] * * * p<.001
Occupational Status	Occupational Status (routine)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Occupational Status (intermediate)	.22[.17;.26] * * * p<.001	.20[.15;.24] * * * p<.001	.19[.13;.24] * * * p<.001	.12[.06;.17] * * * p<.001
	Occupational Status (higher managerial)	.40[.36;.43] * * * p<.001	.48[.44;.51] * * * p<.001	.43[.38;.47] * * * p<.001	.45[.40;.50] * * * p<.001
	Occupational Status (unemployed)	-.23[-.27;-.19] * * * p<.001	-.25[-.30;-.21] * * * p<.001	-.17[-.23;-.12] * * * p<.001	-.14[-.21;-.07] * * * p<.001
Neighbourhood	Relative Neighbourhood Deprivation (most deprived decile)	REFERENCE	REFERENCE	REFERENCE	REFERENCE

	Relative Neighbourhood Deprivation (10 - <20%)	.11[.05;.17] * * * p<.001	.10[.04;.16] * * * p<.001	.19[.11;.27] * * * p<.001	.11[.03;.18] * * * p<.001
	Relative Neighbourhood Deprivation (20 - <30%)	.18[.12;.24] * * * p<.001	.23[.16;.29] * * * p<.001	.24[.16;.32] * * * p<.001	.18[.10;.26] * * * p<.001
	Relative Neighbourhood Deprivation (30 - <40%)	.27[.21;.34] * * * p<.001	.28[.22;.34] * * * p<.001	.32[.24;.40] * * * p<.001	.22[.14;.29] * * * p<.001
	Relative Neighbourhood Deprivation (40 - <50%)	.29[.23;.35] * * * p<.001	.33[.27;.39] * * * p<.001	.32[.24;.40] * * * p<.001	.25[.18;.33] * * * p<.001
	Relative Neighbourhood Deprivation (50 - <60%)	.36[.30;.42] * * * p<.001	.41[.35;.47] * * * p<.001	.37[.30;.44] * * * p<.001	.29[.21;.36] * * * p<.001
	Relative Neighbourhood Deprivation (60 - <70%)	.44[.38;.50] * * * p<.001	.47[.40;.53] * * * p<.001	.49[.41;.58] * * * p<.001	.37[.28;.46] * * * p<.001
	Relative Neighbourhood Deprivation (70 - <80%)	.49[.43;.55] * * * p<.001	.57[.50;.63] * * * p<.001	.49[.41;.56] * * * p<.001	.47[.39;.54] * * * p<.001
	Relative Neighbourhood Deprivation (80 - <90%)	.49[.43;.55] * * * p<.001	.57[.50;.63] * * * p<.001	.50[.42;.57] * * * p<.001	.46[.38;.54] * * * p<.001
	Relative Neighbourhood Deprivation (least deprived decile)	.60[.54;.66] * * * p<.001	.68[.62;.75] * * * p<.001	.63[.55;.70] * * * p<.001	.57[.49;.65] * * * p<.001
Composite	Composite SEC	.28[.26;.29] * * * p<.001	.32[.30;.33] * * * p<.001	.28[.26;.29] * * * p<.001	.29[.27;.30] * * * p<.001

All coefficients taken from models adjusted for gender, ethnicity and English as an additional language (EAL).

*p<.05
** = p<.01
*** p<.001

Section 7: Sensitivity analysis with age 14 SES predictor variables

Rationale

Our main analysis used SES indicators taken at age 3. We found that the strongest associations were with age 5 language ability. We conducted a sensitivity analysis with age 14 SES indicators, to check whether this result was due to the proximity of the SES exposure to the age 5 language outcome. We therefore predicted age 14 language with age 14 SES indicators, using the same methodology as the main analyses (see methods in Chapter 4).

Method

Vocabulary measures. Details of the vocabulary measures can be found in Chapter 4. The same variables were used in this analysis.

Measures of socioeconomic circumstance.

Five indicators of family SEC were used: parent education, family income, wealth, occupational status and relative neighbourhood deprivation. Operationalisation of these variables is discussed below. These were taken from the age 14 sweep of the MCS2001 cohort.

Parent education. As a measure of parent's education, highest household NVQ level was used (both academic and vocational qualifications derived into NVQ levels 1-5, with level 5 equating to higher qualifications).

Family income. UK OECD weighted income quintiles were used (an indication of household income 1=lowest, 5=highest, accounting for family size).

Wealth. A measure of total net wealth, taken from the age 14 sweep of the MCS2001cohort. This measure was derived from 4 variables: amount outstanding on all mortgages, house value, amount of investments and assets, and amount of debts owed. Outstanding mortgages were subtracted from the house value, to give a measure of housing wealth. Debts owed were taken from the amount of investments and assets, to give a measure of financial wealth. Housing wealth and financial wealth were then summed to give an overall measure of total net wealth.

Occupational status. Highest household occupational status (National Statistics Socioeconomic Classification (NS-SEC) 3 categories: higher managerial; intermediate; routine, with a fourth category for those who were unemployed) at 14 years.

Relative neighbourhood deprivation. Indices of multiple deprivation (IMD) are the government official measure of relative deprivation (Mclennan et al., 2019). We used IMD deciles at age 14 (with 1= most deprived and 10=least deprived) as a measure of relative neighbourhood deprivation.

Analyses.

Language scores at ages 3, 5, 11 and 14 were considered as separate outcome variables. For each age, separate models with each SEC predictor in turn were built to assess the

unadjusted relationship between each predictor and language at each time point. Potential confounding variables were then added to each of the models. A drop-one analysis was used to assess the unique contribution of each predictor; a model with all 5 SEC predictors was compared to models with each predictor removed in turn (see Chapter 4). A composite factor was included as the predictor variable in four separate regression models (each one considering vocabulary at each age), adjusting for the potential confounding variables.

Results

Partial R^2 values for age 3 SEC indicators predicting age 14 vocabulary, compared to age 14 SEC indicators predicting age 14 vocabulary, can be found in Table S7 and Fig S3. With the exception of parent education and occupational status, individual indicators measured at age 14 contributed more variance to age 14 vocabulary. Regression coefficients can be found in Table S8 and are plotted in Figures S4 and S5. Figure S4 displays the regression coefficients for age 3 SEC indicators predicting age 14 vocabulary, compared to age 14 SEC indicators predicting age 14 vocabulary, whilst Figure S5 shows the age 14 SEC coefficients plotted against the main analysis results for all ages. As can be seen from Figure S4, the slopes are similar in steepness, regardless of which age SEC indicators were measured, although the age 14 SEC measures indicate wider inequalities than the age 3 measures. However, when compared to vocabulary at other ages, the main pattern of results remains (see Figure S5): inequalities are widest at the age of 5 and remain persistently wide throughout childhood and into adolescence. Proximity of the SEC measure to age 14 vocabulary does not appear to affect the main pattern of results.

Table S7: Model R^2 for age 3 SEC predictors and age 14 SEC predictors predicting age 14 language

Indicator	Age 3 SEC measures	Age 14 SEC measures
Parent Education	7.2	5.5
Income	5.5	6.5
Wealth	2.4	2.8
Occupation	5.4	3.1
Relative Neighbourhood Deprivation	2.8	3.9
SEC composite	7.8	8.1
All predictors simultaneously	8.8	8.5

R^2 of models adjusted for gender, ethnicity and English as an additional language.

Table S8: Age 14 sensitivity check with Age 14 SES measures: β [95% CIs]

		β [95% CIs] *p value*		
	Indicator	Age 14 Vocabulary		
Parent Education	Parent Education (NVQ1)	REFERENCE		
	Parent Education (None of these/overseas qualifications)	-.04[-.14;.06] p= .430		
	Parent Education (NVQ2	.18[.09;.26] * * * p<.001		
	Parent Education (NVQ3)	.30[.21;.39] * * * p<.001		
	Parent Education (NVQ4)	.52[.43;.60] * * * p<.001		
	Parent Education (NVQ5)	.68[.59;.77] * * * p<.001		
Income	Income Quintile 1		REFERENCE	
	Income Quintile		.13[.07;.19] * * * p<.001	
	Income Quintile 3		.33[.28;.39] * * * p<.001	
	Income Quintile 4		.50[.44;.56] * * * p<.001	
	Income Quintile 5		.74[.68;.80] * * * p<.001	
Wealth	Wealth Quintile 1			REFERENCE
	Wealth Quintile 2			.02[-.07;.11] p= .680
	Wealth Quintile 3			.09[-.00;.19] p= .060
	Wealth Quintile 4			.21[.13;.30] * * * p<.001

	Wealth Quintile 5	.45[.37;.53] * * * p<.001
Occupational Status	Occupational Status (routine)	REFERENCE
	Occupational Status (unemployed)	-.08[-.13;-.03] * * p<.001
	Occupational Status (intermediate)	.19[.13;.24] * * * p<.001
	Occupational Status (higher managerial)	.41[.36;.47] * * * p<.001
Neighbourhood Deprivation	Relative Neighbourhood Deprivation (most deprived decile)	REFERENCE
	Relative Neighbourhood Deprivation (10 - <20%)	.10[.03;.18] * * p= .010
	Relative Neighbourhood Deprivation (20 - <30%)	.14[.06;.21] * * * p<.001
	Relative Neighbourhood Deprivation (30 - <40%)	.24[.16;.32] * * * p<.001
	Relative Neighbourhood Deprivation (40 - <50%)	.29[.21;.37] * * * p<.001
	Relative Neighbourhood Deprivation (50 - <60%)	.36[.28;.44] * * * p<.001
	Relative Neighbourhood Deprivation (60 - <70%)	.46[.38;.54] * * * p<.001
	Relative Neighbourhood Deprivation (70 - <80%)	.43[.35;.51] * * * p<.001

	Relative Neighbourhood Deprivation (80 - <90%)	.50[.42;.58] * * * p<.001	
	Relative Neighbourhood Deprivation (least deprived decile)	.66[.58;.74] * * * p<.001	
Composite	Composite SEC		.29[.27;.31] * * * p<.001

All coefficients taken from models adjusted for gender, ethnicity and English as an additional language (EAL).

*p<.05
** = p<.01
*** p<.001

Model comparisons

All age 14 SES indicators predict unique variance in age 14 vocabulary:

Compared to a model without parent education, a model with all SES predictors was a significantly better fit (Dm(5, 8801.51)= 13.57, *p*<.001). Compared to a model without income, a model with all SES predictors was a significantly better fit (Dm(4, 10349.07)= 21.64, *p*<.001). Compared to a model without wealth, a model with all SES predictors was a significantly better fit to the data (Dm(4, 294.78)= 2.75, *p*=.028). Compared to a model without occupational status, a model with all SES predictors was a significantly better fit to the data (Dm(3,8738.35)= 9.71, *p*<.001). Finally, compared to a model without relative neighbourhood deprivation, a model with all SES predictors was a significantly better fit to the data (Dm(9, 10637.75)= 3.95, *p*<.001).

These findings are in line with that of the main analysis, with the exception of relative neighbourhood deprivation. When measured at the age of 3, relative neighbourhood deprivation did not contribute unique variance in age 14 vocabulary. This perhaps indicates that the proximity of neighbourhood deprivation is important regarding age 14 vocabulary.

Fig S3. Partial R^2 Values for SEC indicators (Ages 3 & 14) for predicting Age 14 Vocabulary

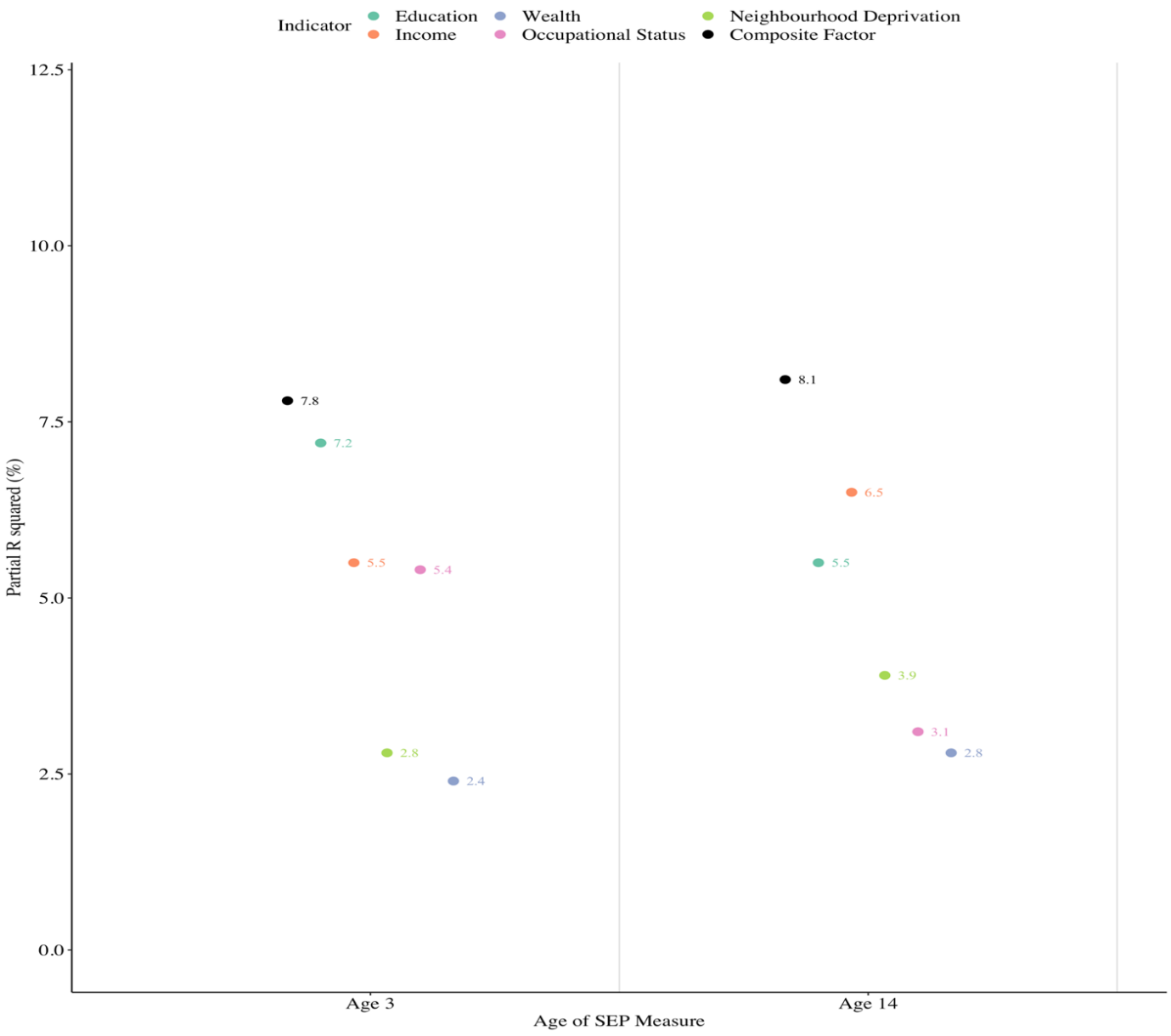


Fig. S4. Relationships between SEC indicators (Ages 3 & 14) and Vocabulary (Age 14)

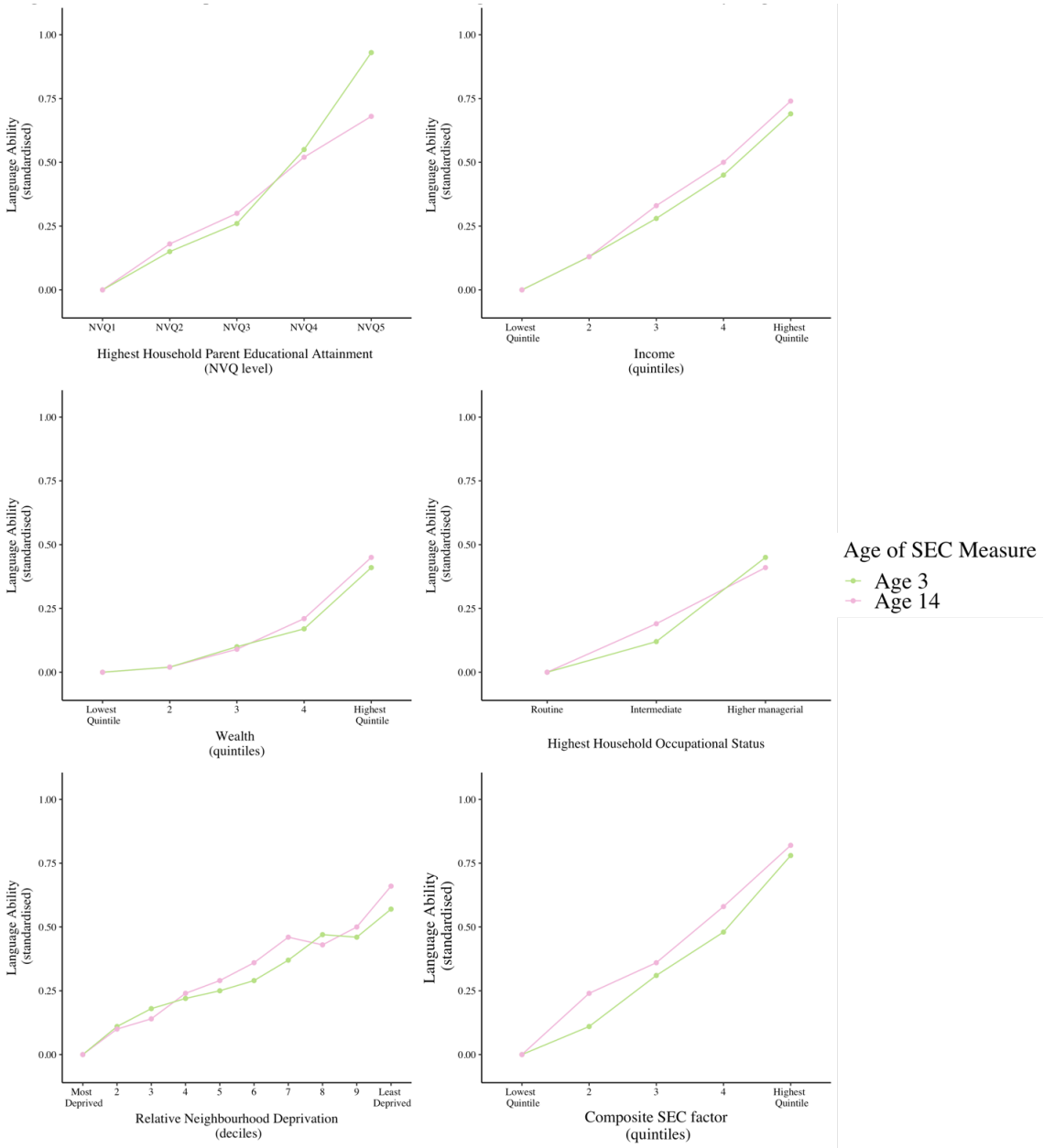
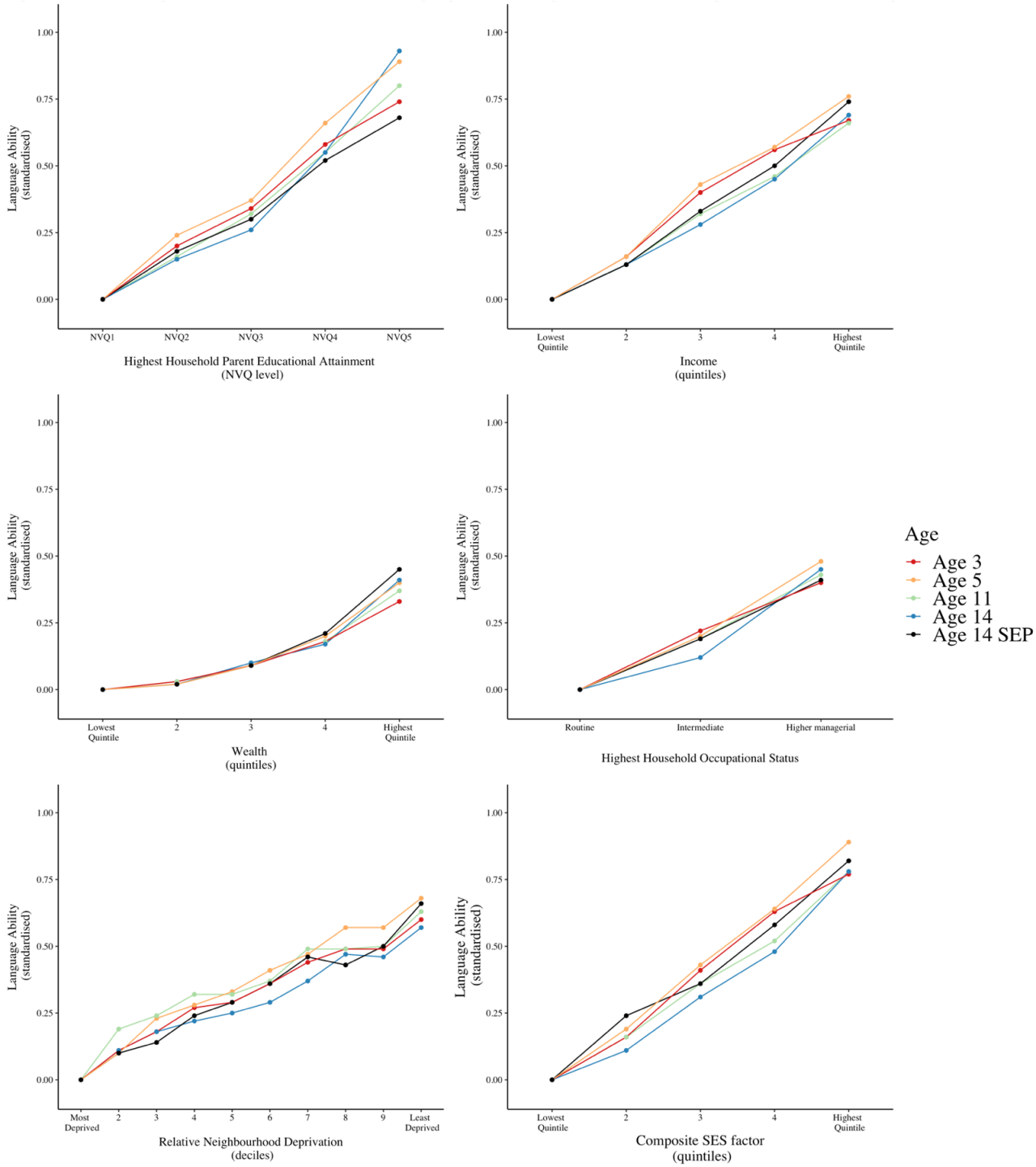


Fig. S5. Relationships between SEC indicators and Vocabulary at ages 3, 5, 11 and 14. Age 14 vocab predicted by age 3 and age 14 SEC indicators.



Section 8: Cross-cohort comparison: Descriptives and coefficients tables

Table S9. Descriptive statistics for language measure by SEC group in each cohort.

	1970-born cohort			~2001-born cohort		
	Early childhood language *Range=0-56*	Late childhood language *Range=0-20*	Adolescent language *Range=0-74*	Early childhood language *Range=10-170*	Late childhood language *Range= 10-179*	Adolescent language *0-20*
Routine	30.36(±11.73) [29.90;30.83]	10.95(±2.65) [10.84;11.05]	37.03(±13.16) [36.51;37.55]	104.14(±15.77) [103.67;104.62]	116.37(±17.54) [115.84;116.89]	6.46 (±2.34) [6.39;6.53]
Intermediate	34.14(±10.76) [33.90;34.38]	11.83(±2.54) [11.77;11.88]	40.21(±12.73) [39.93;40.50]	108.04(±15.46) [107.52;108.57]	120.10(±16.43) [119.54;120.66]	6.81(±2.42) [6.73;6.90]
Higher managerial	38.28(±10.42) [37.95;38.61]	13.06(±2.46) [12.99;13.14]	45.60(±12.31) [45.21;45.99]	113.23(±14.14) [112.87;113.58]	124.60(±14.46) [124.24;124.96]	7.73(±2.74) [7.66;7.80]
Unemployed	31.76(±11.90) [29.27; 34.26]	11.88(±3.12) [11.22;12.53]	39.75(±14.12) [36.79;42.71]	99.07(±17.48) [98.35; 99.79]	113.84(±18.70) [113.07;114.61]	6.13(±2.37) [6.03;6.23]
No /low level qualifications	32.05(±11.34) [31.80;32.30]	11.36(±2.60) [11.30;11.41]	38.42(±13.01) [38.01;38.59]	99.70(±17.11) [99.15;100.24]	113.70(±18.58) [113.10;114.29]	6.10(±2.35) [6.03;6.18]
O levels/GCSEs grades A*-C	36.44(±9.86) [36.09;36.80]	12.33(±2.45) [12.24;12.42]	41.99(±12.43) [41.54;42.43]	106.85(±14.96) [106.43;107.26]	118.22(±16.69) 117.76;118.69]	6.60(±2.33) [6.54;6.67]
Post 16 education	37.90(±10.25) [37.29;38.50]	12.84(±2.39) [12.69;12.98]	44.25(±11.90) [43.55;44.96]	110.33(±14.35) [109.85;110.81]	122.27(±14.76) [121.77;122.76]	7.10(±2.43) [7.02;7.18]
University level	39.44(±10.04) [39.04;39.85]	13.47(±2.37) [13.37;13.56]	47.84(±11.54) [47.37;48.39]	114.95(±14.41) [114.50;115.41]	126.77(±14.00) [126.33;127.21]	8.28(±2.83) [8.19;8.37]

Descriptive statistics combined across 25 imputed datasets. Descriptive statistics are sample and attrition weighted (MCS2001 cohort) and attrition weighted (BCS1970 cohort)

Table S10. Associations between SEC and language ability in the MCS2001 and BCS1970 cohorts in early childhood, late childhood and adolescence

		BCS1970 Cohort			MCS2001 Cohort		
	Indicator	Early Childhood Vocabulary	Late Childhood Vocabulary	Adolescent Vocabulary	Early Childhood Vocabulary	Late Childhood Vocabulary	Adolescent Vocabulary
Occ Parent Education	No/low level qualifications	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	O levels/ GCSEs grades A*-C	.36[.31;.40] * * * p<.001	.36[.31;.40] * * * p<.001	.27[.20;.33] * * * p<.001	.31[.27;.35] * * * p<.001	.25[.20;.30] * * * p<.001	.18[.13;.24] * * * p<.001
	Post 16 education	.48[.41;.55] * * * p<.001	.54[.48;.61] * * * p<.001	.43[.35;.51] * * * p<.001	.54[.49;.58] * * * p<.001	.49[.44;.55] * * * p<.001	.38[.33;.43] * * * p<.001
	University level qualifications	.64[.58;.70] * * * p<.001	.79[.73;.84] * * * p<.001	.70[.63;.77] * * * p<.001	.84[.80;.88] * * * p<.001	.75[.70;.80] * * * p<.001	.84[.78;.89] * * * p<.001
	Routine	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE

Intermediate	.30[.25;.35] * * * p<.001	.32[.27;.37] * * * p<.001	.24[.18;.30] * * * p<.001	.24[.20;.28] * * * p<.001	.22[.17;.27] * * * p<.001	.14[.09;.19] * * * p<.001
Higher managerial	.66[.61;.71] * * * p<.001	.78[.72;.84] * * * p<.001	.64[.57;.72] * * * p<.001	.51[.47;.54] * * * p<.001	.48[.44;.52] * * * p<.001	.49[.44;.54] * * * p<.001
Unemployed	.17[-.09;.43] p= .190	.38[.13;.63] * * * p<.001	.24[-.01;.49] p= .060	-.25[-.30;-.20] * * * p<.001	-.14[-.20;-.08] * * * p<.001	-.12[-.19;-.06] * * * p<.001

All coefficients taken from models adjusted for gender, ethnicity, English as an additional language (EAL) and age of cohort member at the time of the language test.
*p<.05
** = p<.01
*** p<.001

Section 9: Cross cohort supplementary analysis: Ridit scores

Rationale

The education system and occupational structure of the UK has changed over the period that separates the BCS1970 and MCS2001 cohorts, leading to changes in the composition of these two SEC indicators. We therefore conducted a supplementary analysis to our cross-cohort comparison, whereby highest household occupational status and highest household educational attainment were converted to ridit scores to aid comparability across cohorts(Donaldson, 1998). Ridit scores put ordered categories onto a scale of 0-1, based on the distribution of the categories within any dataset. The resulting coefficients of regression models with SEC ridit scores as the predictor provide the slope index of inequality (SII). The SII represents the estimated absolute inequalities in an outcome (here, vocabulary) between the highest and lowest SEC groups (Bann et al., 2018; Renard et al., 2019; WHO, 2013) and accounts for the changes in the composition of the SEC indicator(Regidor, 2004; WHO, 2013). Therefore, this method allows us to compare inequalities in vocabulary in two cohorts, despite the underlying distributions of SEC variables differing across cohorts. However, as this is an absolute measure of inequalities, this method is not able to discern gradients within the distribution and so hence this method forms our supplementary analysis.

Method

Highest household educational attainment and highest household occupational status were converted to ridit scores separately in each cohort. The *toridit()* function from the riditttools package in R was used (Bohlman, 2018). Ridit scores were calculated for each imputed dataset and regression models, where the ridit score was the main predictor, were ran for each imputed dataset. The results of the regression models were then pooled. This procedure was conducted on separate regression models, where early childhood vocabulary, late childhood vocabulary and adolescent vocabulary in each cohort were the outcome variables. This results in 6 separate regression models in each cohort:

1. BCS1970 education ridit, predicting early childhood vocabulary
2. BCS1970 education ridit, predicting late childhood vocabulary

3. BCS1970 education ridit, predicting adolescent vocabulary
4. BCS1970 occupational status ridit, predicting early childhood vocabulary
5. BCS1970 occupational status ridit, predicting late childhood vocabulary
6. BCS1970 occupational status ridit, predicting adolescent vocabulary
7. MCS2001 education ridit, predicting early childhood vocabulary
8. MCS2001 education ridit, predicting late childhood vocabulary
9. MCS2001 education ridit, predicting adolescent vocabulary
10. MCS2001 occupational status ridit, predicting early childhood vocabulary
11. MCS2001 occupational status ridit, predicting late childhood vocabulary
12. MCS2001 occupational status ridit, predicting adolescent vocabulary

All models controlled for gender, ethnicity and English as an additional language (EAL).

Results

Regression coefficients can be found in Table S11. Because our ridit scores rank occupation and education from the lowest SEC to the highest SEC, positive coefficients are indicative of higher vocabulary abilities among the highest SEC group (WHO, 2013). Coefficients indicate better vocabulary scores in the most advantaged group. This is the case for all ages and in both cohorts.

The results from this supplementary analysis confirm the results of the main cross cohort comparison analysis. As can be seen from Table S11, inequalities based on highest household education are largest in the MCS2001 cohort for early childhood and adolescent vocabulary, but in the BCS1970 cohort for late childhood language ability. Turning to highest household occupational status, inequalities are largest for vocabulary at all ages in the BCS1970 cohort, indicated by the bigger coefficients for this cohort. A comparison of the partial R^2 values for the main analysis and ridit score analysis can be found in Table S12 and Figure S6. These are similar across both analyses.

Table S11: Regression coefficients for models predicting vocabulary using SEC ridit scores

	β [95% CIs] *p value*			
	Highest Household Education (ridit score)		Highest Household Occupation (ridit score)	
	1970	2001	1970	2001
Early Childhood Vocabulary	.97[.90;1.05]*** *p<.001*	1.07[1.02;1.13]*** *p<.001*	.86[.79;.92]*** *p<.001*	.81[.75;.86]*** *p<.001*
Late Childhood Vocabulary	1.14[1.07;1.21]*** *p<.001*	.98[.92;1.04]*** *p<.001*	1.02[.95;1.09]*** *p<.001*	.76[.70;.83]*** *p<.001*
Adolescent Vocabulary	.97[.88;1.07]*** *p<.001*	1.07[1; 1.14]*** *p<.001*	.85[.76;.94]*** *p<.001*	.81[.73;.89]*** *p<.001*

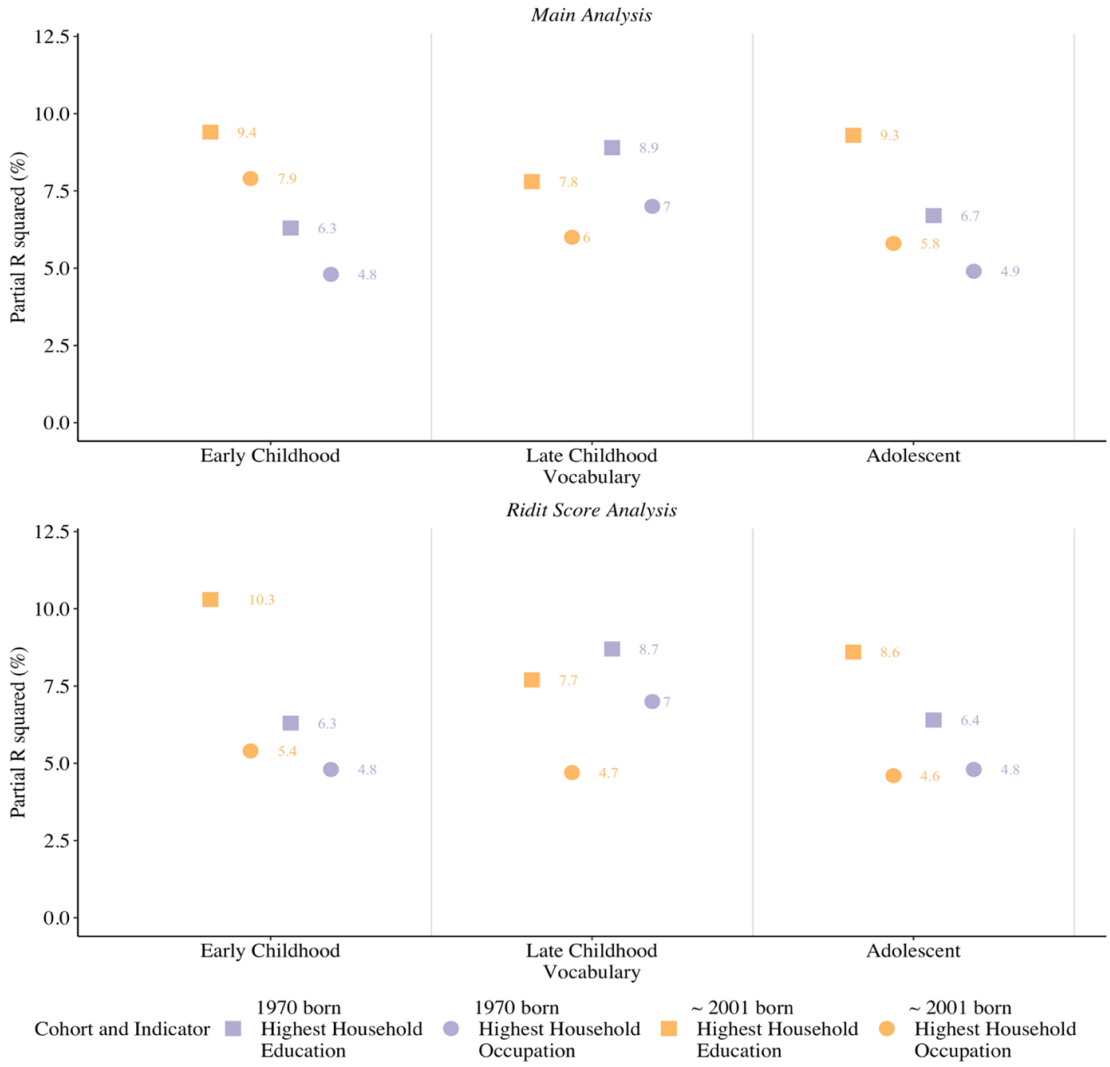
All coefficients taken from models adjusted for gender, ethnicity and English as an additional language (EAL).

Table S12: Partial R^2 values for ridit scores predicting vocabulary throughout childhood in two cohorts

	Partial R^2 (%)			
	Highest Household Education (ridit score)		Highest Household Occupation (ridit score)	
	1970	2001	1970	2001
Early Childhood Vocabulary	6.3	10.3	4.8	5.4
Late Childhood Vocabulary	8.7	7.7	7	4.7
Adolescent Vocabulary	6.4	8.6	4.8	4.6

R^2 of models adjusted for gender, ethnicity and English as an additional language.

Fig. S6. Partial R^2 Values for SEC indicators in each cohort: Comparison of Main and Ridit Score Analyses



Section 10: Cross-cohort Sensitivity Analysis: White Ethnicity Sample

Method

Vocabulary measures (cross-cohort comparison). Details of the vocabulary measures can be found in Chapter 4. The same variables were used in this analysis.

Indicators of socioeconomic circumstance.
Harmonized measures of the following two indicators were used as measures of SEC:

Parental education. The highest academic qualification achieved in the household when the cohort member was aged 5. Where this information is missing, information from previous sweeps was used.

Occupational status. Highest household occupational status at age 5. For the BCS1970 cohort, this was ascertained with the Registrar General's classification. For the MCS2001cohort, the NS-SEC classification system was used. Where this information is missing, information from previous sweeps was used

Analysis plan.

We had 3 separate outcome variables in each cohort (early childhood language ability, late childhood language ability and adolescent language ability). We built two regression models per outcome, one with occupational status as the predictor variable and the other with parent education as the predictor variable. Because our measures of language ability were standardised within each cohort, we were able to directly compare coefficients between cohorts and establish the rate of inequality in language ability at each age in the two cohorts.

Results

Regression coefficients can be found in Table S13 and partial R^2 values can be found in Table S14. The results from this sensitivity analysis confirm the results of the main cross cohort comparison analysis. As can be seen from Table S13, inequalities based on highest household education are largest in the MCS2001 cohort for early childhood and adolescent vocabulary, but in the BCS1970 cohort for late childhood language ability. Turning to highest household occupational status, inequalities are largest for vocabulary at all ages in the BCS1970 cohort, indicated by the bigger coefficients for this cohort. Thus, the ethnic composition of the two cohorts do not appear to be driving the results of our cross-cohort comparison.

Table S13: β[95% CIs] for SEC predicting vocabulary in MCS2001 and BCS1970 Cohorts

		BCS1970 Cohort			MCS2001 Cohort		
	Indicator	Early Childhood Vocabulary	Late Childhood Vocabulary	Adolescent Vocabulary	Early Childhood Vocabulary	Late Childhood Vocabulary	Adolescent Vocabulary
Parental Education	No/low level qualifications	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	O levels/ GCSEs grades A*-C	.39[.34;.43] * * * p<.001	.36[.31;.41] * * * p<.001	.28[.23;.34] * * * p<.001	.34[.29;.39] * * * p<.001	.27[.22;.32] * * * p<.001	.20[.14;.25] * * * p<.001

		BCS1970 Cohort			MCS2001 Cohort		
	Indicator	Early Childhood Vocabulary	Late Childhood Vocabulary	Adolescent Vocabulary	Early Childhood Vocabulary	Late Childhood Vocabulary	Adolescent Vocabulary
Occupational Status	Post 16 education	.51[.44;.58] * * * p<.001	.56[.48;.63] * * * p<.001	.46[.37;.54] * * * p<.001	.59[.53;.64] * * * p<.001	.51[.45;.57] * * * p<.001	.39[.33;.45] * * * p<.001
	University level qualifications	.68[.63;.73] * * * p<.001	.80[.75;.85] * * * p<.001	.71[.65;.78] * * * p<.001	.90[.85;.96] * * * p<.001	.78[.72;.83] * * * p<.001	.85[.79;.92] * * * p<.001
	Routine	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Unemployed	.10[-.22;.42] p= .540	.26[-.09;.62] p= .140	.16[-.28;.60] p= .480	-.32[-.38;-.26] * * * p<.001	-.19[-.26;-.12] * * * p<.001	-.14[-.21;-.07] * * * p<.001
	Intermediate	.33[.28;.38] * * * p<.001	.30[.24;.35] * * * p<.001	.24[.17;.32] * * * p<.001	.25[.20;.30] * * * p<.001	.23[.17;.28] * * * p<.001	.13[.07;.19] * * * p<.001
	Higher managerial	.71[.65;.76] * * * p<.001	.76[.70;.82] * * * p<.001	.64[.56;.72] * * * p<.001	.53[.48;.57] * * * p<.001	.48[.43;.52] * * * p<.001	.49[.44;.53] * * * p<.001

Table S14: Partial R2 Values for cross-cohort comparison (%)

	Partial R^2 (%)			
	Highest Household Education		Highest Household Occupation	
	1970	2001	1970	2001
Early Childhood Vocabulary	7.3	10	5.5	8.8
Late Childhood Vocabulary	9.4	7.7	6.9	6.2
Adolescent Vocabulary	7.2	9.4	4.9	6

Partial R^2 values, all models control for sex and EAL.

Section 11: Sensitivity analysis complete cases for vocabulary at age 3 (*n = 14,569)*

Rationale

We ran a complete cases analysis where no data was missing for vocabulary at age 3. 14.71% of vocabulary scores at age 3 were missing in our main analysis sample. This sensitivity analysis was to see if only using observed scores (rather than using multiple imputation to account for missing data) changed our findings.

Method

Vocabulary measures. Details of the vocabulary measures can be found in Chapter 4. The same variables were used in this analysis.

Measures of socioeconomic circumstance. Five indicators of family SEC were used: parent education, family income, wealth, occupational status and relative neighbourhood deprivation. Operationalisation of these variables can be found in Chapter 4.

Analyses.

Language scores at ages 3, 5, 11 and 14 were considered as separate outcome variables. For each age, separate models with each SEC predictor in turn (parent education, income, wealth, occupational status and neighbourhood deprivation, each in a separate model) were built to assess the unadjusted relationship between each predictor and language at each time point. Potential confounding variables were then added to each of the models. A drop-one analysis was used to assess the unique contribution of each predictor; a model with all 5 SEC predictors was compared to models with each predictor removed in turn (see Chapter 4). A composite factor was included as the predictor variable in four separate regression models (each one considering vocabulary at each age), adjusting for the potential confounding variables. Relative AIC values were used to compare the marginal predictive value of each SEC predictor (see Chapter 4 for details).

Results

Regression coefficients can be found in Table. S15. Model comparisons revealed the same pattern of results as the main analysis: caregiver education, income and occupational status accounted for significant variance in vocabulary at all ages. Neighbourhood statistics accounted for significant variance in vocabulary at ages 3, 5 and 11, while wealth only accounted for significant variance in vocabulary at age 14 (see model comparisons). Partial R^2 values can be found in Table S.16. In line with the main analysis, caregiver education explains the largest proportion of variance in vocabulary at each age, closely followed by income and occupational status. Wealth and relative neighbourhood deprivation consistently contribute the least variance in vocabulary scores, regardless of age. Finally, AIC values indicate that a composite model is a better fit to the data than any one indicator in isolation, but all models included simultaneously is the best fit (see Tables S.17 and S.18). Overall, the level of missing data in age 3 vocabulary did not influence the main pattern of results.

Table S.15. β[95% CIs] for SEC predicting vocabulary for age 3 complete cases(N = 14569)

		β [95% CIs] *p value*			
	Indicator	Age 3	Age 5	Age 11	Age 14
Parent Education	Parent Education (NVQ1)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Parent Education (None of these/overseas qualifications)	-.13[-.21;-.06] * * * p<.001	-.08[-.17;.01] p= .070	-.04[-.14;.06] p= .420	-.05[-.16;.06] p= .370
	Parent Education (NVQ2	.21[.14;.27] * * * p<.001	.24[.17;.32] * * * p<.001	.19[.10;.28] * * * p<.001	.12[.02;.22] * p= .020
	Parent Education (NVQ3)	.36[.29;.43] * * * p<.001	.38[.30;.45] * * * p<.001	.35[.26;.44] * * * p<.001	.24[.14;.34] * * * p<.001
	Parent Education (NVQ4)	.60[.53;.66] * * * p<.001	.68[.60;.75] * * * p<.001	.58[.49;.67] * * * p<.001	.53[.43;.63] * * * p<.001
	Parent Education (NVQ5)	.75[.67;.83] * * * p<.001	.91[.82;1.00] * * * p<.001	.85[.74;.95] * * * p<.001	.90[.79;1.01] * * * p<.001
Income	Income Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Income Quintile	.18[.13;.22] * * * p<.001	.18[.13;.23] * * * p<.001	.12[.06;.19] * * * p<.001	.11[.04;.18] * * * p<.001
	Income Quintile 3	.41[.37;.46] * * * p<.001	.43[.38;.48] * * * p<.001	.30[.24;.36] * * * p<.001	.24[.17;.32] * * * p<.001
	Income Quintile 4	.59[.54;.63] * * * p<.001	.59[.53;.64] * * * p<.001	.46[.40;.53] * * * p<.001	.43[.36;.50] * * * p<.001
	Income Quintile 5	.68[.63;.73] * * * p<.001	.78[.73;.83] * * * p<.001	.67[.60;.73] * * * p<.001	.65[.58;.72] * * * p<.001
Wealth	Wealth Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Wealth Quintile 2	.04[-.02;.10] p= .230	.02[-.05;.10] p= .510	.04[-.03;.12] p= .240	.03[-.04;.10] p= .400

	Wealth Quintile 3	.09[.03;.16] * * * p<.001	.11[.02;.19] * * p= .010	.09[.03;.16] * * * p<.001	.09[.02;.17] * p= .020
	Wealth Quintile 4	.20[.14;.26] * * * p<.001	.21[.14;.29] * * * p<.001	.19[.11;.26] * * * p<.001	.19[.12;.26] * * * p<.001
	Wealth Quintile 5	.34[.28;.39] * * * p<.001	.40[.33;.47] * * * p<.001	.38[.31;.44] * * * p<.001	.42[.35;.49] * * * p<.001
Occupational Status	Occupational Status (routine)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Occupational Status (unemployed)	-.25[-.30;-.20] * * * p<.001	-.27[-.32;-.22] * * * p<.001	-.18[-.25;-.12] * * * p<.001	-.12[-.19;-.04] * * * p<.001
	Occupational Status (intermediate)	.22[.17;.26] * * * p<.001	.18[.13;.23] * * * p<.001	.17[.11;.23] * * * p<.001	.12[.05;.18] * * * p<.001
	Occupational Status (higher managerial)	.39[.35;.43] * * * p<.001	.47[.42;.51] * * * p<.001	.43[.38;.47] * * * p<.001	.44[.39;.50] * * * p<.001
Neighbourhood Deprivation	Relative Neighbourhood Deprivation (most deprived decile)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Relative Neighbourhood Deprivation (10 - <20%)	.13[.07;.19] * * * p<.001	.12[.05;.19] * * * p<.001	.18[.10;.27] * * * p<.001	.12[.03;.20] * * p= .010
	Relative Neighbourhood Deprivation (20 - <30%)	.20[.13;.26] * * * p<.001	.25[.18;.32] * * * p<.001	.26[.18;.34] * * * p<.001	.19[.10;.27] * * * p<.001
	Relative Neighbourhood Deprivation (30 - <40%)	.29[.22;.35] * * * p<.001	.29[.21;.36] * * * p<.001	.33[.25;.41] * * * p<.001	.24[.15;.32] * * * p<.001
	Relative Neighbourhood Deprivation (40 - <50%)	.32[.26;.39] * * * p<.001	.37[.30;.44] * * * p<.001	.32[.24;.40] * * * p<.001	.26[.18;.34] * * * p<.001
	Relative Neighbourhood Deprivation (50 - <60%)	.38[.32;.45] * * * p<.001	.43[.35;.50] * * * p<.001	.38[.31;.46] * * * p<.001	.30[.22;.39] * * * p<.001

	Relative Neighbourhood Deprivation (60 - <70%)	.46[.40;.53] * * * p<.001	.48[.41;.55] * * * p<.001	.50[.42;.58] * * * p<.001	.37[.29;.45] * * * p<.001
	Relative Neighbourhood Deprivation (70 - <80%)	.52[.45;.58] * * * p<.001	.61[.54;.68] * * * p<.001	.50[.42;.58] * * * p<.001	.48[.39;.58] * * * p<.001
	Relative Neighbourhood Deprivation (80 - <90%)	.50[.44;.57] * * * p<.001	.59[.52;.66] * * * p<.001	.49[.42;.57] * * * p<.001	.46[.38;.55] * * * p<.001
	Relative Neighbourhood Deprivation (least deprived decile)	.62[.56;.68] * * * p<.001	.70[.63;.77] * * * p<.001	.62[.54;.71] * * * p<.001	.56[.48;.64] * * * p<.001
Composite	Composite SEC	.28[.26;.29] * * * p<.001	.32[.30;.34] * * * p<.001	.28[.26;.30] * * * p<.001	.28[.26;.30] * * * p<.001

Model comparisons

Age 3. Parent education (Dm(5, 14490.67)= 47.2, *p*<.001), income (Dm(4, 14535)= 18.95, *p*<.001), occupational status (Dm(3, 12186.9)= 14.32, *p*<.001) and relative neighbourhood deprivation (Dm(9, 14511.14)= 2.91, *p*=.002) all accounted for significant variance in language ability at age 3. Wealth did not account for significant variance (Dm(4, 525.11)= 0.61, *p*=.653).

Age 5. Parent education (Dm(5, 4488.89)= 42.23, *p*<.001), income (Dm(4, 3893.41)= 13.62, *p*<.001), occupational status (Dm(3, 2304.74)= 20.24, *p*<.001) and relative neighbourhood deprivation (Dm(9, 7521.41)= 4.2, *p*<.001) all accounted for significant variance in language ability at age 5. Wealth did not account for significant variance (Dm(4, 311.3)= 1.08, *p*=.652).

Age 11. Parent education (Dm(5, 1183.62)= 26.94, *p*<.001), income (Dm(4, 1324.48)= 7.78, *p*<.001), occupational status (Dm(3, 933.84)= 12.83, *p*<.001) and relative neighbourhood deprivation (Dm(9, 2632.98)= 2.72, *p*=.004) all accounted for significant variance in language ability at age 11. Wealth did not account for significant variance (Dm(4, 404.84)= 1.62, *p*=.168).

Age 14. Parent education Dm(5, 800.13)= 32.38, *p*<.001), income (Dm(4, 613.03)= 4.38, *p*=.002), occupational status (Dm(3, 433.06)= 7.98, *p*<.001) and wealth (Dm(4, 390.29)= 4.26, *p*=.002) all accounted for significant variance in language ability at age 14. Relative neighbourhood deprivation did not account for significant variance (Dm(9, 1718.69)= .87, *p*=.549).

Table S.16: Partial R^2 Values for SEC predicting vocabulary: age 3 complete case analysis

	Partial R^2 (%)			
Indicator	Age 3	Age 5	Age 11	Age 14
Parent Education	6.9	8.4	6.6	6.9
Income	6.4	7.8	5.6	5.2
Wealth	1.7	2.4	2.0	2.5
Occupation	6.0	7.8	5.7	5.1
Relative Neighbourhood Deprivation	3.5	4.6	3.2	2.7
SEC composite	7.9	10.3	7.8	7.5

Partial R^2 values, all models control for sex, ethnicity and EAL.

Table S.17: AIC values table (individual indicators vs composite factor) – age 3 complete case analysis

	Age 3		Age 5		Age 11		Age 14	
Indicator	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC
Parent Education	40814.35[40812.56;40816.13]	191.13	41387.92[41358.28;41417.56]	342.86	42984.09[42932.55;43035.62]	204.52	43706.53[43644.05;43769.01]	98.86
Income	40895.87[40893.69;40898.05]	272.65	41500.32[41472.27;41528.36]	455.26	43122.88[43067.4;43178.37]	343.31	43974.81[43910.15;44039.48]	367.14
Wealth	41723.99[41715.09;41732.88]	1100.77	42402.4[42369.74;42435.05]	1357.34	43679.01[43618.21;43739.81]	899.44	44381.32[44314.85;44447.8]	773.65
Occupational Status	40964.56[40961.52;40967.59]	341.34	41490.71[41464.47;41516.96]	445.65	43112.16[43059.45;43164.88]	332.59	43977.33[43912.5;44042.16]	369.66
Neighbourhood Deprivation	41413.62[41412.07;41415.18]	790.4	42042.91[42014.71;42071.1]	997.85	43510.77[43456.12;43565.42]	731.2	44353.78[44284.87;44422.69]	746.11
Composite SEC	40623.22[40620.51;40625.94]	AIC*	41045.06[41017.68;41072.45]	AIC*	42779.57[42723.9;42835.23]	AIC*	43607.67[43544.88;43670.45]	AIC*

AIC* = best model; Values are the mean AIC values across 25 imputed datasets; All models adjusted for sex, ethnicity and EAL.

Table S.18: AIC values table (all indicators simultaneously vs composite factor) – age 3 complete case analysis

	Age 3		Age 5		Age 11		Age 14	
Indicator	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC
SEC composite	40623.22[40620.51;40625.94]	157.14	41045.06[41017.68;41072.45]	107.7	42779.57[42723.9;42835.23]	69.19	43607.67[43544.88;43670.45]	109.98
All indicators	40466.08[40463.97;40468.19]	AIC*	40937.36[40909.41;40965.31]	AIC*	42710.38[42656.95;42763.81]	AIC*	43497.69[43436.04;43559.34]	AIC*

AIC* = best model; Values are the mean AIC values across 25 imputed datasets; All models adjusted for gender, ethnicity and EAL.

Section 12: Sensitivity analysis complete cases for vocabulary at age 5 (N=14,961)

Rationale

We ran a complete cases analysis where no data was missing for vocabulary at age 5. 12.42% of age 5 vocabulary scores were missing from our main analysis sample. This sensitivity analysis was to see if only using observed scores (rather than using multiple imputation to account for missing data) changed our findings.

Method

Vocabulary measures. Details of the vocabulary measures can be found in Chapter 4. The same variables were used in this analysis.

Measures of socioeconomic circumstance. Five indicators of family SEC were used: parent education, family income, wealth, occupational status and relative neighbourhood deprivation. Operationalisation of these variables can be found in Chapter 4.

Analyses.

Language scores at ages 3, 5, 11 and 14 were considered as separate outcome variables. For each age, separate models with each SEC predictor in turn (parent education, income, wealth, occupational status and neighbourhood deprivation, each in a separate model) were built to assess the unadjusted relationship between each predictor and language at each time point. Potential confounding variables were then added to each of the models. A drop-one analysis was used to assess the unique contribution of each predictor; a model with all 5 SEC predictors was compared to models with each predictor removed in turn (see Chapter 4). A composite factor was included as the predictor variable in four separate regression models (each one considering vocabulary at each age), adjusting for the potential confounding variables. Relative AIC values were used to compare the marginal predictive value of each SEC predictor (see Chapter 4 for details).

Results

Regression coefficients can be found in Table S19. Model comparisons revealed the same pattern of results as the main analysis: caregiver education, income and occupational status accounted for significant variance in vocabulary at all ages. Neighbourhood statistics accounted for significant variance in vocabulary at ages 3, 5 and 11, while wealth only accounted for significant variance in vocabulary at age 14 (see model comparisons). Partial R^2 values can be found in Table S20. In line with the main analysis, caregiver education explains the largest proportion of variance in vocabulary at each age, closely followed by income and occupational status. Wealth and relative neighbourhood deprivation consistently contribute the least variance in vocabulary scores, regardless of age. Finally, AIC values indicate that a composite model is a better fit to the data than any one indicator in isolation, but all models included simultaneously is the best fit (see Tables S21 and S22). Overall, the level of missing data in age 5 vocabulary did not influence the main pattern of results.

Table S.19. β[95% CIs] for SEC predicting vocabulary for age 5 complete cases (N=14,961)

		β [95% CIs] *p value*			
	Indicator	Age 3	Age 5	Age 11	Age 14
Parent Education	Parent Education (NVQ1)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Parent Education (None of these/overseas qualifications)	-.11[-.20;-.03] * * p= .010	-.09[-.17;-.02] * p= .020	-.03[-.13;.06] p= .480	-.04[-.14;.06] p= .470
	Parent Education (NVQ2	.19[.12;.27] * * * p<.001	.24[.17;.31] * * * p<.001	.19[.10;.27] * * * p<.001	.14[.06;.23] * * * p<.001
	Parent Education (NVQ3)	.35[.27;.42] * * * p<.001	.37[.30;.44] * * * p<.001	.35[.26;.43] * * * p<.001	.25[.16;.35] * * * p<.001
	Parent Education (NVQ4)	.59[.52;.66] * * * p<.001	.68[.61;.74] * * * p<.001	.58[.49;.66] * * * p<.001	.55[.46;.63] * * * p<.001
	Parent Education (NVQ5)	.76[.68;.85] * * * p<.001	.93[.85;1.01] * * * p<.001	.84[.74;.94] * * * p<.001	.93[.82;1.04] * * * p<.001
Income	Income Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Income Quintile	.17[.12;.22] * * * p<.001	.17[.13;.22] * * * p<.001	.13[.07;.18] * * * p<.001	.14[.07;.20] * * * p<.001

Wealth	Income Quintile 3	.42[.37;.47] * * * p<.001	.45[.40;.49] * * * p<.001	.33[.27;.38] * * * p<.001	.27[.21;.34] * * * p<.001
	Income Quintile 4	.59[.54;.63] * * * p<.001	.59[.55;.64] * * * p<.001	.46[.41;.51] * * * p<.001	.45[.39;.51] * * * p<.001
	Income Quintile 5	.67[.63;.72] * * * p<.001	.78[.74;.83] * * * p<.001	.67[.62;.73] * * * p<.001	.68[.62;.75] * * * p<.001
	Wealth Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Wealth Quintile 2	.03[-.03;.10] p= .290	.03[-.05;.10] p= .510	.04[-.05;.12] p= .410	.02[-.06;.10] p= .600
	Wealth Quintile 3	.09[.02;.16] * p= .020	.10[.02;.18] * * p= .010	.09[.01;.17] * p= .020	.10[.02;.17] * * p= .010
	Wealth Quintile 4	.19[.13;.26] * * * p<.001	.21[.13;.28] * * * p<.001	.19[.11;.27] * * * p<.001	.18[.11;.25] * * * p<.001
	Wealth Quintile 5	.33[.27;.40] * * * p<.001	.40[.33;.48] * * * p<.001	.38[.30;.45] * * * p<.001	.41[.34;.49] * * * p<.001
Occupational Status	Occupational Status (routine)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Occupational Status (unemployed)	-.22[-.27;-.17] * * * p<.001	-.26[-.31;-.21] * * * p<.001	-.18[-.23;-.12] * * * p<.001	-.14[-.20;-.07] * * * p<.001
	Occupational Status (intermediate)	.24[.19;.28] * * * p<.001	.20[.16;.25] * * * p<.001	.19[.14;.25] * * * p<.001	.11[.05;.18] * * * p<.001
	Occupational Status (higher managerial)	.41[.37;.45] * * * p<.001	.49[.45;.53] * * * p<.001	.43[.39;.48] * * * p<.001	.44[.39;.49] * * * p<.001
Neighbourhood Deprivation	Relative Neighbourhood Deprivation (most deprived decile)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Relative Neighbourhood Deprivation (10 - <20%)	.11[.04;.17] * * * p<.001	.11[.04;.17] * * * p<.001	.21[.13;.28] * * * p<.001	.11[.03;.19] * * p= .010

	Relative Neighbourhood Deprivation (20 - <30%)	.17[.11;.24] * * * p<.001	.23[.17;.29] * * * p<.001	.26[.19;.34] * * * p<.001	.17[.09;.26] * * * p<.001
	Relative Neighbourhood Deprivation (30 - <40%)	.28[.22;.35] * * * p<.001	.29[.22;.35] * * * p<.001	.33[.26;.41] * * * p<.001	.22[.14;.30] * * * p<.001
	Relative Neighbourhood Deprivation (40 - <50%)	.28[.21;.35] * * * p<.001	.32[.26;.38] * * * p<.001	.33[.25;.40] * * * p<.001	.25[.17;.33] * * * p<.001
	Relative Neighbourhood Deprivation (50 - <60%)	.36[.30;.43] * * * p<.001	.42[.36;.49] * * * p<.001	.40[.33;.48] * * * p<.001	.28[.20;.36] * * * p<.001
	Relative Neighbourhood Deprivation (60 - <70%)	.44[.37;.51] * * * p<.001	.48[.41;.54] * * * p<.001	.52[.43;.60] * * * p<.001	.37[.28;.46] * * * p<.001
	Relative Neighbourhood Deprivation (70 - <80%)	.49[.42;.56] * * * p<.001	.58[.52;.65] * * * p<.001	.51[.44;.59] * * * p<.001	.47[.39;.56] * * * p<.001
	Relative Neighbourhood Deprivation (80 - <90%)	.47[.41;.54] * * * p<.001	.57[.50;.63] * * * p<.001	.50[.43;.58] * * * p<.001	.45[.36;.54] * * * p<.001
	Relative Neighbourhood Deprivation (least deprived decile)	.59[.53;.66] * * * p<.001	.69[.62;.75] * * * p<.001	.63[.55;.70] * * * p<.001	.56[.48;.64] * * * p<.001
Composite	Composite SEC	.28[.26;.30] * * * p<.001	.33[.31;.34] * * * p<.001	.28[.26;.30] * * * p<.001	.29[.26;.31] * * * p<.001

Table S.20. Partial R^2 Values for SEC predicting vocabulary: age 5 complete cases

	Partial R^2 (%)			
Indicator	Age 3	Age 5	Age 11	Age 14
Parent Education	6.9	8.9	6.6	7.1
Income	6.5	8.0	5.7	5.5
Wealth	1.6	2.4	2.1	2.4
Occupation	6.1	8.3	5.8	5.3
Relative Neighbourhood Deprivation	3.3	4.5	3.2	2.7
SEC composite	7.9	10.6	7.9	7.7

Partial R^2 values, all models control for sex, ethnicity and EAL.

Table S.21. AIC values table (individual indicators vs composite factor): age 5 complete cases

	Age 3		Age 5		Age 11		Age 14	
Indicator	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC
Parent Education	41588.25[41559.26;41617.25]	211.01	41810.35[41809.19;41811.51]	331.89	44025.98[43973.86;44078.09]	220.08	44940.31[44890.63;44989.99]	101.72
Income	41657.56[41629.34;41685.79]	280.32	41981.94[41980.44;41983.43]	503.48	44156.11[44105.87;44206.35]	350.21	45196.75[45149.23;45244.26]	358.16
Wealth	42537.25[42504.5;42570.01]	1160.01	42982.27[42962.98;43001.55]	1503.81	44735.75[44680.43;44791.08]	929.85	45676.87[45624.56;45729.18]	838.28
Occupational Status	41720.21[41692.32;41748.09]	342.97	41913.24[41909.03;41917.45]	434.78	44139.83[44087.94;44191.73]	333.93	45229.74[45177.39;45282.09]	391.15
Neighbourhood Deprivation	42248.68[42220.94;42276.43]	871.44	42626.89[42625.65;42628.13]	1148.43	44569.48[44518.66;44620.31]	763.58	45644.47[45600.6;45688.34]	805.88
Composite SEC	41377.24[41348.17;41406.31]	AIC*	41478.46[41473.14;41483.78]	AIC*	43805.9[43755.38;43856.43]	AIC*	44838.59[44786.52;44890.66]	AIC*

AIC* = best model; Values are the mean AIC values across 25 imputed datasets; All models adjusted for sex, ethnicity and EAL.

Table S.22. AIC values table (composite vs all indicators simultaneously): age 5 complete cases

	Age 3		Age 5		Age 11		Age 14	
Indicator	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC
SEC composite	41377.24[41348.17;41406.31]	159.7	41478.46[41473.14;41483.78]	145.96	43805.9[43755.38;43856.43]	80.17	44838.59[44786.52;44890.66]	115.69
All indicators	41217.54[41188.41;41246.67]	AIC*	41332.5[41328.49;41336.52]	AIC*	43725.73[43675.04;43776.42]	AIC*	44722.9[44669.64;44776.15]	AIC*

AIC* = best model; Values are the mean AIC values across 25 imputed datasets; All models adjusted for gender, ethnicity and EAL.

Model comparisons

Age 3. Parent education (Dm(5, 4232.55)= 42.05, p<.001), income (Dm(4, 4673.62)= 18.41, p<.001), occupational status (Dm(3, 2889.17)= 15.21, p<.001) and relative neighbourhood deprivation (Dm(9, 9189.57)= 2.09, p=.027) all accounted for significant variance in language ability at age 3. Wealth did not account for significant variance (Dm(4, 477.29)= 0.78, p=.552).

Age 5. Parent education (Dm(5, 14832.53)= 58.34, p<.001), income (Dm(4, 13799.68)= 14.32, p<.001), occupational status (Dm(3, 11466.53)= 31.91, p<.001) and relative neighbourhood deprivation (Dm(9, 14809.87)= 3.34, p<.001) all accounted for significant variance in language ability at age 5. Wealth did not account for significant variance (Dm(4, 351.35)= 1.33, p=.26).

Age 11. Parent education (Dm(5, 2552.49)= 31.75, p<.001), income (Dm(4, 1960.69)= 8.42, p<.001), occupational status (Dm(3, 900.04)= 14.22, p<.001) and relative neighbourhood deprivation (Dm(9, 3543.62)= 3.31, p<.001) all accounted for significant variance in language ability at age 11. Wealth did not account for significant variance (Dm(4, 284.07)= 1.67, p=.156).

Age 14. Parent education Dm(5, 889.23)= 35.54, p<.001), income (Dm(4, 889.61)= 6.27, p<.001), occupational status (Dm(3, 584.44)= 7.86, p<.001) and wealth (Dm(4, 296)= 3.32, p=.011) all accounted for significant variance in language ability at age 14. Relative neighbourhood deprivation did not account for significant variance (Dm(9, 1835.49)= .77, p=.648).

Section 13: Sensitivity analysis complete cases for vocabulary at age 11(N = 12,994)

Rationale

We ran a complete cases analysis where no data was missing for vocabulary at age 11. 23.93% of age 11 vocabulary scores were missing from our analytical sample. This sensitivity analysis was to see if only using observed scores (rather than using multiple imputation to account for missing data) changed our findings.

Method

Vocabulary measures. Details of the vocabulary measures can be found in Chapter 4. The same variables were used in this analysis.

Measures of socioeconomic circumstance. Five indicators of family SEC were used: parent education, family income, wealth, occupational status and relative neighbourhood deprivation. Operationalisation of these variables can be found in Chapter 4.

Analyses.

Language scores at ages 3, 5, 11 and 14 were considered as separate outcome variables. For each age, separate models with each SEC predictor in turn (parent education, income, wealth, occupational status and neighbourhood deprivation, each in a separate model) were built to assess the unadjusted relationship between each predictor and language at each time point. Potential confounding variables were then added to each of the models. A drop-one analysis was used to assess the unique contribution of each predictor; a model with all 5 SEC predictors was compared to models with each predictor removed in turn (see Chapter 4). A composite factor was included as the predictor variable in four separate regression models (each one considering vocabulary at each age), adjusting for the potential confounding variables. Relative AIC values were used to compare the marginal predictive value of each SEC predictor (see Chapter 4 for details).

Results

Regression coefficients can be found in Table S23. Model comparisons revealed the same pattern of results as the main analysis: caregiver education, income and occupational status accounted for significant variance in vocabulary at all ages. Neighbourhood statistics accounted for significant variance in vocabulary at ages 5 and 11 (which is a deviation from the main findings, where neighbourhood deprivation contributed unique variance to age 3 vocabulary). Wealth only accounted for significant variance in vocabulary at age 14 (see model comparisons). Partial R^2 values can be found in Table S24. In line with the main analysis, caregiver education explains the largest proportion of variance in vocabulary at each age, closely followed by income and occupational status. Wealth and relative neighbourhood deprivation consistently contribute the least variance in vocabulary scores, regardless of age. Finally, AIC values indicate that a composite model is a better fit to the data than any one indicator in isolation, but all models included simultaneously is the best fit (see Tables S25 and S26). Despite one minor discrepancy (relative neighbourhood deprivation no longer contributed unique variance to age 3 vocabulary),

overall, the level of missing data in age 11 vocabulary did not influence the main pattern of results.

Table S.23: β[95% CIs] for SEC predicting vocabulary for age 11 complete cases (N = 12,994)

		β [95% CIs] *p value*			
	Indicator	Age 3	Age 5	Age 11	Age 14
Parent Education	Parent Education (NVQ1)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Parent Education (None of these/overseas qualifications)	-.12[-.21;-.04] * * p= .010	-.13[-.22;-.04] * * * p<.001	-.10[-.19;-.01] * p= .030	-.06[-.17;.04] p= .250
	Parent Education (NVQ2	.22[.14;.29] * * * p<.001	.23[.16;.31] * * * p<.001	.19[.11;.27] * * * p<.001	.15[.05;.24] * * * p<.001
	Parent Education (NVQ3)	.33[.25;.41] * * * p<.001	.36[.28;.44] * * * p<.001	.35[.27;.43] * * * p<.001	.25[.16;.35] * * * p<.001
	Parent Education (NVQ4)	.59[.52;.66] * * * p<.001	.64[.57;.72] * * * p<.001	.58[.50;.65] * * * p<.001	.54[.46;.63] * * * p<.001
	Parent Education (NVQ5)	.76[.68;.85] * * * p<.001	.90[.81;.99] * * * p<.001	.85[.76;.94] * * * p<.001	.94[.84;1.05] * * * p<.001
Income	Income Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Income Quintile	.16[.11;.21] * * * p<.001	.18[.13;.23] * * * p<.001	.14[.09;.20] * * * p<.001	.13[.07;.20] * * * p<.001
	Income Quintile 3	.42[.37;.47] * * * p<.001	.43[.38;.48] * * * p<.001	.34[.29;.39] * * * p<.001	.28[.22;.35] * * * p<.001
	Income Quintile 4	.57[.52;.62] * * * p<.001	.56[.51;.62] * * * p<.001	.48[.43;.53] * * * p<.001	.44[.38;.50] * * * p<.001
	Income Quintile 5	.67[.62;.72] * * * p<.001	.76[.71;.81] * * * p<.001	.69[.64;.74] * * * p<.001	.69[.62;.75] * * * p<.001
Wealth	Wealth Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE

	Wealth Quintile 2	.05[-.01;.12] p= .110	.03[-.04;.10] p= .360	.05[-.02;.12] p= .170	.04[-.03;.12] p= .260
	Wealth Quintile 3	.11[.05;.18] * * * p<.001	.12[.04;.20] * * * p<.001	.11[.04;.19] * * * p<.001	.12[.04;.19] * * * p<.001
	Wealth Quintile 4	.22[.15;.30] * * * p<.001	.22[.14;.30] * * * p<.001	.21[.14;.28] * * * p<.001	.21[.13;.29] * * * p<.001
	Wealth Quintile 5	.36[.30;.43] * * * p<.001	.43[.36;.49] * * * p<.001	.40[.34;.46] * * * p<.001	.45[.38;.51] * * * p<.001
Occupational Status	Occupational Status (routine)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Occupational Status (unemployed)	-.24[-.29;-.19] * * * p<.001	-.26[-.31;-.21] * * * p<.001	-.19[-.24;-.14] * * * p<.001	-.13[-.19;-.06] * * * p<.001
	Occupational Status (intermediate)	.22[.17;.27] * * * p<.001	.19[.14;.23] * * * p<.001	.20[.15;.25] * * * p<.001	.12[.06;.19] * * * p<.001
	Occupational Status (higher managerial)	.40[.36;.44] * * * p<.001	.46[.42;.50] * * * p<.001	.44[.40;.48] * * * p<.001	.45[.39;.50] * * * p<.001
Neighbourhood Deprivation	Relative Neighbourhood Deprivation (most deprived decile)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Relative Neighbourhood Deprivation (10 - <20%)	.11[.04;.18] * * * p<.001	.12[.05;.19] * * * p<.001	.24[.17;.31] * * * p<.001	.11[.03;.19] * * p= .010
	Relative Neighbourhood Deprivation (20 - <30%)	.18[.11;.25] * * * p<.001	.24[.17;.31] * * * p<.001	.30[.23;.37] * * * p<.001	.18[.10;.27] * * * p<.001
	Relative Neighbourhood Deprivation (30 - <40%)	.26[.19;.34] * * * p<.001	.29[.21;.36] * * * p<.001	.36[.29;.44] * * * p<.001	.21[.13;.30] * * * p<.001
	Relative Neighbourhood Deprivation (40 - <50%)	.29[.22;.36] * * * p<.001	.33[.26;.40] * * * p<.001	.37[.30;.44] * * * p<.001	.25[.17;.34] * * * p<.001

	Relative Neighbourhood Deprivation (50 - <60%)	.37[.29;.44] * * * p<.001	.40[.33;.47] * * * p<.001	.41[.34;.48] * * * p<.001	.27[.18;.36] * * * p<.001
	Relative Neighbourhood Deprivation (60 - <70%)	.44[.36;.51] * * * p<.001	.47[.39;.54] * * * p<.001	.55[.48;.62] * * * p<.001	.36[.27;.45] * * * p<.001
	Relative Neighbourhood Deprivation (70 - <80%)	.45[.38;.52] * * * p<.001	.56[.48;.63] * * * p<.001	.53[.46;.60] * * * p<.001	.45[.36;.53] * * * p<.001
	Relative Neighbourhood Deprivation (80 - <90%)	.49[.42;.56] * * * p<.001	.59[.52;.66] * * * p<.001	.55[.48;.62] * * * p<.001	.46[.37;.55] * * * p<.001
	Relative Neighbourhood Deprivation (least deprived decile)	.60[.52;.67] * * * p<.001	.68[.61;.75] * * * p<.001	.67[.60;.74] * * * p<.001	.56[.47;.64] * * * p<.001
Composite	Composite SEC	.28[.26;.29] * * * p<.001	.31[.30;.33] * * * p<.001	.29[.27;.30] * * * p<.001	.29[.27;.31] * * * p<.001

Table S.24. Partial R^2 Values for SEC predicting vocabulary: age 11 complete cases

	Partial R^2 (%)			
Indicator	Age 3	Age 5	Age 11	Age 14
Parent Education	6.8	8.5	7.1	7.3
Income	6.2	7.3	6.0	5.4
Wealth	1.9	2.7	2.2	2.7
Occupation	6.0	7.7	6.1	5.2
Relative Neighbourhood Deprivation	3.2	4.3	3.5	2.6
SEC composite	7.7	9.9	8.3	7.7

Partial R^2 values, all models control for sex, ethnicity and EAL.

Table S.25: AIC values table (individual indicators vs composite factor): age 11 complete cases

	Age 3		Age 5		Age 11		Age 14	
Indicator	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC
Parent Education	35857.58[35833.25;35881.9]	163.03	36040.51[36015.21;36065.81]	254.78	37943.98[37943.27;37944.69]	177.11	38945.92[38916.84;38975]	68.96
Income	35942.1[35915.64;35968.57]	247.55	36219.99[36196.89;36243.1]	434.26	38103.02[38102.09;38103.95]	336.15	39203.89[39175.75;39232.03]	326.93
Wealth	36638.44[36612.85;36664.04]	943.89	36957.17[36929.89;36984.44]	1171.44	38616.21[38606.38;38626.03]	849.34	39573[39540.03;39605.97]	696.04
Occupational Status	35976.98[35952.11;36001.84]	282.43	36165.32[36140.58;36190.06]	379.59	38077.26[38075.39;38079.13]	310.39	39228.87[39203.45;39254.29]	351.91
Neighbourhood Deprivation	36438.5[36415.09;36461.91]	743.95	36712.91[36688.14;36737.69]	927.18	38453.12[38452.71;38453.52]	686.25	39599.99[39571.76;39628.21]	723.03
Composite SEC	35694.55[35668.43;35720.67]	AIC*	35785.73[35761.64;35809.83]	AIC*	37766.87[37764.59;37769.15]	AIC*	38876.96[38848.83;38905.09]	AIC*

AIC* = best model; Values are the mean AIC values across 25 imputed datasets; All models adjusted for sex, ethnicity and EAL.

Table S.26. AIC values table (composite vs all indicators simultaneously): age 11 complete cases

	Age 3		Age 5		Age 11		Age 14	
Indicator	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC
SEC composite	35694.55[35668.43;35720.67]	142.72	35785.73[35761.64;35809.83]	117.12	37766.87[37764.59;37769.15]	83.28	38876.96[38848.83;38905.09]	103.18
All indicators	35551.83[35526.3;35577.37]	AIC*	35668.61[35643.54;35693.68]	AIC*	37683.59[37681.5;37685.69]	AIC*	38773.78[38744.9;38802.66]	AIC*

AIC* = best model; Values are the mean AIC values across 25 imputed datasets; All models adjusted for gender, ethnicity and EAL.

Model comparisons

Age 3. Parent education (Dm(5, 5504.05)= 38.47, p<.001), income (Dm(4, 5590.27)= 14.83, p<.001) and occupational status (Dm(3, 3281.71)= 13.69, p<.001) all accounted for significant variance in language ability at age 3. Relative neighbourhood Deprivation (Dm(9,

6625.28)= 1.43, *p*=.171) and wealth did not account for significant variance (Dm(4, 419.56)= 1, *p*=.407).

Age 5. Parent education (Dm(5, 6207.93)= 45.78, *p*<.001), income (Dm(4, 6054.71)= 9.69, *p*<.001), occupational status (Dm(3, 3326.28)= 21.73, *p*<.001) and relative neighbourhood deprivation (Dm(9, 8532.65)= 2.54, *p*=.007) all accounted for significant variance in language ability at age 5. Wealth did not account for significant variance (Dm(4, 411.26)= 1.86, *p*=.116).

Age 11. Parent education (Dm(5, 12928.62)= 39.71, *p*<.001), income (Dm(4, 12548.64)= 8.46, *p*<.001), occupational status (Dm(3, 12258.81)= 16.94, *p*<.001) and relative neighbourhood deprivation (Dm(9, 12936.71)= 4.95, *p*<.001) all accounted for significant variance in language ability at age 11. Wealth did not account for significant variance (Dm(4, 458.59)= 1.43, *p*=.223).

Age 14. Parent education Dm(5, 2138.88)= 40.53, *p*<.001), income (Dm(4, 1863.75)= 5.8, *p*<.001), occupational status (Dm(3, 727.25)= 7.27, *p*<.001) and wealth (Dm(4, 367.93)= 3.84, *p*=.005) all accounted for significant variance in language ability at age 14. Relative neighbourhood deprivation did not account for significant variance (Dm(9, 2767.9)= .5, *p*=.875).

Section 14: Sensitivity analysis complete cases for vocabulary at age 14 (N = 10,790)

Rationale

We ran a complete cases analysis where no data was missing for vocabulary at age 14. 36.83% of age 14 vocabulary scores were missing in our analytical sample. This sensitivity analysis was to see if only using observed scores (rather than using multiple imputation to account for missing data) changed our findings.

Method

Vocabulary measures. Details of the vocabulary measures can be found in Chapter 4. The same variables were used in this analysis.

Measures of socioeconomic circumstance. Five indicators of family SEC were used: parent education, family income, wealth, occupational status and relative neighbourhood deprivation. Operationalisation of these variables can be found in Chapter 4.

Analyses.

Language scores at ages 3, 5, 11 and 14 were considered as separate outcome variables. For each age, separate models with each SEC predictor in turn (parent education, income, wealth, occupational status and neighbourhood deprivation, each in a separate model) were built to assess the unadjusted relationship between each predictor and language at each time point. Potential confounding variables were then added to each of the models. A drop-one analysis was used to assess the unique contribution of each predictor; a model with all 5 SEC predictors was compared to models with each predictor removed in turn (see Chapter 4). A composite factor

was included as the predictor variable in four separate regression models (each one considering vocabulary at each age), adjusting for the potential confounding variables. Relative AIC values were used to compare the marginal predictive value of each SEC predictor (see Chapter 4 for details).

Results

Regression coefficients can be found in Table S27. Model comparisons revealed the same pattern of results as the main analysis: caregiver education, income and occupational status accounted for significant variance in vocabulary at all ages. Neighbourhood statistics accounted for significant variance in vocabulary at ages 5 and 11 (which is a deviation from the main findings, where neighbourhood deprivation contributed unique variance to age 3 vocabulary). Wealth only accounted for significant variance in vocabulary at age 14 (see model comparisons). Partial R^2 values can be found in Table S28. In line with the main analysis, caregiver education explains the largest proportion of variance in vocabulary at each age, closely followed by income and occupational status. Wealth and relative neighbourhood deprivation consistently contribute the least variance in vocabulary scores, regardless of age. Finally, AIC values indicate that a composite model is a better fit to the data than any one indicator in isolation, but all models included simultaneously is the best fit (see Tables S29 and S30). Despite one minor discrepancy (relative neighbourhood deprivation no longer contributed unique variance to age 3 vocabulary), overall, the level of missing data in age 14 vocabulary did not influence the main pattern of results.

Table S. 27 β[95% CIs] for SEC predicting vocabulary for age 14 complete cases (N = 10,790)

		β [95% CIs] *p value*			
	Indicator	Age 3	Age 5	Age 11	Age 14
Parent Education	Parent Education (NVQ1)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Parent Education (None of these/overseas qualifications)	-.14[-.24;-.04] * * p= .010	-.13[-.23;-.03] * * p= .010	-.12[-.23;-.00] * p= .040	-.09[-.20;.01] p= .090
	Parent Education (NVQ2	.18[.10;.27] * * * p<.001	.21[.13;.30] * * * p<.001	.15[.06;.25] * * * p<.001	.16[.07;.25] * * * p<.001
	Parent Education (NVQ3)	.33[.24;.42] * * * p<.001	.34[.26;.43] * * * p<.001	.31[.21;.41] * * * p<.001	.28[.18;.37] * * * p<.001
	Parent Education (NVQ4)	.55[.47;.64] * * * p<.001	.61[.53;.69] * * * p<.001	.54[.45;.63] * * * p<.001	.56[.48;.65] * * * p<.001

	Parent Education (NVQ5)	.71[.61;.81] * * * p<.001	.86[.76;.95] * * * p<.001	.81[.70;.92] * * * p<.001	.97[.86;1.07] * * * p<.001
Income	Income Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Income Quintile	.17[.11;.23] * * * p<.001	.17[.11;.22] * * * p<.001	.14[.08;.20] * * * p<.001	.15[.09;.21] * * * p<.001
	Income Quintile 3	.44[.39;.50] * * * p<.001	.42[.36;.47] * * * p<.001	.31[.25;.37] * * * p<.001	.29[.23;.36] * * * p<.001
	Income Quintile 4	.55[.50;.61] * * * p<.001	.52[.47;.58] * * * p<.001	.45[.39;.52] * * * p<.001	.45[.39;.51] * * * p<.001
	Income Quintile 5	.66[.60;.71] * * * p<.001	.74[.68;.80] * * * p<.001	.67[.61;.73] * * * p<.001	.71[.65;.77] * * * p<.001
Wealth	Wealth Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Wealth Quintile 2	.06[-.01;.13] p= .080	.03[-.05;.12] p= .410	.05[-.04;.14] p= .310	.02[-.06;.11] p= .600
	Wealth Quintile 3	.11[.04;.18] * * * p<.001	.10[.02;.17] * * p= .010	.10[.01;.18] * p= .030	.11[.02;.19] * * p= .010
	Wealth Quintile 4	.22[.14;.29] * * * p<.001	.22[.14;.30] * * * p<.001	.20[.12;.28] * * * p<.001	.20[.11;.29] * * * p<.001
	Wealth Quintile 5	.36[.29;.44] * * * p<.001	.41[.33;.48] * * * p<.001	.39[.31;.47] * * * p<.001	.45[.37;.53] * * * p<.001
Occupational Status	Occupational Status (routine)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Occupational Status (unemployed)	-.21[-.27;-.16] * * * p<.001	-.24[-.30;-.18] * * * p<.001	-.15[-.21;-.08] * * * p<.001	-.13[-.19;-.07] * * * p<.001
	Occupational Status (intermediate)	.21[.16;.27] * * * p<.001	.16[.11;.22] * * * p<.001	.21[.15;.27] * * * p<.001	.11[.05;.17] * * * p<.001
	Occupational Status (higher managerial)	.40[.35;.44] * * * p<.001	.46[.42;.51] * * * p<.001	.46[.41;.51] * * * p<.001	.46[.41;.51] * * * p<.001

Neighbourhood Deprivation	Relative Neighbourhood Deprivation (most deprived decile)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Relative Neighbourhood Deprivation (10 - <20%)	.11[.03;.19] * * p= .010	.08[-.00;.15] * p= .050	.22[.14;.30] * * * p<.001	.12[.04;.20] * * * p<.001
	Relative Neighbourhood Deprivation (20 - <30%)	.22[.14;.30] * * * p<.001	.23[.15;.30] * * * p<.001	.28[.20;.36] * * * p<.001	.20[.11;.28] * * * p<.001
	Relative Neighbourhood Deprivation (30 - <40%)	.30[.22;.38] * * * p<.001	.29[.21;.37] * * * p<.001	.35[.27;.44] * * * p<.001	.23[.15;.32] * * * p<.001
	Relative Neighbourhood Deprivation (40 - <50%)	.28[.21;.36] * * * p<.001	.29[.21;.37] * * * p<.001	.33[.25;.41] * * * p<.001	.26[.17;.34] * * * p<.001
	Relative Neighbourhood Deprivation (50 - <60%)	.36[.28;.43] * * * p<.001	.37[.30;.45] * * * p<.001	.41[.32;.49] * * * p<.001	.28[.20;.37] * * * p<.001
	Relative Neighbourhood Deprivation (60 - <70%)	.44[.36;.52] * * * p<.001	.45[.37;.52] * * * p<.001	.51[.43;.60] * * * p<.001	.37[.29;.46] * * * p<.001
	Relative Neighbourhood Deprivation (70 - <80%)	.47[.39;.55] * * * p<.001	.56[.48;.64] * * * p<.001	.53[.45;.61] * * * p<.001	.48[.40;.57] * * * p<.001
	Relative Neighbourhood Deprivation (80 - <90%)	.51[.44;.59] * * * p<.001	.57[.50;.65] * * * p<.001	.56[.47;.64] * * * p<.001	.49[.41;.57] * * * p<.001
	Relative Neighbourhood Deprivation (least deprived decile)	.58[.50;.65] * * * p<.001	.64[.56;.71] * * * p<.001	.64[.56;.72] * * * p<.001	.56[.48;.65] * * * p<.001

Composite	Composite SEC	.27[.25;.29] * * * p<.001	.31[.29;.32] * * * p<.001	.28[.26;.30] * * * p<.001	.30[.28;.32] * * * p<.001

Table S.28. Partial R^2 Values for SEC predicting vocabulary: age 14 complete cases

	Partial R^2 (%)			
Indicator	Age 3	Age 5	Age 11	Age 14
Parent Education	6.3	7.9	6.9	7.9
Income	5.9	6.8	5.6	5.6
Wealth	1.9	2.5	2.2	2.8
Occupation	5.5	7.2	5.9	5.4
Relative Neighbourhood Deprivation	3.1	4.2	3.4	2.7
SEC composite	7.2	9.3	8.0	8.1

Partial R^2 values, all models control for sex, ethnicity and EAL.

Table S.29. AIC values table (individual indicators vs composite factor): age 14 complete cases

	Age 3		Age 5		Age 11		Age 14	
Indicator	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC
Parent Education	29635.95[29615.66;29656.25]	133.08	29774.56[29751.8;29797.31]	207.29	31432.23[31399.14;31465.32]	138.47	32261.55[32261.02;32262.09]	31.26
Income	29691.77[29670.6;29712.94]	188.9	29917.98[29896.29;29939.68]	350.71	31582.63[31549.11;31616.16]	288.87	32525.7[32525.3;32526.1]	295.41
Wealth	30227.75[30207.13;30248.36]	724.88	30483.48[30458.82;30508.14]	916.21	31967.75[31932.69;32002.81]	673.99	32846.1[32834.96;32857.24]	615.81
Occupational Status	29739.03[29718.63;29759.43]	236.16	29857.75[29835.65;29879.85]	290.48	31541.55[31507.39;31575.7]	247.79	32546.51[32544.33;32548.69]	316.22
Neighbourhood Deprivation	30077.42[30056.65;30098.18]	574.55	30281.38[30258.83;30303.92]	714.11	31844.83[31811.73;31877.94]	551.07	32866.51[32866.31;32866.71]	636.22
Composite SEC	29502.87[29482.88;29522.85]	AIC*	29567.27[29544.3;29590.23]	AIC*	31293.76[31260.6;31326.93]	AIC*	32230.29[32227.65;32232.93]	AIC*

AIC* = best model; Values are the mean AIC values across 25 imputed datasets; All models adjusted for sex, ethnicity and EAL.

Table S.30. AIC values table (composite vs all indicators simultaneously): age 14 complete cases

	Age 3		Age 5		Age 11		Age 14	
Indicator	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC
SEC composite	29502.87[29482.88;29522.85]	108.17	29567.27[29544.3;29590.23]	90.04	31293.76[31260.6;31326.93]	53.8	32230.29[32227.65;32232.93]	104.91
All indicators	29394.7[29375.39;29414.01]	AIC*	29477.23[29454.18;29500.29]	AIC*	31239.96[31206.2;31273.72]	AIC*	32125.38[32120.95;32129.8]	AIC*

AIC* = best model; Values are the mean AIC values across 25 imputed datasets; All models adjusted for gender, ethnicity and EAL.

Model comparisons

Age 3. Parent education (Dm(5, 4257.94)= 29.29, p<.001), income (Dm(4, 4648.14)= 12.78, p<.001) and occupational status (Dm(3, 3201.15)= 7.81, p<.001) all accounted for significant variance in language ability at age 3. Relative neighbourhood deprivation (Dm(9, 6908.91)= 1.31, p=.224) and wealth did not account for significant variance (Dm(4, 403.39)= 1.67, p=.155).

Age 5. Parent education (Dm(5, 6987.62)= 35.65, p<.001), income (Dm(4, 6800.64)= 7.39, p<.001), occupational status (Dm(3, 4462.65)= 19.07, p<.001) and relative neighbourhood deprivation (Dm(9, 8612.14)= 2.73, p=.003) all accounted for significant variance in language ability at age 5. Wealth did not account for significant variance (Dm(4, 367.25)= 1.62, p=.169).

Age 11. Parent education (Dm(5, 4076.02)= 28.29, p<.001), income (Dm(4, 6126.23)= 5.13, p<.001), occupational status (Dm(3, 4100.79)= 13.5, p<.001) and relative neighbourhood deprivation (Dm(9, 8269)= 2.9, p=.002) all accounted for significant variance in language ability at age 11. Wealth did not account for significant variance (Dm(4, 395.56)= 1.35, p=.251).

Age 14. Parent education Dm(5, 10718.62)= 50.03, p<.001), income (Dm(4, 10214.59)= 6.17, p<.001), occupational status (Dm(3, 8465.78)=8.25, p<.001) and wealth (Dm(4, 440.57)= 3.99, p=.003) all accounted for significant variance in language ability at age 14. Relative neighbourhood deprivation did not account for significant variance (Dm(9, 10710.4)= .91, p=.518).

Section 15: Sensitivity analysis: Analytical sample with at least one wealth measure *(N=12,025)*

Rationale

Our wealth measure was derived from 4 variables following multiple imputation: amount outstanding on mortgages, house value, total assets and savings and total debts. Missing data for these items is high, meaning a lot of wealth information is imputed. We therefore ran a sensitivity analysis whereby we only included everyone with a response to at least 1 wealth measure in our analyses.

Method

Vocabulary measures. Details of the vocabulary measures can be found in Chapter 4. The same variables were used in this analysis.

Measures of socioeconomic circumstance. Five indicators of family SEC were used: parent education, family income, wealth, occupational status and relative neighbourhood deprivation. Operationalisation of these variables can be found in Chapter 4.

Analyses.

Language scores at ages 3, 5, 11 and 14 were considered as separate outcome variables. For each age, separate models with each SEC predictor in turn (parent education, income, wealth, occupational status and neighbourhood deprivation, each in a separate model) were built to assess the unadjusted relationship between each predictor and language at each time point. Potential confounding variables were then added to each of the models. A drop-one analysis was used to assess the unique contribution of each predictor; a model with all 5 SEC predictors was compared to models with each predictor removed in turn (see Chapter 4). A composite factor was included as the predictor variable in four separate regression models (each one considering vocabulary at each age), adjusting for the potential confounding variables. Relative AIC values were used to compare the marginal predictive value of each SEC predictor (see Chapter 4 for details).

Results

Regression coefficients can be found in table S31. Model comparisons revealed the same pattern of results as the main analysis: caregiver education, income and occupational status accounted for significant variance in vocabulary at all ages. Neighbourhood statistics accounted for significant variance in vocabulary at ages 5 and 11 (which is a deviation from the main findings, where neighbourhood deprivation contributed unique variance to age 3 vocabulary). Wealth only accounted for significant variance in vocabulary at age 14 (see model comparisons). Partial R^2 values can be found in Table S32. In line with the main analysis, caregiver education explains the largest proportion of variance in vocabulary at each age, closely followed by income and occupational status. Wealth and relative neighbourhood deprivation consistently contribute the least variance in vocabulary scores, regardless of age. Finally, AIC values indicate that a composite model is a better fit to the data than any one indicator in isolation, but all models included simultaneously is the best fit (see Tables S33 and S34). Despite one minor discrepancy (relative neighbourhood deprivation no longer contributed unique variance to age 3 vocabulary), overall, the level of missing data in the wealth variable did not influence the main pattern of results.

Table S. 31. β[95% CIs] for SEC predicting vocabulary for sensitivity check: analytical sample with at least one wealth measure (N=12,025)

		β [95% CIs] *p value*			
	Indicator	Age 3	Age 5	Age 11	Age 14
Parent Education	Parent Education (NVQ1)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Parent Education (None of these/overseas qualifications)	-.11[-.21;-.01] * p= .030	-.13[-.23;-.03] * * p= .010	-.07[-.17;.03] p= .180	-.05[-.16;.06] p= .380
	Parent Education (NVQ2	.23[.15;.31] * * * p<.001	.24[.15;.32] * * * p<.001	.22[.14;.31] * * * p<.001	.15[.06;.25] * * * p<.001
	Parent Education (NVQ3)	.34[.25;.42] * * * p<.001	.35[.26;.44] * * * p<.001	.37[.29;.46] * * * p<.001	.27[.17;.37] * * * p<.001
	Parent Education (NVQ4)	.59[.51;.67] * * * p<.001	.64[.56;.73] * * * p<.001	.61[.53;.69] * * * p<.001	.55[.46;.64] * * * p<.001
	Parent Education (NVQ5)	.77[.67;.86] * * * p<.001	.91[.81;1.00] * * * p<.001	.88[.78;.98] * * * p<.001	.95[.84;1.06] * * * p<.001
Income	Income Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE

	Income Quintile	.15[.09;.21] * * * p<.001	.16[.11;.22] * * * p<.001	.13[.07;.18] * * * p<.001	.12[.06;.19] * * * p<.001
	Income Quintile 3	.41[.36;.47] * * * p<.001	.41[.36;.46] * * * p<.001	.32[.26;.37] * * * p<.001	.28[.21;.34] * * * p<.001
	Income Quintile 4	.57[.51;.62] * * * p<.001	.56[.50;.61] * * * p<.001	.47[.42;.53] * * * p<.001	.43[.36;.49] * * * p<.001
	Income Quintile 5	.64[.59;.70] * * * p<.001	.74[.69;.79] * * * p<.001	.68[.62;.74] * * * p<.001	.66[.59;.72] * * * p<.001
Wealth	Wealth Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Wealth Quintile 2	.05[-.03;.13] p= .200	.03[-.04;.10] p= .430	.05[-.03;.13] p= .210	.03[-.06;.11] p= .540
	Wealth Quintile 3	.11[.04;.18] * * * p<.001	.12[.05;.18] * * * p<.001	.12[.06;.19] * * * p<.001	.11[.02;.20] * p= .020
	Wealth Quintile 4	.22[.16;.29] * * * p<.001	.22[.16;.28] * * * p<.001	.22[.14;.29] * * * p<.001	.20[.12;.28] * * * p<.001
	Wealth Quintile 5	.36[.29;.42] * * * p<.001	.42[.36;.48] * * * p<.001	.41[.34;.48] * * * p<.001	.44[.35;.52] * * * p<.001
Occupational Status	Occupational Status (routine)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Occupational Status (unemployed)	-.21[-.27;-.16] * * * p<.001	-.23[-.29;-.18] * * * p<.001	-.19[-.24;-.13] * * * p<.001	-.10[-.17;-.04] * * * p<.001
	Occupational Status (intermediate)	.22[.17;.28] * * * p<.001	.19[.14;.24] * * * p<.001	.20[.15;.26] * * * p<.001	.12[.06;.18] * * * p<.001
	Occupational Status (higher managerial)	.40[.36;.45] * * * p<.001	.47[.43;.52] * * * p<.001	.45[.40;.49] * * * p<.001	.46[.40;.51] * * * p<.001
Neighbourhood	Relative Neighbourhood Deprivation (most deprived decile)	REFERENCE	REFERENCE	REFERENCE	REFERENCE

	Relative Neighbourhood Deprivation (10 - <20%)	.11[.04;.19] * * * p<.001	.11[.03;.18] * * * p<.001	.22[.14;.30] * * * p<.001	.11[.02;.20] * p= .020
	Relative Neighbourhood Deprivation (20 - <30%)	.18[.10;.25] * * * p<.001	.23[.16;.31] * * * p<.001	.29[.21;.37] * * * p<.001	.16[.07;.25] * * * p<.001
	Relative Neighbourhood Deprivation (30 - <40%)	.26[.18;.34] * * * p<.001	.30[.22;.38] * * * p<.001	.37[.29;.45] * * * p<.001	.21[.11;.30] * * * p<.001
	Relative Neighbourhood Deprivation (40 - <50%)	.29[.21;.37] * * * p<.001	.33[.26;.41] * * * p<.001	.37[.29;.45] * * * p<.001	.26[.16;.36] * * * p<.001
	Relative Neighbourhood Deprivation (50 - <60%)	.36[.29;.44] * * * p<.001	.40[.33;.48] * * * p<.001	.42[.34;.49] * * * p<.001	.26[.17;.35] * * * p<.001
	Relative Neighbourhood Deprivation (60 - <70%)	.43[.36;.51] * * * p<.001	.45[.38;.53] * * * p<.001	.55[.47;.62] * * * p<.001	.36[.27;.45] * * * p<.001
	Relative Neighbourhood Deprivation (70 - <80%)	.44[.36;.52] * * * p<.001	.56[.49;.64] * * * p<.001	.54[.47;.62] * * * p<.001	.46[.36;.55] * * * p<.001
	Relative Neighbourhood Deprivation (80 - <90%)	.47[.39;.55] * * * p<.001	.56[.49;.63] * * * p<.001	.55[.47;.63] * * * p<.001	.42[.33;.52] * * * p<.001
	Relative Neighbourhood Deprivation (least deprived decile)	.58[.51;.66] * * * p<.001	.67[.60;.74] * * * p<.001	.68[.60;.75] * * * p<.001	.54[.45;.63] * * * p<.001
Composite	Composite SEC	.27[.25;.29] * * * p<.001	.31[.29;.33] * * * p<.001	.29[.27;.31] * * * p<.001	.28[.26;.30] * * * p<.001

Model comparisons

Age 3. Parent education (Dm(5, 3944.27)= 32.06, *p*<.001), income (Dm(4, 2620.94)= 14.4, *p*<.001) and occupational status (Dm(3, 1733.15)= 10, *p*<.001) all accounted for significant

variance in language ability at age 3. Relative neighbourhood deprivation (Dm(9, 5554.74)= 1.33, *p*=.213) and wealth did not account for significant variance (Dm(4, 411.33)= 0.73, *p*=.574).

Age 5. Parent education (Dm(5, 4899.98)= 42.22, *p*<.001), income (Dm(4, 5110.01)= 8.58, *p*<.001), occupational status (Dm(3, 2891.98)= 18.26, *p*<.001) and relative neighbourhood deprivation (Dm(9, 9107.31)= 2.5, *p*=.007) all accounted for significant variance in language ability at age 5. Wealth did not account for significant variance (Dm(4, 499.74)= 1.3, *p*=.269).

Age 11. Parent education (Dm(5, 10635.59)= 34.75, *p*<.001), income (Dm(4, 9737)= 7.45, *p*<.001), occupational status (Dm(3, 6914.39)= 16.79, *p*<.001) and relative neighbourhood deprivation (Dm(9, 11398.15)= 3.98, *p*<.001) all accounted for significant variance in language ability at age 11. Wealth did not account for significant variance (Dm(4, 595.78)= 1.46, *p*=.213).

Age 14. Parent education Dm(5, 2154.79)= 39.21, *p*<.001), income (Dm(4, 1326.92)= 3.76, *p*=.005), occupational status (Dm(3, 881.23)= 8.87, *p*<.001) and wealth (Dm(4, 331.37)= 2.93, *p*=.021) all accounted for significant variance in language ability at age 14. Relative neighbourhood deprivation did not account for significant variance (Dm(9, 3442.6)= .66, *p*=.747).

Table S.32. Partial R^2 Values for SEC predicting vocabulary: analytical sample with at least one wealth measure

	Partial R^2 (%)			
Indicator	Age 3	Age 5	Age 11	Age 14
Parent Education	6.4	8.3	7.1	7.2
Income	5.9	7.0	5.9	5.0
Wealth	1.8	2.6	2.4	2.6
Occupation	5.6	7.3	6.2	5.1
Relative Neighbourhood Deprivation	3.0	4.1	3.6	2.4
SEC composite	7.3	9.7	8.4	7.5

Partial R^2 values, all models control for sex, ethnicity and EAL.

Table S.33. AIC values table (individual indicators vs composite factor): analytical sample with at least one wealth variable

	Age 3		Age 5		Age 11		Age 14	
Indicator	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC
Parent Education	33462.96[33426.81;33499.11]	146.84	33580.49[33560.21;33600.77]	215.97	35126.02[35108.99;35143.05]	175.3	36049.08[36018.12;36080.04]	43.62
Income	33526.53[33489.91;33563.15]	210.41	33772.87[33752.49;33793.24]	408.35	35281.25[35264.26;35298.24]	330.53	36326.66[36298.27;36355.05]	321.2
Wealth	34120.93[34089.64;34152.23]	804.81	34401.7[34381.89;34421.51]	1037.18	35727.39[35706.73;35748.06]	776.67	36624.92[36594.96;36654.88]	619.46
Occupational Status	33576.78[33542.03;33611.53]	260.66	33724.51[33703.27;33745.74]	359.99	35243.18[35226.63;35259.74]	292.46	36312.14[36283.53;36340.76]	306.68
Neighbourhood Deprivation	33971.07[33935.26;34006.87]	654.95	34206.3[34187.05;34225.55]	841.78	35590.89[35574.28;35607.5]	640.17	36661.24[36630.09;36692.39]	655.78
Composite SEC	33316.12[33280.23;33352.01]	AIC*	33364.52[33343.68;33385.35]	AIC*	34950.72[34933.26;34968.19]	AIC*	36005.46[35975.99;36034.93]	AIC*

AIC* = best model; Values are the mean AIC values across 25 imputed datasets; All models adjusted for sex, ethnicity and EAL.

Table S.34. AIC values table (composite vs all indicators simultaneously): analytical sample with at least one wealth variable

	Age 3		Age 5		Age 11		Age 14	
Indicator	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC
SEC composite	33316.12[33280.23;33352.01]	117.17	33364.52[33343.68;33385.35]	92.11	34950.72[34933.26;34968.19]	65.22	36005.46[35975.99;36034.93]	100.8
All indicators	33198.95[33162.17;33235.73]	AIC*	33272.41[33249.99;33294.83]	AIC*	34885.5[34868.45;34902.55]	AIC*	35904.66[35874.44;35934.89]	AIC*

AIC* = best model; Values are the mean AIC values across 25 imputed datasets; All models adjusted for gender, ethnicity and EAL.

Section 16: Sensitivity analysis: Analytical sample with at least two wealth measures (N = 9,367)

Rationale

We repeated sensitivity analysis x, using only those who had a response for at least 2 wealth measures in our analyses, to determine if the amount of missing data was affecting our results for wealth, given wealth was found to be the weakest predictor of language.

Method

Vocabulary measures. Details of the vocabulary measures can be found in Chapter 4. The same variables were used in this analysis.

Measures of socioeconomic circumstance. Five indicators of family SEC were used: parent education, family income, wealth, occupational status and relative neighbourhood deprivation. Operationalisation of these variables can be found in Chapter 4.

Analyses.

Language scores at ages 3, 5, 11 and 14 were considered as separate outcome variables. For each age, separate models with each SEC predictor in turn (parent education, income, wealth, occupational status and neighbourhood deprivation, each in a separate model) were built to assess the unadjusted relationship between each predictor and language at each time point. Potential confounding variables were then added to each of the models. A drop-one analysis was used to assess the unique contribution of each predictor; a model with all 5 SEC predictors was compared to models with each predictor removed in turn (see Chapter 4). A composite factor was included as the predictor variable in four separate regression models (each one considering vocabulary at each age), adjusting for the potential confounding variables. Relative AIC values were used to compare the marginal predictive value of each SEC predictor (see Chapter 4 for details).

Results

Regression coefficients can be found in Table S35. Model comparisons revealed the same pattern of results as the main analysis: caregiver education, income and occupational status accounted for significant variance in vocabulary at all ages. Neighbourhood statistics accounted for significant variance in vocabulary at ages 5 and 11 (which is a deviation from the main findings, where neighbourhood deprivation contributed unique variance to age 3 vocabulary). Wealth only accounted for significant variance in vocabulary at age 14 (see model comparisons). Partial R^2 values can be found in Table S36. In line with the main analysis, caregiver education explains the largest proportion of variance in vocabulary at each age, closely followed by income and occupational status. Wealth and relative neighbourhood deprivation consistently contribute the least variance in vocabulary scores, regardless of age. Finally, AIC values indicate that a composite model is a better fit to the data than any one indicator in isolation, but all models included simultaneously is the best fit (see Tables S37 and S38). Despite one minor discrepancy (relative neighbourhood deprivation no longer contributed unique variance to age 3 vocabulary),

overall, the level of missing data in the wealth variable did not influence the main pattern of results.

Table S.35. β[95% CIs] for SEC predicting vocabulary for wealth sensitivity check: analytical sample with at least two wealth measures (N= 9,367)

		β [95% CIs] *p value*			
	Indicator	Age 3	Age 5	Age 11	Age 14
Parent Education	Parent Education (NVQ1)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Parent Education (None of these/overseas qualifications)	-.13[-.26;-.01] * p= .030	-.10[-.23;.03] p= .120	-.03[-.15;.10] p= .690	-.01[-.16;.14] p= .880
	Parent Education (NVQ2	.23[.13;.33] * * * p<.001	.28[.17;.38] * * * p<.001	.26[.15;.36] * * * p<.001	.16[.03;.28] * * p= .010
	Parent Education (NVQ3)	.34[.24;.45] * * * p<.001	.38[.27;.49] * * * p<.001	.39[.28;.49] * * * p<.001	.28[.16;.41] * * * p<.001
	Parent Education (NVQ4)	.59[.49;.68] * * * p<.001	.67[.57;.77] * * * p<.001	.61[.51;.71] * * * p<.001	.54[.42;.66] * * * p<.001
	Parent Education (NVQ5)	.76[.64;.87] * * * p<.001	.92[.80;1.03] * * * p<.001	.89[.78;1.00] * * * p<.001	.94[.80;1.07] * * * p<.001
Income	Income Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Income Quintile	.13[.06;.20] * * * p<.001	.13[.06;.20] * * * p<.001	.13[.06;.20] * * * p<.001	.10[.02;.18] * * p= .010
	Income Quintile 3	.38[.31;.44] * * * p<.001	.36[.29;.43] * * * p<.001	.26[.19;.32] * * * p<.001	.22[.14;.29] * * * p<.001
	Income Quintile 4	.53[.46;.59] * * * p<.001	.51[.44;.57] * * * p<.001	.42[.35;.48] * * * p<.001	.38[.30;.45] * * * p<.001
	Income Quintile 5	.61[.54;.67] * * * p<.001	.69[.63;.75] * * * p<.001	.62[.56;.69] * * * p<.001	.60[.53;.68] * * * p<.001
Wealth	Wealth Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE

	Wealth Quintile 2	.06[-.02;.14] p= .140	.03[-.05;.11] p= .430	.06[-.02;.14] p= .180	.02[-.07;.11] p= .600
	Wealth Quintile 3	.14[.06;.21] * * * p<.001	.14[.06;.22] * * * p<.001	.14[.05;.22] * * * p<.001	.12[.03;.21] * * p= .010
	Wealth Quintile 4	.24[.16;.31] * * * p<.001	.25[.17;.33] * * * p<.001	.23[.15;.32] * * * p<.001	.21[.12;.29] * * * p<.001
	Wealth Quintile 5	.36[.29;.43] * * * p<.001	.41[.34;.48] * * * p<.001	.41[.33;.49] * * * p<.001	.44[.36;.51] * * * p<.001
Occupational Status	Occupational Status (routine)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Occupational Status (unemployed)	-.21[-.28;-.13] * * * p<.001	-.20[-.27;-.13] * * * p<.001	-.18[-.25;-.11] * * * p<.001	-.09[-.17;-.00] * p= .050
	Occupational Status (intermediate)	.20[.14;.26] * * * p<.001	.17[.11;.23] * * * p<.001	.16[.10;.23] * * * p<.001	.10[.03;.17] * * p= .010
	Occupational Status (higher managerial)	.39[.34;.44] * * * p<.001	.46[.41;.51] * * * p<.001	.40[.35;.46] * * * p<.001	.42[.36;.48] * * * p<.001
Neighbourhood Deprivation	Relative Neighbourhood Deprivation (most deprived decile)	REFERENCE	REFERENCE	REFERENCE	REFERENCE
	Relative Neighbourhood Deprivation (10 - <20%)	.13[.04;.22] * * * p<.001	.09[-.01;.18] p= .070	.21[.11;.30] * * * p<.001	.11[.00;.21] * p= .040
	Relative Neighbourhood Deprivation (20 - <30%)	.21[.12;.30] * * * p<.001	.22[.12;.31] * * * p<.001	.26[.17;.35] * * * p<.001	.12[.01;.22] * p= .030
	Relative Neighbourhood Deprivation (30 - <40%)	.25[.16;.34] * * * p<.001	.27[.18;.37] * * * p<.001	.39[.30;.48] * * * p<.001	.20[.10;.30] * * * p<.001
	Relative Neighbourhood Deprivation (40 - <50%)	.27[.18;.36] * * * p<.001	.27[.18;.36] * * * p<.001	.33[.24;.42] * * * p<.001	.22[.12;.32] * * * p<.001

	Relative Neighbourhood Deprivation (50 - <60%)	.35[.27;.44] * * * p<.001	.36[.27;.45] * * * p<.001	.38[.29;.47] * * * p<.001	.20[.10;.31] * * * p<.001
	Relative Neighbourhood Deprivation (60 - <70%)	.40[.31;.50] * * * p<.001	.42[.33;.51] * * * p<.001	.47[.38;.57] * * * p<.001	.36[.25;.46] * * * p<.001
	Relative Neighbourhood Deprivation (70 - <80%)	.42[.33;.51] * * * p<.001	.52[.43;.61] * * * p<.001	.49[.40;.58] * * * p<.001	.43[.33;.53] * * * p<.001
	Relative Neighbourhood Deprivation (80 - <90%)	.45[.37;.54] * * * p<.001	.49[.40;.58] * * * p<.001	.50[.41;.59] * * * p<.001	.37[.26;.47] * * * p<.001
	Relative Neighbourhood Deprivation (least deprived decile)	.55[.47;.64] * * * p<.001	.61[.53;.70] * * * p<.001	.60[.51;.68] * * * p<.001	.47[.37;.57] * * * p<.001
Composite	Composite SEC	.25[.23;.27] * * * p<.001	.29[.27;.31] * * * p<.001	.26[.24;.28] * * * p<.001	.26[.24;.29] * * * p<.001

Model comparisons

Age 3. Parent education (Dm(5, 5124.53)= 26.99, *p*<.001), income (Dm(4, 4762.47)= 9.74, *p*<.001) and occupational status (Dm(3, 2745.59)= 6.91, *p*<.001) all accounted for significant variance in language ability at age 3. Relative neighbourhood deprivation (Dm(9, 6211.92)= 0.96, *p*=.47) and wealth did not account for significant variance (Dm(4, 538.95)= 0.78, *p*=.539).

Age 5. Parent education (Dm(5, 4657.52)= 33.47, *p*<.001), income (Dm(4, 4704.94)= 6.01, *p*<.001), occupational status (Dm(3, 3578.05)= 12.63, *p*<.001) and relative neighbourhood deprivation (Dm(9, 7562.51)= 1.79, *p*=.064) all accounted for significant variance in language ability at age 5. Wealth did not account for significant variance (Dm(4, 832.96)= 1.21, *p*=.304).

Age 11. Parent education (Dm(5, 8776.67)= 29.23, *p*<.001), income (Dm(4, 8215.89)= 5.37, *p*<.001), occupational status (Dm(3, 6662.41)= 9.28, *p*<.001) and relative neighbourhood deprivation (Dm(9, 8838.14)= 2.4, *p*=.01) all accounted for significant variance in language ability at age 11. Wealth did not account for significant variance (Dm(4, 631.4)= 1.99, *p*=.094).

Age 14. Parent education Dm(5, 2118.34)= 30.7, *p*<.001), income (Dm(4, 2066.04)= 2.91, *p*=.02), occupational status (Dm(3, 918.75)= 6.21, *p*<.001) and wealth (Dm(4, 507.79)= 3.27, *p*=.012) all accounted for significant variance in language ability at age 14. Relative neighbourhood deprivation did not account for significant variance (Dm(9, 3233.57)= .95, *p*=.479).

Table S.36 Partial R^2 Values for SEC predicting vocabulary: analytical sample with at least two wealth measures

	Partial R^2 (%)			
Indicator	Age 3	Age 5	Age 11	Age 14
Parent Education	5.7	7.4	6.2	6.4
Income	5.0	5.9	4.7	4.2
Wealth	1.8	2.6	2.4	2.6
Occupation	4.6	6.1	4.7	4.2
Relative Neighbourhood Deprivation	2.4	3.3	2.7	2.0
SEC composite	6.3	8.6	6.9	6.5

Partial R^2 values, all models control for sex, ethnicity and EAL.

Table S.37. AIC values table (individual indicators vs composite factor): analytical sample with at least two wealth measures

	Age 3		Age 5		Age 11		Age 14	
Indicator	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC
Parent Education	26307.46[26277.76;26337.16]	79.04	26437.31[26421.76;26452.86]	138.64	27356.75[27342.2;27371.29]	88.33	28156.52[28119.69;28193.36]	16.97
Income	26391.84[26361.5;26422.17]	163.42	26606.85[26591.34;26622.36]	308.18	27503.03[27487.93;27518.12]	234.61	28374.73[28339.36;28410.09]	235.18
Wealth	26742.31[26710.21;26774.4]	513.89	26970.86[26956.48;26985.24]	672.19	27729.38[27715.04;27743.72]	460.96	28533.94[28498.76;28569.12]	394.39
Occupational Status	26426.98[26397.71;26456.24]	198.56	26582.2[26567.64;26596.76]	283.53	27495.47[27480.63;27510.3]	227.05	28371.7[28334.63;28408.76]	232.15
Neighbourhood Deprivation	26684.4[26655.73;26713.06]	455.98	26895.78[26879.43;26912.14]	597.11	27713.23[27697.58;27728.88]	444.81	28601.99[28565.47;28638.51]	462.44
Composite SEC	26228.42[26197.82;26259.02]	AIC*	26298.67[26283.14;26314.2]	AIC*	27268.42[27253.76;27283.08]	AIC*	28139.55[28104.17;28174.93]	AIC*

AIC* = best model; Values are the mean AIC values across 25 imputed datasets; All models adjusted for sex, ethnicity and EAL.

Table S.38. AIC values table (composite vs all indicators simultaneously): analytical sample with at least two wealth measures

	Age 3		Age 5		Age 11		Age 14	
Indicator	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC	AIC	ΔAIC
SEC composite	26228.42[26197.82;26259.02]	75.33	26298.67[26283.14;26314.2]	50.11	27268.42[27253.76;27283.08]	47.07	28139.55[28104.17;28174.93]	82.65
All indicators	26153.09[26122.93;26183.25]	AIC*	26248.56[26233.06;26264.06]	AIC*	27221.35[27207.04;27235.66]	AIC*	28056.9[28020.89;28092.9]	AIC*

AIC* = best model; Values are the mean AIC values across 25 imputed datasets; All models adjusted for gender, ethnicity and EAL.

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Appendix 3: Supplementary material for Chapter 5

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Section 1: Confirmatory Factor Analysis of SEC indicators

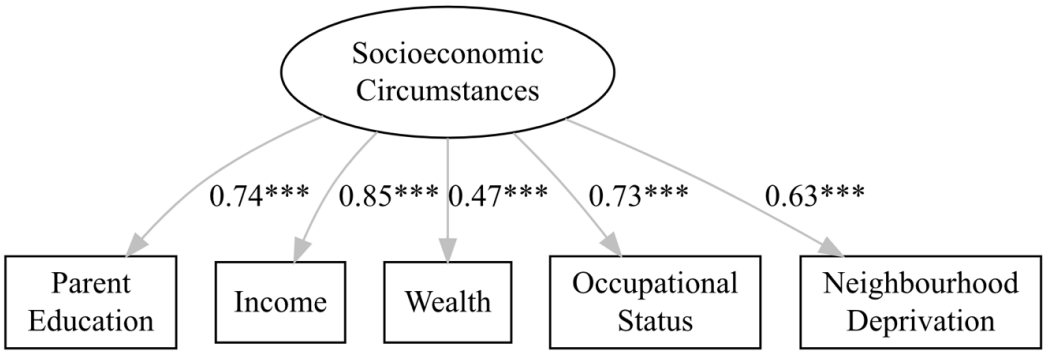
Using the lavaan package in R (Rosseel, 2012), a CFA was conducted to create a latent variable of SES. A robust weighted least squares estimator (WLSMV in the lavaan package) was used. This was due to the fact that maximum likelihood estimators are not currently supported for ordered data in the package. A latent variable factor score was then created for each individual imputed dataset and converted into a *z* score, and regression models, where the composite factor score was the moderator variable, were ran for each imputed dataset. The results of the regression models were then pooled.

The latent variable was made up of highest household education, income, wealth, occupational status and relative neighbourhood deprivation. These variables were added to the CFA model in this order. Factor loadings can be found in Figure S1.

Model fit was examined with the normed χ^2 ^{2} (χ^2/df) statistic (Ullman, 2001), Comparative Fit Index (CFI) (Hu & Bentler, 1999), Root Mean Square Error of Approximation (RMSEA)(MacCallum et al., 1996), Standardized Root Mean Square Residual (SRMR)(Hu & Bentler, 1999) and Tucker Lewis Index (TLI)(Hu & Bentler, 1999). Normed χ^2 statistics between 1 and 2 suggest a good model fit, and between 2 and 3 suggest an acceptable model fit (Carmines & McIver, 1981). CFI and TLI values of >.9 indicate an acceptable fit and >.95 indicate a good model fit (Hu & Bentler, 1999). RMSEA values of 0.01 indicate an excellent model fit, 0.05 indicates a good fit and 0.08 indicates an acceptable model fit (MacCallum et al., 1996). Finally, SRMR values <.08 are indicative of a good fit (Hu & Bentler, 1999). Robust fit indices are reported.

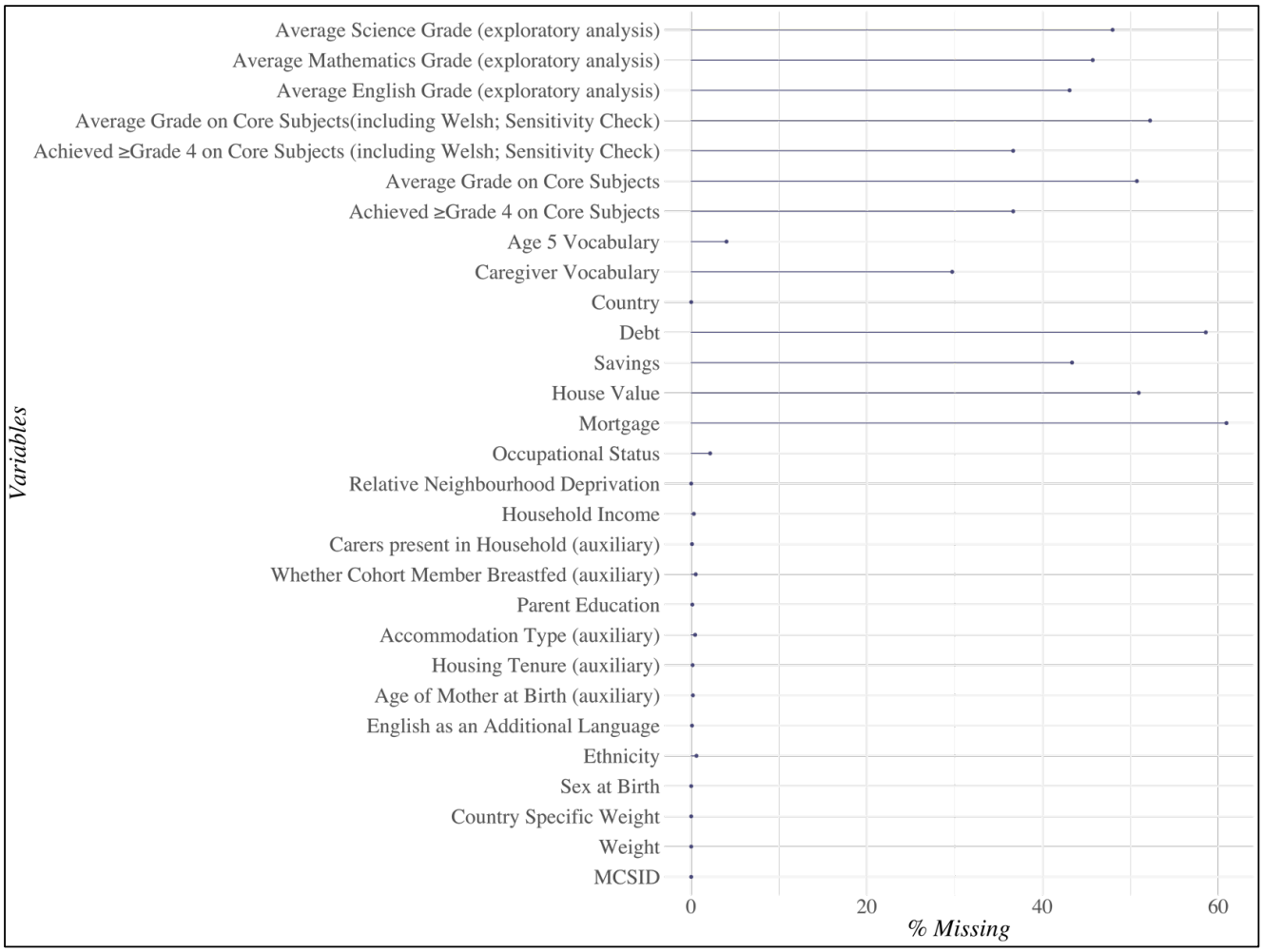
The model converged on 25 imputed datasets. Estimates were pooled across the 25 imputed datasets, using Rubin's rules (Rubin, 1984). The normed χ^2 statistic indicated a poor model fit (normed χ^2 (χ^2/5)) = 18.32. The remaining fit indices indicated the model was a good fit to the data (RMSEA = 0.033; SRMR = 0.026; TLI = 0.993; CFI= 0.996). Standardised factor loadings indicate that all variables loaded onto the latent construct (see Figure S1).

Figure S1: Factor Loadings for CFA



Section 2: Proportions of missing data in analytical sample

Figure S2: Proportions of Missing Data for each Variable used in Analyses or as Auxiliary Imputation Variables



Section 3: Complete cases for whether or not cohort member achieved ≥grade 4 on the core subjects (sensitivity analysis)

Rationale

We ran a complete cases analysis where no data was missing for the binary outcome variable indicating whether or not cohort members achieved ≥grade 4 on the core subjects. 36.65% of this outcome variable were missing from our main analysis sample. This sensitivity analysis was to see if only using observed scores (rather than using multiple imputation to account for missing data) changed our findings.

Method

Details of the predictor, outcome (in this case, ≥grade 4 on core subjects), control variables and moderation variables can be found in Chapter 5. The same variables were used in this analysis.

Analysis plan.

Full details of the analysis plan can be found in Chapter 5: the same analyses were repeated here, on a different sample (those who had a response in the binary variable).

Results

9,868 cohort members had a response for the binary variable of whether or not they achieved ≥grade 4 on the core subjects. Of these 9868 cohort members, 35.61% (3514 cohort members) did not have ≥grade 4 on the core subjects.

RQ1a & RQ2a. Does early childhood vocabulary predict whether cohort members achieve a functional level in core subject examinations at the end of secondary school? Does any such relation hold over and above SEC and caregiver vocabulary factors?

In an unadjusted model (i.e., not including any potential confounding variables), there was a significant relation between age 5 vocabulary and achieving a grade 4 or above on the core subjects at the end of secondary school, such that with every SD unit increase in age 5 vocabulary, the odds of passing the benchmark of ≥ grade 4 on the core subjects increased by 87% (OR = .1.87, 95% CIs = [1.78;1.97]). To test whether this relation held when potential confounding factors were included, we first tested whether two sets of potential confounding variables predicted whether the benchmark of ≥ grade 4 on the core subjects was reached (see Table 3). We subsequently assessed whether vocabulary explained variance over and above these variables. Compared to a model with no predictors, a model with sociodemographic confounding variables significantly improved the model fit (Dm(36, 8602.12)=37.13, p<.001). Further, compared to a model containing only sociodemographic predictors, a model that also included caregiver vocabulary significantly improved the model fit (Dm(1, 445.76) = 140.86, p<.001), indicating that caregiver vocabulary predicted variance in achieving the benchmark above sociodemographic variables. Finally, adding age 5 vocabulary scores to a model containing sociodemographic and caregiver vocabulary factors significantly improved the model fit (Dm(1, 901.86) = 265.46, p<.001), such that higher vocabulary scores were associated with increased odds of passing the benchmark grade threshold: after controlling for sociodemographic and caregiver vocabulary factors, with every SD unit increase in age 5 vocabulary, the odds of passing the benchmark of ≥ grade 4 on the core subjects increased by 66% (OR = 1.66, 95% CIs = [1.56;1.77]; see table S1).

Table S1: Predicting Educational Attainment (≥grade 4 on core subjects, complete cases) (N=9,868)

	Binary Outcome (OR[95% CIs])		
Variable	Model 1	Model 2	Model 3

Sociodemographic confounders			
Sex (male)	REFERENCE	REFERENCE	REFERENCE
Sex (female)	1.41[1.29;1.55] * * * p<.001	1.42[1.29;1.55] * * * p<.001	1.39[1.26;1.53] * * * p<.001
Ethnicity (White)	REFERENCE	REFERENCE	REFERENCE
Ethnicity (mixed)	1.10[.85;1.44] p= .468	1.14[.87;1.49] p= .352	1.13[.86;1.49] p= .383
Ethnicity (Indian)	1.91[1.23;2.98] * * p= .004	2.41[1.53;3.78] * * * p<.001	2.53[1.60;4.00] * * * p<.001
Ethnicity (Pakistani & Bangladeshi)	1.32[.97;1.80] p= .078	1.67[1.22;2.29] * * p= .001	2.08[1.51;2.87] * * * p<.001
Ethnicity (Black/ Black British)	1.55[1.16;2.08] * * p= .003	1.91[1.41;2.58] * * * p<.001	2.22[1.63;3.03] * * * p<.001
Ethnicity (other incl. Chinese)	2.55[1.56;4.19] * * * p<.001	3.35[2.04;5.53] * * * p<.001	4.41[2.64;7.35] * * * p<.001
EAL (English only)	REFERENCE	REFERENCE	REFERENCE
EAL (English and another language)	1.52[1.19;1.96] * * p= .001	1.78[1.37;2.30] * * * p<.001	2.16[1.66;2.81] * * * p<.001
EAL (only another language)	1.76[1.23;2.54] * * p= .002	2.29[1.58;3.33] * * * p<.001	3.20[2.19;4.69] * * * p<.001
Country (England)	REFERENCE	REFERENCE	REFERENCE

Country (Wales)	.83[.67;1.03] p= .083	.85[.69;1.06] p= .151	.89[.71;1.10] p= .277
Country (Scotland)	.39[.33;.46] * * * p<.001	.37[.31;.44] * * * p<.001	.35[.30;.42] * * * p<.001
Country (Northern Ireland)	1.47[1.14;1.90] * * p= .003	1.53[1.18;1.97] * * p= .001	1.47[1.14;1.91] * * p= .003
Parent Education (NVQ1)	REFERENCE	REFERENCE	REFERENCE
Parent Education (None of these/overseas qualifications)	1.13[.88;1.46] p= .337	1.19[.92;1.54] p= .186	1.25[.96;1.62] p= .099
Parent Education (NVQ2)	1.58[1.27;1.97] * * * p<.001	1.47[1.17;1.83] * * * p<.001	1.44[1.14;1.80] * * p= .002
Parent Education (NVQ3)	1.98[1.57;2.51] * * * p<.001	1.71[1.35;2.17] * * * p<.001	1.68[1.31;2.14] * * * p<.001
Parent Education (NVQ4)	2.68[2.12;3.37] * * * p<.001	2.08[1.65;2.64] * * * p<.001	1.94[1.53;2.47] * * * p<.001
Parent Education (NVQ5)	4.34[3.16;5.96] * * * p<.001	2.82[2.03;3.91] * * * p<.001	2.56[1.84;3.57] * * * p<.001
Income Quintile 1	REFERENCE	REFERENCE	REFERENCE
Income Quintile 2	1.15[.98;1.35] p= .081	1.11[.95;1.31] p= .201	1.10[.93;1.30] p= .253
Income Quintile 3	1.47[1.23;1.76] * * * p<.001	1.40[1.17;1.68] * * * p<.001	1.32[1.09;1.59] * * p= .004

Income Quintile 4	1.65[1.36;2.01] * * * p<.001	1.55[1.27;1.89] * * * p<.001	1.52[1.24;1.86] * * * p<.001
Income Quintile 5	2.11[1.69;2.64] * * * p<.001	1.88[1.50;2.35] * * * p<.001	1.78[1.41;2.24] * * * p<.001
Occupational Status (routine)	REFERENCE	REFERENCE	REFERENCE
Occupational Status (unemployed)	.89[.75;1.05] p= .170	.86[.72;1.02] p= .083	.89[.75;1.07] p= .211
Occupational Status (intermediate)	1.27[1.10;1.46] * * p= .001	1.18[1.02;1.37] * p= .022	1.18[1.02;1.37] * p= .029
Occupational Status (higher managerial)	1.86[1.60;2.16] * * * p<.001	1.60[1.37;1.86] * * * p<.001	1.57[1.34;1.83] * * * p<.001
Wealth Quintile 1	REFERENCE	REFERENCE	REFERENCE
Wealth Quintile 2	1.14[.91;1.42] p= .261	1.14[.91;1.43] p= .242	1.16[.92;1.45] p= .208
Wealth Quintile 3	1.17[.96;1.43] p= .122	1.17[.95;1.43] p= .134	1.17[.95;1.43] p= .140
Wealth Quintile 4	1.26[1.00;1.60] * p= .048	1.25[.99;1.57] p= .059	1.24[.99;1.56] p= .057
Wealth Quintile 5	1.47[1.14;1.89] * * p= .003	1.36[1.06;1.76] * p= .018	1.37[1.06;1.76] * p= .017

Relative Neighbourhood Deprivation (most deprived decile)	REFERENCE	REFERENCE	REFERENCE
Relative Neighbourhood Deprivation (10 - <20%)	1.05[.87;1.27] p= .578	1.04[.86;1.26] p= .681	1.03[.85;1.25] p= .758
Relative Neighbourhood Deprivation (20 - <30%)	1.02[.84;1.23] p= .865	1.00[.82;1.21] p= .995	.98[.80;1.19] p= .818
Relative Neighbourhood Deprivation (30 - <40%)	1.15[.94;1.41] p= .175	1.09[.89;1.34] p= .404	1.06[.86;1.31] p= .593
Relative Neighbourhood Deprivation (40 - <50%)	1.16[.95;1.42] p= .147	1.09[.89;1.34] p= .384	1.07[.87;1.32] p= .497
Relative Neighbourhood Deprivation (50 - <60%)	1.18[.96;1.44] p= .120	1.11[.90;1.36] p= .342	1.09[.88;1.34] p= .443

Relative Neighbourhood Deprivation (60 - <70%)	1.30[1.04;1.61] * p= .019	1.20[.96;1.49] p= .108	1.18[.94;1.47] p= .146
Relative Neighbourhood Deprivation (70 - <80%)	1.38[1.10;1.72] * * p= .005	1.26[1.01;1.58] * p= .045	1.24[.98;1.56] p= .068
Relative Neighbourhood Deprivation (80 - <90%)	1.84[1.46;2.32] * * * p<.001	1.72[1.36;2.18] * * * p<.001	1.71[1.35;2.17] * * * p<.001
Relative Neighbourhood Deprivation (least deprived decile)	1.74[1.37;2.21] * * * p<.001	1.59[1.25;2.02] * * * p<.001	1.50[1.18;1.92] * * p= .001
Caregiver Vocabulary			
Caregiver Vocabulary (Word Activity Test Score)		1.55[1.44;1.67] * * * p<.001	1.40[1.30;1.51] * * * p<.001
Cohort Member Vocabulary			

Cohort Member	
Vocabulary	1.66[1.56;1.77] * * *
(Naming	p<.001
Vocabulary Score)	
R2 (%)	

RQ3. Is any relation between age 5 vocabulary and attainment moderated by SEC?

When controlling for sex, ethnicity, EAL status, country and caregiver vocabulary skill, a significant positive relation between a composite measure of SEC and the likelihood of achieving a grade 4 or above on the core subjects at the end of secondary school was observed, such that with every SD unit increase in SEC, the odds of passing this benchmark increases (OR = 2.03, 95% CIs = 1.9;2.17]). Similarly, a significant positive relation between vocabulary skill and achieving a grade 4 or above on the core subjects was observed, such that for every SD unit increase in vocabulary, the odds of passing this benchmark increases (OR = 1.69, 95% CIs = [1.6; 1.8]). Further, the relationship between age 5 vocabulary and achieving a grade 4 or above on the core subjects at the end of secondary school is moderated by one's SEC, with an additional increase in the odds of passing the benchmark threshold with each SD unit increase of vocabulary, for each additional SD unit increase in SEC (OR = 1.1, 95% CIs = [1.04; 1.18]).

To determine the significance of the interaction term, a model with the SEC composite*age 5 vocabulary interaction term was compared to a model without this interaction term. Compared to a model controlling for sex, ethnicity, EAL status, country, and caregiver vocabulary, a model which also included an SEC composite*age 5 vocabulary score interaction term significantly increased the model fit (Dm(1, 612.38) = 9.47, p =.002), indicating that the relationship between age 5 vocabulary and the likelihood of achieving ≥ grade 4 on the core subjects is significantly moderated by early childhood SEC.

Overall, not imputing this outcome variable did not change the main pattern of results. Vocabulary predicted unique variance in whether or not cohort members achieved ≥grade 4 on the core subjects, and SEC moderated this relation.

Section 4: Complete cases for average grade on core subjects (sensitivity analysis)

Rationale

We ran a complete cases analysis where no data was missing for the average grade across core subjects outcome variable. 50.73% of this outcome variable were missing from our main analysis sample. This sensitivity analysis was to see if only using observed scores (rather than using multiple imputation to account for missing data) changed our findings.

Method

Details of the predictor, outcome (in this case, average grade), control variables and moderation variables can be found in Chapter 5. The same variables were used in this analysis.

Analysis plan.

Full details of the analysis plan can be found in Chapter 5: the same analyses were repeated here, on a different sample (those who had a response in the continuous outcome variable). The moderation analyses (research question 3) were not run here, as this analysis did not include the continuous outcome variable.

Results.

7674 cohort members had an average grade for the core subjects. In an unadjusted model (i.e., not including any potential confounding variables), a significant positive relation was observed, such that higher vocabulary scores were associated with higher levels of overall achievement (β = .34, 95% CIs = [.31;.36]). To test whether this relation held when potential confounding factors were included, we first tested whether two sets of potential confounding variables level of achievement on the core subjects (see Table S2). We subsequently assessed whether vocabulary explained variance over and above these variables. Compared to a model with no predictors, a model with sociodemographic confounding variables significantly improved the model fit (Dm(36, 7125.72)=66.59, p<.001). Further, compared to a model containing only sociodemographic predictors, a model that also included caregiver vocabulary significantly improved the model fit (Dm(1, 1263.79) = 301.17, p<.001), indicating that caregiver vocabulary predicted variance in achieving the benchmark above sociodemographic variables. Finally, adding age 5 vocabulary scores to a model containing sociodemographic and caregiver vocabulary factors significantly improved the model fit (Dm(1, 1199.17) = 294.23, p<.001), with higher vocabulary scores significantly predicting higher levels of overall achievement, above and beyond sociodemographic and caregiver vocabulary factors (β = .21, 95% CIs = [.19;.24]; see table S2).

Overall, not imputing this outcome variable did not affect the main pattern of results: age 5 vocabulary still predicted unique variance in the average grade achieved in core subjects.

Table S2: Predicting Educational Attainment (average grade on core subjects, complete cases) (N=7,674)

	Continuous Outcome (β[95% CIs]		
Variable	Model 1	Model 2	Model 3
Sociodemographic confounders			
Sex (male)	REFERENCE	REFERENCE	REFERENCE
Sex (female)	.14[.10;.18] * * * p<.001	.13[.09;.17] * * * p<.001	.13[.09;.17] * * * p<.001
Ethnicity (White)	REFERENCE	REFERENCE	REFERENCE

Ethnicity (mixed)	.10[-.01;.22] p= .084	.12[.01;.24] * p= .034	.12[.00;.23] * p= .043
Ethnicity (Indian)	.16[.00;.31] * p= .045	.30[.15;.45] * * * p<.001	.30[.15;.45] * * * p<.001
Ethnicity (Pakistani & Bangladeshi)	.15[.01;.28] * p= .031	.30[.17;.43] * * * p<.001	.38[.25;.51] * * * p<.001
Ethnicity (Black/ Black British)	.13[-.00;.26] p= .053	.25[.12;.38] * * * p<.001	.30[.17;.43] * * * p<.001
Ethnicity (other incl. Chinese)	.51[.33;.69] * * * p<.001	.68[.50;.86] * * * p<.001	.74[.56;.91] * * * p<.001
EAL (English only)	REFERENCE	REFERENCE	REFERENCE
EAL (English and another language)	.17[.07;.26] * * * p<.001	.25[.15;.34] * * * p<.001	.32[.23;.42] * * * p<.001
EAL (only another language)	.25[.10;.40] * * p= .001	.39[.25;.54] * * * p<.001	.52[.38;.67] * * * p<.001
Country (England)	REFERENCE	REFERENCE	REFERENCE
Country (Wales)	-.13[-.22;-.03] * * p= .009	-.10[-.20;-.01] * p= .030	-.09[-.18;.01] p= .065
Country (Scotland)	-.20[-.29;-.11] * * * p<.001	-.23[-.32;-.14] * * * p<.001	-.24[-.33;-.16] * * * p<.001
Country (Northern Ireland)	.34[.23;.45] * * * p<.001	.36[.25;.46] * * * p<.001	.35[.24;.45] * * * p<.001

Parent Education (NVQ1)	REFERENCE	REFERENCE	REFERENCE
Parent Education (None of these/overseas qualifications)	.10[-.04;.23] p= .159	.11[-.02;.24] p= .103	.12[-.00;.25] p= .059
Parent Education (NVQ2)	.22[.11;.34] * * * p<.001	.18[.06;.29] * * p= .003	.16[.05;.27] * * p= .005
Parent Education (NVQ3)	.30[.18;.42] * * * p<.001	.20[.08;.32] * * p= .001	.18[.07;.30] * * p= .002
Parent Education (NVQ4)	.53[.42;.65] * * * p<.001	.38[.26;.49] * * * p<.001	.34[.22;.45] * * * p<.001
Parent Education (NVQ5)	.88[.75;1.02] * * * p<.001	.62[.48;.75] * * * p<.001	.57[.44;.70] * * * p<.001
Income Quintile 1	REFERENCE	REFERENCE	REFERENCE
Income Quintile 2	.03[-.05;.11] p= .470	-.00[-.08;.08] p= .944	-.01[-.08;.07] p= .879
Income Quintile 3	.12[.03;.21] * * p= .008	.09[.00;.17] * p= .047	.07[-.02;.15] p= .116
Income Quintile 4	.19[.10;.28] * * * p<.001	.14[.05;.23] * * p= .002	.13[.04;.22] * * p= .005
Income Quintile 5	.37[.27;.46] * * * p<.001	.29[.19;.38] * * * p<.001	.27[.17;.36] * * * p<.001
Occupational Status (routine)	REFERENCE	REFERENCE	REFERENCE

Occupational Status (unemployed)	-.00[-.09;.08] p= .943	-.02[-.11;.07] p= .637	.00[-.08;.09] p= .951
Occupational Status (intermediate)	.09[.02;.16] * * p= .007	.06[-.01;.13] p= .074	.06[-.01;.12] p= .098
Occupational Status (higher managerial)	.32[.25;.39] * * * p<.001	.23[.16;.29] * * * p<.001	.21[.14;.28] * * * p<.001
Wealth Quintile 1	REFERENCE	REFERENCE	REFERENCE
Wealth Quintile 2	.01[-.08;.10] p= .800	.02[-.07;.11] p= .729	.02[-.07;.11] p= .645
Wealth Quintile 3	.04[-.06;.13] p= .421	.03[-.06;.12] p= .487	.03[-.06;.12] p= .481
Wealth Quintile 4	.09[-.00;.19] p= .050	.08[-.01;.17] p= .079	.08[-.01;.16] p= .079
Wealth Quintile 5	.28[.18;.38] * * * p<.001	.23[.13;.33] * * * p<.001	.23[.13;.32] * * * p<.001
Relative Neighbourhood Deprivation (most deprived decile)	REFERENCE	REFERENCE	REFERENCE
Relative Neighbourhood Deprivation (10 - <20%)	.06[-.03;.16] p= .212	.04[-.06;.13] p= .425	.03[-.06;.12] p= .565

Relative Neighbourhood Deprivation (20 - <30%)	.03[-.07;.13] p= .551	.01[-.08;.11] p= .809	-.00[-.09;.09] p= .959
Relative Neighbourhood Deprivation (30 - <40%)	.01[-.09;.11] p= .829	-.03[-.13;.07] p= .560	-.04[-.14;.05] p= .398
Relative Neighbourhood Deprivation (40 - <50%)	.05[-.05;.15] p= .338	.01[-.09;.11] p= .825	-.01[-.10;.09] p= .879
Relative Neighbourhood Deprivation (50 - <60%)	-.04[-.14;.06] p= .449	-.08[-.17;.02] p= .114	-.09[-.18;.01] p= .064
Relative Neighbourhood Deprivation (60 - <70%)	.09[-.01;.19] p= .075	.04[-.06;.14] p= .392	.03[-.07;.13] p= .543
Relative Neighbourhood Deprivation (70 - <80%)	.09[-.01;.19] p= .085	.02[-.08;.12] p= .643	.01[-.09;.10] p= .897
Relative Neighbourhood Deprivation (80 - <90%)	.16[.06;.26] * * p= .002	.11[.01;.21] * p= .026	.10[-.00;.19] p= .054

Relative Neighbourhood Deprivation (least deprived decile)	.13[.03;.23] * p= .012	.07[-.03;.17] p= .146	.05[-.05;.15] p= .312
Caregiver Vocabulary			
Caregiver Vocabulary (Word Activity Test Score)		.26[.23;.29] * * * p<.001	.21[.18;.24] * * * p<.001
Cohort Member Vocabulary			
Cohort Member Vocabulary (Naming Vocabulary Score)			.21[.19;.24] * * * p<.001
R2 (%)	25.67[23.96;27.4]	28.81[27.06;30.57]	31.77[30;33.53]

Section 5: Welsh included as a core subject for those who were born in Wales (sensitivity analysis)

Rationale

Since Welsh is a compulsory GCSE for those sitting the examinations in Wales, we included Welsh as a core subject for cohort members in Wales to assess whether including this in our conceptualisation of core subjects changes the pattern of our results.

Method

Details of the predictor, control variables and moderation variables can be found in Chapter 5. The same variables were used in this analysis. The outcome variables deviate from the main analysis; these are detailed below.

Outcome variable: grade 4 and above on core subjects (0 = yes; 1 = no). "Core subjects" were identified as English, Mathematics, Science, and Welsh for those who reported their country as Wales. If cohort members scored ≥grade 4 (or C) in these subjects, they were classed as having ≥grade 4 on the core subjects.

Outcome variable: average grade on the core subjects. Anyone who reported taking at least one English subject, at least one maths subject and at least one science subject and at least one Welsh subject (for those living in Wales), and who reported a grade for these subjects was included in this variable. An English score was created (if the cohort member reported a grade for both English language and English literature, the mean of these two subjects represented the English score; if a cohort member reported only one grade, this was used as the English score). Similarly, maths and science scores were also calculated (again, if more than one subject from a core subject area was reported, the mean of these was calculated and this then represented that subject's score). For those living in Wales, a welsh score was created. The mean of the English, maths and science scores was taken as the outcome variable, and for those living in wales, the mean of the English, maths, science and Welsh scores was taken as the outcome variable.

Analysis plan.

Full details of the analysis plan can be found in Chapter 5: the same analyses were repeated here, with Welsh subjects included in the outcome variables.

Results.

Of the original analytical sample (*N*=15, 576), 2144 cohort members lived in Wales (13% of analytic sample). For these cohort members, Welsh GCSE was also required as a core subject in this analysis. For the rest of the sample (those living in England, Scotland, or Northern Ireland), the core subjects were English, Maths and Science. When the ≥grade 4 on core subjects binary variable was conceptualised in this way, 39.77% of cohort members did not have the core subjects at ≥grade 4 (pooled across 25 imputed datasets).

RQ1a & RQ2a. Does early childhood vocabulary predict whether cohort members achieve a functional level in core subject examinations at the end of secondary school? Does any such relation hold over and above SEC and caregiver vocabulary factors?

In an unadjusted model (i.e., not including any potential confounding variables), there was a significant relation between age 5 vocabulary and achieving a grade 4 or above on the core subjects at the end of secondary school, such that with every SD unit increase in age 5 vocabulary, the odds of passing the benchmark of ≥ grade 4 on the core subjects increased by 79% (OR = .1.79, 95% CIs = [1.70; 1.88]). To test whether this relation held when potential confounding factors were included, we first tested whether two sets of potential confounding variables predicted whether the benchmark of ≥ grade 4 on the core subjects was reached (see Table 3). We subsequently assessed whether vocabulary explained variance over and above these variables. Compared to a model with no predictors, a model with sociodemographic confounding variables significantly improved the model fit (Dm(36, 3479.21)=36.89, p<.001). Further, compared to a model containing only sociodemographic predictors, a model that also included caregiver vocabulary significantly improved the model fit (Dm(1, 65.1) = 103.74, p<.001), indicating that caregiver vocabulary predicted variance in achieving the benchmark above sociodemographic variables. Finally, adding age 5 vocabulary scores to a model containing sociodemographic and caregiver vocabulary factors significantly improved

the model fit (Dm(1, 66.01) = 192.18, p<.001), such that higher vocabulary scores were associated with increased odds of passing the benchmark grade threshold: after controlling for sociodemographic and caregiver vocabulary factors, with every SD unit increase in age 5 vocabulary, the odds of passing the benchmark of ≥ grade 4 on the core subjects increased by 58% (OR = 1.58, 95% CIs = [1.48;1.68]; see table S3).

RQ1b & RQ2b. Does early childhood vocabulary predict the level of achievement in the core subjects? Does any such relation hold over and above SEC and caregiver vocabulary factors?

In an unadjusted model (i.e., not including any potential confounding variables), a significant positive relation was observed, such that higher vocabulary scores were associated with higher levels of overall achievement (β = .34, 95% CIs = [.31;.36]). To test whether this relation held when potential confounding factors were included, we first tested whether two sets of potential confounding variables level of achievement on the core subjects (see Table S3). We subsequently assessed whether vocabulary explained variance over and above these variables. Compared to a model with no predictors, a model with sociodemographic confounding variables significantly improved the model fit (Dm(36, 2620.18)=64.26, *p*<.001). Further, compared to a model containing only sociodemographic predictors, a model that also included caregiver vocabulary significantly improved the model fit (Dm(1, 59.61) = 217.62, p<.001), indicating that caregiver vocabulary predicted variance in achieving the benchmark above sociodemographic variables. Finally, adding age 5 vocabulary scores to a model containing sociodemographic and caregiver vocabulary factors significantly improved the model fit (Dm(1, 54.25) = 241.43, p<.001), with higher vocabulary scores significantly predicting higher levels of overall achievement, above and beyond sociodemographic and caregiver vocabulary factors (β = .21, 95% CIs = [.18;.23]; see table S3).

RQ3. Is any relation between age 5 vocabulary and attainment moderated by SEC?

When controlling for sex, ethnicity, EAL status, country and caregiver vocabulary skill, a significant positive relation between a composite measure of SEC and the likelihood of achieving a grade 4 or above on the core subjects at the end of secondary school was observed, such that with every SD unit increase in SEC, the odds of passing this benchmark increases (OR = 1.86, 95% CIs = 1.76;1.97]). Similarly, a significant positive relation between vocabulary skill and achieving a grade 4 or above on the core subjects was observed, such that for every SD unit increase in vocabulary, the odds of passing this benchmark increases (OR = 1.59, 95% CIs = [1.49; 1.69]). However, the relationship between age 5 vocabulary and achieving a grade 4 or above on the core subjects at the end of secondary school is not moderated by one's SEC (OR = 1.03, 95% CIs = [0.97; 1.09]). To determine the significance of the interaction term, a model with the SEC composite*age 5 vocabulary interaction term was compared to a model without this interaction term. Compared to a model controlling for sex, ethnicity, EAL status, country, and caregiver vocabulary, a model which also included an SEC composite*age 5 vocabulary score interaction term did not significantly increase the model fit (Dm(1, 94.66) = 0.77, p=.382), indicating that the relationship between age 5 vocabulary and the likelihood of achieving ≥ grade 4 on the core subjects is not moderated by early childhood SEC.

Table S3: Predicting Educational Attainment (≥grade 4 on core subjects and average grade, including Welsh as a core subject) (N=15,576)

	Binary Outcome (OR [95% CIs]			Continuous Outcome (β [95% CIs]		
Variable	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Sociodemographic confounders						
Sex (male)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Sex (female)	1.47[1.33;1.63] * * * p<.001	1.47[1.33;1.64] * * * p<.001	1.45[1.30;1.61] * * * p<.001	.11[.08;.15] * * * p<.001	.11[.07;.15] * * * p<.001	.10[.06;.14] * * * p<.001
Ethnicity (White)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Ethnicity (mixed)	1.08[.80;1.46] p= .597	1.09[.80;1.48] p= .573	1.09[.80;1.48] p= .583	.08[-.04;.19] p= .186	.08[-.03;.19] p= .148	.08[-.03;.19] p= .154
Ethnicity (Indian)	1.90[1.24;2.93] * * p= .004	2.22[1.43;3.44] * * * p<.001	2.28[1.46;3.56] * * * p<.001	.14[-.02;.29] p= .096	.23[.08;.39] * * p= .004	.23[.07;.38] * * p= .004
Ethnicity (Pakistani & Bangladeshi)	1.34[1.00;1.80] p= .052	1.60[1.18;2.17] * * p= .003	1.92[1.41;2.62] * * * p<.001	.12[-.03;.26] p= .124	.23[.08;.38] * * p= .003	.31[.16;.46] * * * p<.001
Ethnicity (Black/ Black British)	1.57[1.15;2.12] * * p= .004	1.81[1.33;2.48] * * * p<.001	2.07[1.50;2.86] * * * p<.001	.09[-.04;.22] p= .167	.18[.05;.30] * * p= .006	.23[.11;.36] * * * p<.001
Ethnicity (other incl. Chinese)	2.73[1.66;4.50] * * * p<.001	3.23[1.95;5.33] * * * p<.001	3.92[2.34;6.56] * * * p<.001	.43[.24;.62] * * * p<.001	.53[.34;.72] * * * p<.001	.59[.40;.77] * * * p<.001
EAL (English only)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE

EAL (English and another language)	1.57[1.22;2.01] * * * p<.001	1.82[1.42;2.34] * * * p<.001	2.19[1.69;2.83] * * * p<.001	.21[.11;.32] * * * p<.001	.29[.18;.39] * * * p<.001	.36[.25;.46] * * * p<.001
EAL (only another language)	1.79[1.23;2.60] * * p= .003	2.31[1.59;3.36] * * * p<.001	3.15[2.13;4.67] * * * p<.001	.26[.12;.39] * * * p<.001	.39[.26;.52] * * * p<.001	.51[.38;.65] * * * p<.001
Country (England)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Country (Wales)	.38[.31;.46] * * * p<.001	.38[.31;.46] * * * p<.001	.38[.31;.47] * * * p<.001	-.01[-.08;.07] p= .872	.01[-.06;.08] p= .794	.02[-.05;.10] p= .521
Country (Scotland)	.41[.35;.48] * * * p<.001	.40[.34;.47] * * * p<.001	.38[.33;.46] * * * p<.001	-.06[-.15;.03] p= .188	-.06[-.15;.02] p= .151	-.07[-.16;.02] p= .117
Country (Northern Ireland)	1.54[1.22;1.95] * * * p<.001	1.60[1.26;2.03] * * * p<.001	1.56[1.22;1.98] * * * p<.001	.32[.21;.42] * * * p<.001	.33[.23;.43] * * * p<.001	.32[.22;.42] * * * p<.001
Parent Education (NVQ1)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Parent Education (None of these/overseas qualifications)	1.14[.89;1.47] p= .296	1.19[.92;1.54] p= .174	1.21[.93;1.57] p= .147	.07[-.05;.19] p= .269	.09[-.03;.21] p= .139	.10[-.02;.22] p= .103
Parent Education (NVQ2)	1.60[1.29;1.99] * * * p<.001	1.51[1.21;1.87] * * * p<.001	1.47[1.18;1.83] * * * p<.001	.15[.03;.26] * p= .013	.11[-.01;.22] p= .075	.09[-.03;.20] p= .125
Parent Education (NVQ3)	1.99[1.55;2.55] * * * p<.001	1.77[1.38;2.29] * * * p<.001	1.71[1.32;2.22] * * * p<.001	.22[.10;.35] * * * p<.001	.15[.02;.28] * p= .025	.13[-.00;.25] p= .053

Parent Education (NVQ4)	2.63[2.10;3.30] * * * p<.001	2.13[1.69;2.70] * * * p<.001	1.97[1.55;2.51] * * * p<.001	.46[.33;.58] * * * p<.001	.32[.20;.45] * * * p<.001	.28[.16;.40] * * * p<.001
Parent Education (NVQ5)	3.71[2.72;5.05] * * * p<.001	2.57[1.85;3.55] * * * p<.001	2.33[1.67;3.26] * * * p<.001	.80[.66;.93] * * * p<.001	.57[.43;.71] * * * p<.001	.51[.38;.65] * * * p<.001
Income Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Income Quintile 2	1.13[.95;1.35] p= .151	1.10[.92;1.32] p= .271	1.12[.93;1.34] p= .238	.02[-.06;.10] p= .615	.00[-.07;.08] p= .924	.01[-.07;.08] p= .861
Income Quintile 3	1.41[1.17;1.71] * * * p<.001	1.36[1.13;1.65] * * p= .002	1.31[1.08;1.60] * * p= .007	.13[.05;.22] * * p= .003	.11[.02;.19] * p= .012	.09[.00;.17] * p= .040
Income Quintile 4	1.70[1.38;2.09] * * * p<.001	1.61[1.31;1.98] * * * p<.001	1.55[1.25;1.92] * * * p<.001	.19[.10;.29] * * * p<.001	.16[.07;.25] * * * p<.001	.14[.05;.22] * * p= .003
Income Quintile 5	1.78[1.43;2.21] * * * p<.001	1.61[1.29;1.99] * * * p<.001	1.53[1.22;1.91] * * * p<.001	.37[.27;.46] * * * p<.001	.30[.21;.39] * * * p<.001	.28[.19;.37] * * * p<.001
Occupational Status (routine)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Occupational Status (unemployed)	.86[.74;1.00] p= .056	.85[.73;.99] * p= .040	.89[.76;1.05] p= .162	-.03[-.11;.05] p= .507	-.03[-.11;.05] p= .421	-.01[-.09;.07] p= .853
Occupational Status (intermediate)	1.30[1.13;1.51] * * * p<.001	1.23[1.06;1.42] * * p= .006	1.21[1.05;1.41] * p= .011	.10[.04;.17] * * p= .002	.07[.00;.13] * p= .040	.06[-.00;.12] p= .069
Occupational Status (higher managerial)	1.84[1.57;2.15] * * * p<.001	1.60[1.36;1.89] * * * p<.001	1.57[1.32;1.85] * * * p<.001	.33[.26;.39] * * * p<.001	.24[.18;.31] * * * p<.001	.22[.16;.29] * * * p<.001

Wealth Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Wealth Quintile 2	1.11[.93;1.33] p= .240	1.12[.94;1.34] p= .209	1.13[.94;1.35] p= .191	.01[-.08;.09] p= .901	.01[-.07;.09] p= .826	.01[-.07;.09] p= .818
Wealth Quintile 3	1.16[.98;1.36] p= .079	1.15[.98;1.36] p= .080	1.15[.98;1.36] p= .090	.04[-.06;.13] p= .440	.03[-.06;.12] p= .464	.03[-.05;.12] p= .462
Wealth Quintile 4	1.21[1.03;1.42] * p= .020	1.20[1.02;1.40] * p= .028	1.19[1.02;1.39] * p= .027	.08[-.02;.18] p= .116	.07[-.03;.17] p= .145	.07[-.03;.16] p= .147
Wealth Quintile 5	1.24[1.04;1.49] * p= .020	1.18[.98;1.42] p= .076	1.17[.97;1.42] p= .094	.26[.15;.37] * * * p<.001	.22[.11;.33] * * * p<.001	.22[.11;.33] * * * p<.001
Relative Neighbourhood Deprivation (most deprived decile)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Relative Neighbourhood Deprivation (10 - <20%)	1.06[.88;1.28] p= .552	1.05[.87;1.28] p= .599	1.04[.86;1.27] p= .671	.06[-.04;.15] p= .229	.05[-.04;.14] p= .271	.05[-.04;.14] p= .311
Relative Neighbourhood Deprivation (20 - <30%)	1.03[.84;1.27] p= .772	1.01[.82;1.25] p= .912	.99[.79;1.22] p= .900	.04[-.05;.13] p= .368	.03[-.06;.12] p= .524	.02[-.07;.11] p= .691

Relative Neighbourhood Deprivation (30 - <40%)	1.13[.93;1.38] p= .204	1.10[.90;1.34] p= .354	1.08[.88;1.32] p= .472	-.01[-.11;.09] p= .856	-.03[-.13;.07] p= .531	-.04[-.13;.06] p= .412
Relative Neighbourhood Deprivation (40 - <50%)	1.23[1.01;1.50] * p= .040	1.18[.96;1.45] p= .111	1.16[.94;1.43] p= .163	.04[-.06;.15] p= .427	.02[-.09;.12] p= .754	.01[-.10;.11] p= .910
Relative Neighbourhood Deprivation (50 - <60%)	1.24[1.02;1.52] * p= .031	1.19[.97;1.46] p= .087	1.16[.94;1.42] p= .168	-.03[-.12;.07] p= .590	-.05[-.15;.04] p= .265	-.07[-.16;.02] p= .149
Relative Neighbourhood Deprivation (60 - <70%)	1.32[1.06;1.63] * p= .012	1.24[.99;1.54] p= .058	1.22[.98;1.52] p= .079	.08[-.01;.17] p= .085	.04[-.05;.13] p= .418	.03[-.06;.12] p= .544
Relative Neighbourhood Deprivation (70 - <80%)	1.47[1.14;1.88] * * p= .003	1.36[1.06;1.75] * p= .018	1.32[1.02;1.71] * p= .035	.10[-.01;.21] p= .063	.05[-.05;.16] p= .335	.03[-.07;.14] p= .540
Relative Neighbourhood Deprivation (80 - <90%)	1.72[1.35;2.19] * * * p<.001	1.62[1.27;2.08] * * * p<.001	1.60[1.24;2.06] * * * p<.001	.12[.04;.21] * * p= .006	.09[-.00;.17] p= .056	.07[-.02;.16] p= .108

Relative Neighbourhood Deprivation (least deprived decile)	1.65[1.27;2.16] * * * p<.001	1.53[1.16;2.00] * * p= .003	1.46[1.11;1.92] * * p= .008	.14[.03;.24] * * p= .009	.09[-.01;.19] p= .093	.06[-.04;.16] p= .219
Caregiver Vocabulary						
Caregiver Vocabulary (Word Activity Test Score)		1.46[1.36;1.57] * * * p<.001	1.34[1.24;1.45] * * * p<.001		.22[.19;.25] * * * p<.001	.18[.15;.21] * * * p<.001
Cohort Member Vocabulary						
Cohort Member Vocabulary (Naming Vocabulary Score)			1.58[1.48;1.68] * * * p<.001			.21[.18;.23] * * * p<.001
R2 (%)				23.89[22.16;25.65]	26.34[24.66;28.04]	29.17[27.27;31.08]

Section 6: Analyses done by country, in England, Wales, Scotland and Northern Ireland separately (sensitivity analysis)

Rationale

Due to the different education systems and examinations taken in each of these countries, we ran each analysis on each country separately, to see if any one country is driving any particular finding.

Method

Details of the predictor, outcome, control and moderation variables can be found in Chapter 5. The same variables were used in this analysis. Ethnicity and whether or not English was spoken as an additional language (control variables) were collapsed into binary variables of White and ethnic minorities, due to the low proportions of ethnic minorities and other languages spoken in these countries.

Analysis plan.

Country-specific sample and attrition weights were used in this set of sensitivity analyses. Full details of the analysis plan can be found in Chapter 5: the same analyses were repeated here, on each country separately.

Results

Of the original analytical sample (N=15,576), 10,076 cohort members were from England, 2,144 were from Wales, 1,821 were from Scotland and 1,535 were from Northern Ireland. Descriptive statistics for each country can be found in Table S4.

RQ1a & RQ2a. Does early childhood vocabulary predict whether cohort members achieve a functional level in core subject examinations at the end of secondary school? Does any such relation hold over and above SEC and caregiver vocabulary factors?

England

In an unadjusted model (i.e., not including any potential confounding variables), there was a significant relation between age 5 vocabulary and achieving a grade 4 or above on the core subjects at the end of secondary school for cohort members in England, such that with every SD unit increase in age 5 vocabulary, the odds of passing the benchmark of ≥ grade 4 on the core subjects increased by 89% (OR = .1.89, 95% CIs = [1.78; 2.00]). To test whether this relation held when potential confounding factors were included, we first tested whether two sets of potential confounding variables predicted whether the benchmark of ≥ grade 4 on the core subjects was reached (see Table S5). We subsequently assessed whether vocabulary explained variance over and above these variables. Compared to a model with no predictors, a model with sociodemographic confounding variables significantly improved the model fit (Dm(28, 2994.94)=28.46, p<.001). Further, compared to a model containing only sociodemographic predictors, a model that also included caregiver vocabulary significantly improved the model fit (Dm(1, 116.28) = 79.42, p<.001), indicating that caregiver vocabulary predicted variance in achieving the benchmark above sociodemographic variables. Finally, adding age 5 vocabulary scores to a model containing sociodemographic and caregiver vocabulary factors significantly improved the model fit (Dm(1, 78.78) = 142.29, p<.001), such that higher vocabulary scores were associated with increased odds of passing the benchmark grade threshold: after controlling for sociodemographic and caregiver vocabulary factors, with every SD unit increase in age 5 vocabulary, the odds of passing the benchmark of ≥ grade 4 on the core subjects increased by 63% (OR = 1.63, 95% CIs = [1.5;1.77]; see table S5).

Table S4: Descriptive Statistics for each Country

	Proportion (%) or Mean(±SD) [95% CIs]			
Variable	England (N = 10,076)	Wales (N = 2144)	Scotland (N = 1821)	Northern Ireland (N = 1535)
Vocabulary				
Cohort Member Vocabulary (Naming Vocabulary Score)	54.41(±11.15) [54.19;54.63]	53.65(±9.79) [53.24;54.06]	56.04(±10.52) [55.55;56.52]	55.58(±10.99) [55.03;56.13]
Caregiver Vocabulary (Word Activity Test Score)	11.14(±4.09) [11.06;11.22]	10.91(±3.62) [10.76;11.06]	11.68(±3.85) [11.51;11.86]	10.89(±3.7) [10.71;11.08]
Cohort Member Education				
Core Subjects Grade ≥ 4: No	36.69	40.15	52.99	34.31
Core Subjects Grade ≥ 4: Yes	63.31	59.85	47.01	65.69
Average GCSE grade (England, Wales & Northern Ireland)	4.85(±1.69) [4.82;4.88]	4.59(±1.65) [4.52;4.66]	3.69(±0.94) [3.65;3.73]	4.9(±1.64) [4.82;4.98]
Demographics				
Sex (Male)	51.12	52.18	50.17	50.83
Sex (Female)	48.88	47.82	49.83	49.17
Ethnicity (White)	83.61	96.78	97.42	99.21
Ethnicity (minority)	16.39	3.22	2.58	0.79

EAL (English only)	87.48	87.68	97.54	98.93
EAL (another language present)	12.52	12.32	2.46	1.07
Socioeconomic Circumstances				
Parent Education (NVQ1)	5.55	6.47	3.06	5.21
Parent Education (None of these/overseas qualifications)	9.85	8.5	7.43	10.66
Parent Education (NVQ2)	25.17	25.03	21.69	26.44
Parent Education (NVQ3)	15.23	17.79	22.65	16.61
Parent Education (NVQ4)	36.69	35.66	36.06	33.27
Parent Education (NVQ5)	7.51	6.54	9.11	7.81
Income Quintile 1	20.96	23.61	19.3	19.79
Income Quintile 2	19.63	22.53	19.75	27.18
Income Quintile 3	19.78	19.35	20.1	22.44
Income Quintile 4	19.56	18.66	20.25	17.69
Income Quintile 5	20.07	15.85	20.6	12.9
Wealth Quintile 1	17.23	20.75	20.36	24.1
Wealth Quintile 2	17.08	22.09	21.52	21.54
Wealth Quintile 3	19.1	21.16	19.93	19.91
Wealth Quintile 4	21.39	19.54	20.51	20.16

Wealth Quintile 5	25.2	16.46	17.68	14.3
Occupational Status (routine)	21.28	24.94	25.05	24.32
Occupational Status (unemployed)	18.91	20.85	15.63	19.09
Occupational Status (intermediate)	19.47	16	17.08	23.25
Occupational Status (higher managerial)	40.34	38.21	42.24	33.34
Relative Neighbourhood Deprivation (most deprived decile)	12.39	9.01	11.07	10.56
Relative Neighbourhood Deprivation (10 - <20%)	10.41	12.44	8.67	13.98
Relative Neighbourhood Deprivation (20 - <30%)	10.06	10.76	9.9	11.62
Relative Neighbourhood Deprivation (30 - <40%)	8.9	10.62	9.88	9.77
Relative Neighbourhood Deprivation (40 - <50%)	10.27	6.18	9.29	7.82
Relative Neighbourhood Deprivation (50 - <60%)	9.83	7.96	10.27	10.07

Relative Neighbourhood Deprivation (60 - <70%)	9.36	8.12	7.78	6.4
Relative Neighbourhood Deprivation (70 - <80%)	9.37	8.24	9.26	9.75
Relative Neighbourhood Deprivation (80 - <90%)	9.32	11.2	12.87	12.15
Relative Neighbourhood Deprivation (least deprived decile)	10.09	15.47	11.02	7.86

Descriptives are computed across 25 imputed datasets and pooled. Descriptives are sample and attrition weighted using MCS2001 country specific weights

Wales

In an unadjusted model (i.e., not including any potential confounding variables), there was a significant relation between age 5 vocabulary and achieving a grade 4 or above on the core subjects at the end of secondary school for cohort members in Wales, such that with every SD unit increase in age 5 vocabulary, the odds of passing the benchmark of ≥ grade 4 on the core subjects increased by 97% (OR = .1.97, 95% CIs = [1.68; 2.31]). To test whether this relation held when potential confounding factors were included, we first tested whether two sets of potential confounding variables predicted whether the benchmark of ≥ grade 4 on the core subjects was reached (see Table S6). We subsequently assessed whether vocabulary explained variance over and above these variables. Compared to a model with no predictors, a model with sociodemographic confounding variables significantly improved the model fit (Dm(28, 1387.76)=7.62, p<.001). Further, compared to a model containing only sociodemographic predictors, a model that also included caregiver vocabulary significantly improved the model fit (Dm(1, 63.45) = 8.57, p = .005), indicating that caregiver vocabulary predicted variance in achieving the benchmark above sociodemographic variables. Finally, adding age 5 vocabulary scores to a model containing sociodemographic and caregiver vocabulary factors significantly improved the model fit (Dm(1, 75.41) = 24.01, p<.001), such that higher vocabulary scores were associated with increased odds of passing the benchmark grade threshold: after controlling for sociodemographic and caregiver vocabulary factors, with every SD unit increase in age 5 vocabulary, the odds of passing the benchmark of ≥ grade 4 on the core subjects increased by 55% (OR = 1.55, 95% CIs = [1.30;1.85]; see table S6).

Scotland

In an unadjusted model (i.e., not including any potential confounding variables), there was a significant relation between age 5 vocabulary and achieving a grade 4 or above on the core subjects at the end of secondary school for cohort members in Scotland, such that with every SD unit increase in age 5 vocabulary, the odds of passing the benchmark of ≥ grade 4 on the core subjects increased by 90% (OR = .1.90, 95% CIs = [1.59; 2.26]). To test whether this relation held when potential confounding factors were included, we first tested whether two sets of potential confounding variables predicted whether the benchmark of ≥ grade 4 on the core subjects was reached (see Table S7). We subsequently assessed whether vocabulary explained variance over and above these variables. Compared to a model with no predictors, a model with sociodemographic confounding variables significantly improved the model fit (Dm(28, 1157.09)=6.25, p<.001). Further, compared to a model containing only sociodemographic predictors, a model that also included caregiver vocabulary significantly improved the model fit (Dm(1, 74.13) = 15.19, p<.001), indicating that caregiver vocabulary predicted variance in achieving the benchmark above sociodemographic variables. Finally, adding age 5 vocabulary scores to a model containing sociodemographic and caregiver vocabulary factors significantly improved the model fit (Dm(1, 66.18) = 17.28, p<.001), such that higher vocabulary scores were associated with increased odds of passing the benchmark grade threshold: after controlling for sociodemographic and caregiver vocabulary factors, with every SD unit increase in age 5 vocabulary, the odds of passing the benchmark of ≥ grade 4 on the core subjects increased by 46% (OR = 1.46, 95% CIs = [1.22;1.75]; see table S7).

Northern Ireland

In an unadjusted model (i.e., not including any potential confounding variables), there was a significant relation between age 5 vocabulary and achieving a grade 4 or above on the core subjects at the end of secondary school for cohort members in Northern Ireland, such that with every SD unit increase in age 5 vocabulary, the odds of passing the benchmark of ≥ grade 4 on the core subjects increased by 72% (OR = 1.72, 95% CIs = [1.50; 1.98]). To test whether this relation held when potential confounding factors were included, we first tested whether two sets of potential confounding variables predicted whether the benchmark of ≥ grade 4 on the core subjects was reached (see Table S8). We subsequently assessed whether vocabulary explained variance over and above these variables. Compared to a model with no predictors, a model with sociodemographic confounding variables significantly improved the model fit (Dm(28, 1035.1)=5.17, p<.001). Further, compared to a model containing only sociodemographic predictors, a model that also included caregiver vocabulary significantly improved the model fit (Dm(1, 93.51) = 16.63, p<.001), indicating that caregiver vocabulary predicted variance in achieving the benchmark above sociodemographic variables. Finally, adding age 5 vocabulary scores to a model containing sociodemographic and caregiver vocabulary factors significantly improved the model fit (Dm(1, 91.76) = 22.38, p<.001), such that higher vocabulary scores were associated with increased odds of passing the benchmark grade threshold: after controlling for sociodemographic and caregiver vocabulary factors, with every SD unit increase in age 5 vocabulary, the odds of passing the benchmark of ≥ grade 4 on the core subjects increased by 45% (OR = 1.45, 95% CIs = [1.24;1.69]; see table S8).

RQ1b & RQ2b. Does early childhood vocabulary predict the level of achievement in the core subjects? Does any such relation hold over and above SEC and caregiver vocabulary factors?

England

In an unadjusted model (i.e., not including any potential confounding variables), a significant positive relation was observed for cohort members in England, such that higher vocabulary scores were associated with higher levels of overall achievement (β = .39, 95% CIs = [.36;.42]). To test whether this relation held when potential confounding factors were included, we first tested whether two sets of potential confounding variables level of achievement on the core subjects (see Table S5). We subsequently assessed whether vocabulary explained variance over and above these variables. Compared to a model with no predictors, a model with sociodemographic confounding variables significantly improved the model fit (Dm(28, 2772.56)=74.82, p<.001). Further, compared to a model containing only sociodemographic predictors, a model that also included caregiver vocabulary significantly improved the model fit (Dm(1, 83.17) = 176.24, p<.001), indicating that caregiver vocabulary predicted variance in achieving the benchmark above sociodemographic variables. Finally, adding age 5 vocabulary scores to a model containing sociodemographic and caregiver vocabulary factors significantly improved the model fit (Dm(1, 69.14) = 257.88, p<.001), with higher vocabulary scores significantly predicting higher levels of overall achievement, above and beyond sociodemographic and caregiver vocabulary factors (β = .25, 95% CIs = [.22;.28]; see table S5).

Wales

In an unadjusted model (i.e., not including any potential confounding variables), a significant positive relation was observed for cohort members in Wales, such that higher vocabulary scores were associated with higher levels of overall achievement (β = .41, 95% CIs = [.34;.47]). To test whether this relation held when potential confounding factors were included, we first tested whether two sets of potential confounding variables level of achievement on the core subjects (see Table S6). We subsequently assessed whether vocabulary explained variance over and above these variables. Compared to a model with no predictors, a model with sociodemographic confounding variables significantly improved the model fit (Dm(28, 1409.1)=16.41, p<.001). Further, compared to a model containing only sociodemographic predictors, a model that also included caregiver vocabulary significantly improved the model fit (Dm(1, 98.44) = 26.94, p<.001), indicating that caregiver vocabulary predicted variance in achieving the benchmark above sociodemographic variables. Finally, adding age 5 vocabulary scores to a model containing sociodemographic and caregiver vocabulary factors significantly improved the model fit (Dm(1, 84.52) = 48.53, p<.001), with higher vocabulary scores significantly predicting higher levels of overall achievement, above and beyond sociodemographic and caregiver vocabulary factors (β = .23, 95% CIs = [.16;.29]; see table S6).

Scotland

In an unadjusted model (i.e., not including any potential confounding variables), a significant positive relation was observed for cohort members in Scotland, such that higher vocabulary scores were associated with higher levels of overall achievement (β = .41, 95% CIs = [.32;.51]). To test whether this relation held when potential confounding factors were included, we first tested whether two sets of potential confounding variables level of achievement on the core subjects (see Table S7). We subsequently assessed whether vocabulary explained variance over and above these variables. Compared to a model with no predictors, a model with sociodemographic confounding variables significantly improved the model fit (Dm(28, 1120.17)=9.28, p<.001). Further, compared to a model containing only sociodemographic predictors, a model that also included caregiver vocabulary significantly improved the model fit (Dm(1, 65.61) = 14.5, p<.001), indicating that caregiver vocabulary

predicted variance in achieving the benchmark above sociodemographic variables. Finally, adding age 5 vocabulary scores to a model containing sociodemographic and caregiver vocabulary factors significantly improved the model fit (Dm(1, 74.54) = 14.26, p<.001), with higher vocabulary scores significantly predicting higher levels of overall achievement, above and beyond sociodemographic and caregiver vocabulary factors (β = .19, 95% CIs = [.09;.29]; see table S7).

Northern Ireland

In an unadjusted model (i.e., not including any potential confounding variables), a significant positive relation was observed for cohort members in Northern Ireland, such that higher vocabulary scores were associated with higher levels of overall achievement (β = .31, 95% CIs = [.25;.37]). To test whether this relation held when potential confounding factors were included, we first tested whether two sets of potential confounding variables level of achievement on the core subjects (see Table S8). We subsequently assessed whether vocabulary explained variance over and above these variables. Compared to a model with no predictors, a model with sociodemographic confounding variables significantly improved the model fit (Dm(28, 1103.91)=10.41, *p*<.001). Further, compared to a model containing only sociodemographic predictors, a model that also included caregiver vocabulary significantly improved the model fit (Dm(1, 84.95) = 21.47 p<.001), indicating that caregiver vocabulary predicted variance in achieving the benchmark above sociodemographic variables. Finally, adding age 5 vocabulary scores to a model containing sociodemographic and caregiver vocabulary factors significantly improved the model fit (Dm(1, 285.61) = 43.59, p<.001), with higher vocabulary scores significantly predicting higher levels of overall achievement, above and beyond sociodemographic and caregiver vocabulary factors (β = .18, 95% CIs = [.13;.24]; see table S8).

Table S5: Predicting Educational Attainment in England (≥grade 4 on core subjects and average grade) (N=10,076)

	Binary Outcome (OR [95% CIs]			Continuous Outcome (β [95% CIs]		
Variable	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Sociodemographic confounders						
Sex (male)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Sex (female)	1.30[1.16;1.45] * * * p<.001	1.30[1.16;1.45] * * * p<.001	1.26[1.12;1.41] * * * p<.001	.15[.11;.19] * * * p<.001	.15[.10;.19] * * * p<.001	.13[.09;.17] * * * p<.001

Ethnicity (White)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Ethnicity (minority)	1.30[1.05;1.62] * p= .018	1.41[1.13;1.75] * * p= .003	1.52[1.22;1.90] * * * p<.001	.13[.05;.20] * * p= .002	.18[.10;.26] * * * p<.001	.22[.14;.29] * * * p<.001
EAL (English only)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
EAL (another language present)	1.72[1.34;2.21] * * * p<.001	2.21[1.70;2.88] * * * p<.001	2.99[2.28;3.93] * * * p<.001	.24[.15;.33] * * * p<.001	.37[.28;.47] * * * p<.001	.49[.39;.59] * * * p<.001
Parent Education (NVQ1)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Parent Education (None of these/overseas qualifications)	1.21[.86;1.70] p= .270	1.27[.90;1.78] p= .171	1.29[.91;1.83] p= .145	.10[-.04;.23] p= .163	.13[-.01;.26] p= .069	.14[.00;.27] * p= .044
Parent Education (NVQ2)	1.52[1.18;1.96] * * p= .001	1.43[1.11;1.85] * * p= .006	1.40[1.08;1.81] * p= .012	.22[.09;.34] * * * p<.001	.18[.05;.30] * * p= .005	.16[.04;.28] * p= .011
Parent Education (NVQ3)	1.82[1.39;2.40] * * * p<.001	1.63[1.24;2.15] * * * p<.001	1.57[1.19;2.08] * * p= .002	.30[.18;.43] * * * p<.001	.23[.10;.35] * * * p<.001	.20[.08;.32] * * p= .002
Parent Education (NVQ4)	2.58[1.95;3.40] * * * p<.001	2.11[1.59;2.79] * * * p<.001	1.93[1.45;2.56] * * * p<.001	.56[.43;.68] * * * p<.001	.43[.30;.55] * * * p<.001	.37[.24;.49] * * * p<.001
Parent Education (NVQ5)	4.48[2.95;6.82] * * * p<.001	3.08[2.03;4.68] * * * p<.001	2.75[1.80;4.21] * * * p<.001	.93[.78;1.09] * * * p<.001	.70[.54;.86] * * * p<.001	.62[.47;.78] * * * p<.001
Income Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE

Income Quintile 2	1.09[.89;1.35] p= .405	1.06[.86;1.31] p= .596	1.08[.87;1.34] p= .489	.00[-.08;.09] p= .963	-.02[-.10;.07] p= .682	-.01[-.09;.07] p= .825
Income Quintile 3	1.34[1.06;1.71] * p= .016	1.29[1.01;1.65] * p= .040	1.25[.97;1.60] p= .085	.12[.02;.22] * p= .017	.09[-.00;.19] p= .057	.07[-.02;.17] p= .124
Income Quintile 4	1.56[1.22;2.00] * * * p<.001	1.47[1.15;1.89] * * p= .002	1.43[1.11;1.84] * * p= .006	.19[.09;.30] * * * p<.001	.15[.05;.25] * * p= .003	.13[.03;.23] * p= .010
Income Quintile 5	1.82[1.31;2.52] * * * p<.001	1.64[1.18;2.27] * * p= .004	1.57[1.12;2.20] * * p= .009	.36[.24;.48] * * * p<.001	.29[.18;.40] * * * p<.001	.26[.15;.37] * * * p<.001
Occupational Status (routine)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Occupational Status (unemployed)	.83[.68;1.03] p= .085	.82[.66;1.01] p= .064	.86[.70;1.07] p= .170	-.04[-.12;.04] p= .376	-.05[-.13;.04] p= .265	-.02[-.10;.06] p= .658
Occupational Status (intermediate)	1.32[1.11;1.57] * * p= .002	1.24[1.05;1.47] * p= .013	1.21[1.02;1.45] * p= .030	.13[.04;.21] * * p= .003	.09[.01;.17] * p= .031	.07[-.01;.16] p= .072
Occupational Status (higher managerial)	1.93[1.56;2.38] * * * p<.001	1.69[1.37;2.08] * * * p<.001	1.64[1.32;2.03] * * * p<.001	.36[.27;.46] * * * p<.001	.27[.18;.37] * * * p<.001	.25[.16;.34] * * * p<.001
Wealth Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Wealth Quintile 2	1.09[.87;1.37] p= .439	1.10[.88;1.38] p= .391	1.10[.89;1.38] p= .372	.02[-.07;.11] p= .694	.02[-.07;.11] p= .601	.02[-.06;.11] p= .583
Wealth Quintile 3	1.10[.85;1.41] p= .458	1.10[.85;1.41] p= .469	1.09[.85;1.40] p= .496	.02[-.09;.14] p= .659	.02[-.09;.13] p= .692	.02[-.09;.12] p= .722

Wealth Quintile 4	1.19[.93;1.51] p= .163	1.18[.92;1.50] p= .187	1.18[.92;1.50] p= .186	.07[-.02;.17] p= .132	.07[-.03;.16] p= .168	.06[-.03;.16] p= .164
Wealth Quintile 5	1.33[.99;1.77] p= .056	1.26[.94;1.70] p= .114	1.26[.94;1.71] p= .124	.23[.12;.33] * * * p<.001	.19[.09;.30] * * * p<.001	.19[.09;.29] * * * p<.001
Relative Neighbourhood Deprivation (most deprived decile)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Relative Neighbourhood Deprivation (10 - <20%)	1.13[.92;1.40] p= .251	1.12[.91;1.39] p= .281	1.11[.89;1.38] p= .350	.06[-.03;.16] p= .173	.06[-.04;.15] p= .225	.05[-.04;.14] p= .289
Relative Neighbourhood Deprivation (20 - <30%)	1.11[.89;1.39] p= .355	1.09[.87;1.37] p= .470	1.06[.84;1.33] p= .643	.06[-.04;.16] p= .213	.05[-.05;.14] p= .349	.03[-.07;.13] p= .553
Relative Neighbourhood Deprivation (30 - <40%)	1.19[.93;1.53] p= .172	1.16[.90;1.49] p= .263	1.13[.87;1.47] p= .349	.06[-.04;.16] p= .262	.04[-.07;.14] p= .498	.02[-.08;.12] p= .648
Relative Neighbourhood Deprivation (40 - <50%)	1.20[.97;1.49] p= .088	1.15[.92;1.43] p= .211	1.13[.90;1.41] p= .291	.07[-.03;.17] p= .151	.04[-.06;.14] p= .402	.03[-.07;.13] p= .564

Relative Neighbourhood Deprivation (50 - <60%)	1.25[.98;1.59] p= .076	1.20[.94;1.53] p= .146	1.16[.91;1.50] p= .232	.06[-.04;.15] p= .253	.03[-.07;.12] p= .547	.01[-.08;.11] p= .783
Relative Neighbourhood Deprivation (60 - <70%)	1.31[1.03;1.67] * p= .029	1.23[.96;1.57] p= .103	1.22[.95;1.57] p= .119	.10[.00;.20] * p= .048	.06[-.04;.15] p= .250	.05[-.05;.14] p= .341
Relative Neighbourhood Deprivation (70 - <80%)	1.51[1.17;1.96] * * p= .002	1.40[1.08;1.82] * p= .011	1.36[1.04;1.78] * p= .026	.18[.07;.29] * * p= .001	.13[.02;.24] * p= .019	.10[-.00;.21] p= .058
Relative Neighbourhood Deprivation (80 - <90%)	1.85[1.42;2.42] * * * p<.001	1.74[1.33;2.28] * * * p<.001	1.69[1.28;2.24] * * * p<.001	.25[.14;.35] * * * p<.001	.20[.10;.31] * * * p<.001	.18[.08;.29] * * * p<.001
Relative Neighbourhood Deprivation (least deprived decile)	1.76[1.33;2.32] * * * p<.001	1.61[1.21;2.14] * * p= .001	1.54[1.15;2.05] * * p= .004	.21[.10;.32] * * * p<.001	.15[.04;.26] * * p= .006	.13[.02;.23] * p= .024
Caregiver Vocabulary						
Caregiver Vocabulary (Word Activity Test Score)		1.45[1.34;1.58] * * * p<.001	1.32[1.21;1.44] * * * p<.001		.23[.19;.26] * * * p<.001	.17[.14;.20] * * * p<.001

Cohort Member Vocabulary						
Cohort Member Vocabulary (Naming Vocabulary Score)			1.63[1.50;1.77] * * * p<.001			.25[.22;.28] * * * p<.001
R2 (%)				26.46[24.52;28.42]	28.86[26.81;30.92]	32.56[30.48;34.64]

Table S6: Predicting Educational Attainment in Wales (≥grade 4 on core subjects and average grade) (N=2,144)

	Binary Outcome (OR[95% CIs]			Continuous Outcome (B[95% CIs]		
Variable	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Sociodemographic confounders						
Sex (male)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Sex (female)	1.28[1.02;1.62] * p= .037	1.27[1.00;1.60] * p= .047	1.26[.99;1.60] p= .059	.22[.13;.31] * * * p<.001	.21[.12;.30] * * * p<.001	.21[.11;.30] * * * p<.001
Ethnicity (White)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Ethnicity (Minority)	2.29[1.01;5.18] * p= .046	2.41[1.04;5.54] * p= .040	2.55[1.07;6.11] * p= .036	.29[-.01;.59] p= .055	.32[.02;.61] * p= .035	.33[.03;.62] * p= .032
EAL (English only)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE

EAL (another language present)	1.30[.90;1.89] p= .164	1.30[.89;1.90] p= .172	1.46[.99;2.15] p= .054	.05[-.12;.22] p= .538	.05[-.12;.22] p= .534	.12[-.05;.28] p= .166
Parent Education (NVQ1)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Parent Education (None of these/overseas qualifications)	.99[.56;1.76] p= .967	1.02[.57;1.83] p= .955	1.06[.59;1.93] p= .836	.03[-.22;.29] p= .803	.05[-.20;.31] p= .689	.08[-.18;.33] p= .554
Parent Education (NVQ2)	1.32[.83;2.09] p= .247	1.21[.75;1.94] p= .441	1.20[.74;1.94] p= .470	.15[-.05;.35] p= .142	.10[-.10;.30] p= .348	.09[-.11;.29] p= .377
Parent Education (NVQ3)	1.88[1.13;3.13] * p= .016	1.71[1.02;2.89] * p= .043	1.60[.94;2.71] p= .083	.26[.04;.48] * p= .023	.20[-.03;.43] p= .086	.15[-.07;.38] p= .175
Parent Education (NVQ4)	1.98[1.18;3.35] * p= .010	1.64[.95;2.84] p= .075	1.58[.91;2.74] p= .101	.39[.17;.61] * * * p<.001	.27[.05;.49] * p= .015	.24[.03;.45] * p= .027
Parent Education (NVQ5)	2.71[1.23;5.97] * p= .014	2.00[.89;4.50] p= .093	1.91[.84;4.30] p= .121	.71[.41;1.01] * * * p<.001	.52[.21;.82] * * * p<.001	.48[.19;.78] * * p= .002
Income Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Income Quintile 2	1.17[.76;1.81] p= .463	1.16[.75;1.80] p= .496	1.11[.71;1.74] p= .643	.06[-.13;.26] p= .530	.05[-.14;.25] p= .585	.03[-.17;.23] p= .753
Income Quintile 3	1.39[.88;2.19] p= .156	1.35[.86;2.13] p= .187	1.23[.77;1.95] p= .378	.17[-.03;.37] p= .097	.15[-.04;.35] p= .128	.10[-.10;.30] p= .317

Income Quintile 4	1.97[1.21;3.22] * * p= .007	1.88[1.16;3.06] * p= .011	1.70[1.03;2.81] * p= .038	.40[.18;.62] * * * p<.001	.36[.15;.58] * * p= .001	.30[.08;.52] * * p= .008
Income Quintile 5	2.47[1.40;4.36] * * p= .002	2.30[1.31;4.05] * * p= .004	1.98[1.11;3.54] * p= .020	.47[.24;.70] * * * p<.001	.42[.19;.65] * * * p<.001	.33[.11;.56] * * p= .004
Occupational Status (routine)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Occupational Status (unemployed)	.80[.49;1.32] p= .376	.81[.49;1.33] p= .403	.81[.48;1.34] p= .403	-.09[-.30;.11] p= .370	-.08[-.28;.12] p= .426	-.08[-.28;.13] p= .449
Occupational Status (intermediate)	1.52[1.06;2.18] * p= .023	1.50[1.05;2.15] * p= .027	1.46[1.01;2.12] * p= .047	.22[.04;.39] * p= .018	.21[.03;.38] * p= .023	.19[.01;.37] * p= .037
Occupational Status (higher managerial)	1.93[1.34;2.78] * * * p<.001	1.80[1.24;2.61] * * p= .002	1.86[1.27;2.71] * * p= .002	.25[.09;.41] * * p= .003	.19[.03;.35] * p= .018	.21[.05;.36] * p= .011
Wealth Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Wealth Quintile 2	1.14[.71;1.82] p= .579	1.14[.71;1.82] p= .587	1.16[.73;1.85] p= .519	.05[-.14;.23] p= .626	.04[-.14;.23] p= .646	.06[-.13;.24] p= .546
Wealth Quintile 3	1.04[.69;1.58] p= .834	1.03[.68;1.56] p= .887	1.04[.69;1.56] p= .857	.07[-.10;.24] p= .402	.06[-.10;.23] p= .456	.07[-.09;.23] p= .404
Wealth Quintile 4	1.16[.74;1.82] p= .509	1.14[.72;1.80] p= .572	1.10[.69;1.75] p= .681	.16[-.02;.33] p= .079	.14[-.03;.32] p= .112	.12[-.05;.29] p= .163
Wealth Quintile 5	1.65[.96;2.83] p= .070	1.59[.92;2.74] p= .096	1.56[.90;2.72] p= .112	.37[.16;.57] * * * p<.001	.34[.14;.55] * * p= .001	.33[.12;.53] * * p= .002

Relative Neighbourhood Deprivation (most deprived decile)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Relative Neighbourhood Deprivation (10 - <20%)	1.09[.66;1.81] p= .732	1.07[.64;1.80] p= .785	1.02[.61;1.72] p= .934	.03[-.16;.23] p= .734	.02[-.18;.22] p= .815	-.00[-.20;.19] p= .967
Relative Neighbourhood Deprivation (20 - <30%)	1.27[.79;2.06] p= .321	1.25[.77;2.03] p= .370	1.20[.73;1.95] p= .471	.05[-.15;.25] p= .638	.03[-.17;.24] p= .746	.01[-.19;.21] p= .936
Relative Neighbourhood Deprivation (30 - <40%)	1.11[.69;1.81] p= .663	1.10[.67;1.80] p= .707	1.03[.62;1.69] p= .919	.02[-.20;.24] p= .862	.01[-.20;.22] p= .920	-.02[-.24;.19] p= .816
Relative Neighbourhood Deprivation (40 - <50%)	1.56[.85;2.87] p= .151	1.53[.83;2.84] p= .172	1.46[.79;2.71] p= .229	.10[-.15;.34] p= .433	.08[-.16;.33] p= .503	.05[-.19;.29] p= .681
Relative Neighbourhood Deprivation (50 - <60%)	1.21[.70;2.09] p= .489	1.18[.68;2.05] p= .546	1.07[.62;1.86] p= .803	.07[-.16;.30] p= .541	.06[-.17;.28] p= .629	.00[-.22;.22] p= .991

Relative Neighbourhood Deprivation (60 - <70%)	1.16[.64;2.11] p= .632	1.07[.59;1.94] p= .824	.98[.53;1.80] p= .945	.15[-.09;.39] p= .211	.10[-.14;.33] p= .410	.05[-.18;.28] p= .680
Relative Neighbourhood Deprivation (70 - <80%)	1.40[.78;2.52] p= .252	1.35[.75;2.42] p= .315	1.23[.67;2.24] p= .499	.13[-.11;.37] p= .287	.10[-.14;.34] p= .404	.06[-.18;.29] p= .630
Relative Neighbourhood Deprivation (80 - <90%)	1.39[.79;2.44] p= .246	1.34[.76;2.35] p= .305	1.23[.70;2.18] p= .467	.11[-.11;.33] p= .327	.08[-.14;.30] p= .460	.04[-.18;.26] p= .721
Relative Neighbourhood Deprivation (least deprived decile)	1.93[1.13;3.29] * p= .017	1.83[1.07;3.15] * p= .028	1.68[.97;2.91] p= .063	.23[.02;.43] * p= .033	.19[-.02;.40] p= .072	.15[-.06;.36] p= .156
Caregiver Vocabulary					.19[.12;.26] * * * p<.001	.15[.07;.22] * * * p<.001
Caregiver Vocabulary (Word Activity Test Score)		1.35[1.10;1.65] * * p= .005	1.26[1.03;1.54] * p= .026			
Cohort Member Vocabulary						

Cohort Member Vocabulary (Naming Vocabulary Score)			1.55[1.30;1.85] * * * p<.001			.23[.16;.29] * * * p<.001
R2 (%)				26.91[22.73;31.18]	28.53[24.3;32.82]	31.51[27.32;35.73]

Table S7: Predicting Educational Attainment in Scotland (≥grade 4 on core subjects and average grade) (N=1,821)

	Binary Outcome (OR [95% CIs]			Continuous Outcome (β [95% CIs]		
Variable	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Sociodemographic confounders						
Sex (male)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Sex (female)	1.66[1.17;2.35] * * p= .005	1.71[1.20;2.45] * * p= .004	1.70[1.18;2.46] * * p= .005	.64[.41;.86] * * * p<.001	.65[.42;.88] * * * p<.001	.64[.41;.87] * * * p<.001
Ethnicity (White)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Ethnicity (Minority)	1.91[.78;4.70] p= .156	2.18[.88;5.40] p= .092	2.04[.81;5.12] p= .127	.23[-.38;.85] p= .451	.31[-.31;.92] p= .323	.27[-.34;.88] p= .382
EAL (English only)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
EAL (another language present)	1.25[.54;2.93] p= .601	1.49[.61;3.62] p= .383	1.67[.67;4.16] p= .270	.07[-.54;.68] p= .816	.18[-.43;.79] p= .561	.24[-.37;.85] p= .441

Parent Education (NVQ1)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Parent Education (None of these/overseas qualifications)	.88[.27;2.90] p= .830	.93[.28;3.03] p= .896	.96[.29;3.18] p= .950	-.07[-.70;.57] p= .833	-.03[-.66;.59] p= .912	-.01[-.63;.62] p= .987
Parent Education (NVQ2)	1.02[.36;2.86] p= .971	.98[.35;2.73] p= .969	.97[.34;2.75] p= .954	-.06[-.60;.48] p= .834	-.09[-.63;.46] p= .756	-.09[-.63;.45] p= .740
Parent Education (NVQ3)	1.48[.50;4.38] p= .474	1.30[.44;3.88] p= .627	1.31[.43;3.96] p= .628	.10[-.49;.70] p= .730	.02[-.58;.62] p= .936	.02[-.57;.62] p= .938
Parent Education (NVQ4)	2.27[.77;6.68] p= .135	1.79[.60;5.33] p= .290	1.79[.59;5.43] p= .296	.43[-.15;1.02] p= .143	.28[-.32;.88] p= .357	.27[-.33;.87] p= .364
Parent Education (NVQ5)	3.11[1.01;9.64] * p= .049	2.20[.70;6.99] p= .176	2.22[.69;7.16] p= .180	.70[.06;1.35] * p= .033	.48[-.19;1.15] p= .157	.47[-.19;1.13] p= .163
Income Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Income Quintile 2	1.54[.95;2.49] p= .078	1.53[.94;2.49] p= .089	1.50[.92;2.46] p= .104	.18[-.07;.43] p= .155	.18[-.07;.43] p= .167	.16[-.09;.42] p= .197
Income Quintile 3	1.74[.98;3.10] p= .057	1.71[.95;3.06] p= .073	1.57[.87;2.83] p= .130	.33[.01;.66] * p= .043	.32[-.00;.64] p= .052	.27[-.05;.59] p= .102
Income Quintile 4	1.94[1.11;3.41] * p= .021	1.86[1.05;3.29] * p= .033	1.72[.97;3.04] p= .064	.38[.06;.70] * p= .019	.35[.03;.67] * p= .030	.30[-.01;.62] p= .058
Income Quintile 5	2.03[1.10;3.72] * p= .023	1.91[1.04;3.53] * p= .038	1.74[.94;3.23] p= .077	.45[.07;.83] * p= .020	.41[.03;.78] * p= .033	.35[-.02;.73] p= .062

Occupational Status (routine)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Occupational Status (unemployed)	1.15[.66;2.02] p= .615	1.13[.65;1.99] p= .661	1.20[.68;2.10] p= .525	.06[-.25;.38] p= .693	.06[-.26;.37] p= .723	.08[-.23;.39] p= .599
Occupational Status (intermediate)	1.31[.84;2.06] p= .232	1.25[.79;1.96] p= .340	1.30[.82;2.06] p= .262	.09[-.20;.39] p= .527	.06[-.24;.35] p= .690	.08[-.21;.37] p= .582
Occupational Status (higher managerial)	1.62[1.06;2.48] * p= .027	1.39[.91;2.12] p= .123	1.37[.89;2.11] p= .147	.25[-.06;.56] p= .114	.15[-.15;.46] p= .327	.14[-.16;.44] p= .362
Wealth Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Wealth Quintile 2	1.20[.74;1.95] p= .445	1.20[.74;1.97] p= .451	1.21[.74;1.98] p= .450	.08[-.17;.33] p= .516	.08[-.17;.33] p= .521	.08[-.17;.33] p= .518
Wealth Quintile 3	1.45[.99;2.14] p= .056	1.47[1.00;2.17] p= .053	1.48[.99;2.20] p= .054	.19[-.08;.45] p= .161	.19[-.07;.46] p= .156	.19[-.07;.46] p= .154
Wealth Quintile 4	1.39[.87;2.20] p= .165	1.37[.85;2.20] p= .193	1.32[.81;2.14] p= .256	.26[-.04;.57] p= .093	.25[-.06;.56] p= .108	.23[-.08;.54] p= .140
Wealth Quintile 5	1.92[1.18;3.15] * * p= .010	1.83[1.11;3.04] * p= .019	1.76[1.06;2.91] * p= .029	.47[.14;.80] * * p= .006	.44[.10;.78] * p= .012	.41[.07;.75] * p= .018
Relative Neighbourhood Deprivation (most deprived decile)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE

Relative Neighbourhood Deprivation (10 - <20%)	.89[.47;1.65] p= .699	.90[.48;1.69] p= .753	.89[.47;1.70] p= .729	-.01[-.39;.36] p= .945	.00[-.37;.37] p= .997	.01[-.37;.38] p= .973
Relative Neighbourhood Deprivation (20 - <30%)	1.11[.60;2.06] p= .741	1.08[.57;2.05] p= .803	1.05[.55;2.02] p= .872	.07[-.26;.41] p= .660	.06[-.27;.39] p= .726	.05[-.28;.38] p= .769
Relative Neighbourhood Deprivation (30 - <40%)	1.15[.67;1.98] p= .617	1.07[.62;1.86] p= .809	1.02[.58;1.78] p= .955	.14[-.26;.54] p= .484	.09[-.30;.49] p= .636	.07[-.32;.46] p= .726
Relative Neighbourhood Deprivation (40 - <50%)	1.45[.76;2.80] p= .258	1.38[.71;2.69] p= .336	1.29[.65;2.57] p= .457	.28[-.08;.64] p= .124	.24[-.11;.60] p= .180	.21[-.14;.57] p= .238
Relative Neighbourhood Deprivation (50 - <60%)	1.55[.92;2.63] p= .100	1.40[.81;2.39] p= .224	1.29[.74;2.25] p= .364	.12[-.23;.47] p= .488	.05[-.30;.41] p= .767	.02[-.33;.37] p= .929
Relative Neighbourhood Deprivation (60 - <70%)	1.72[.93;3.17] p= .082	1.56[.83;2.95] p= .165	1.40[.73;2.70] p= .307	.37[-.04;.78] p= .080	.30[-.11;.72] p= .149	.25[-.16;.66] p= .235
Relative Neighbourhood Deprivation (70 - <80%)	1.10[.61;2.00] p= .751	.98[.53;1.80] p= .945	.91[.49;1.70] p= .770	.04[-.37;.45] p= .835	-.03[-.44;.38] p= .888	-.06[-.47;.34] p= .765

Relative Neighbourhood Deprivation (80 - <90%)	2.12[1.21;3.73] * * p= .009	1.99[1.12;3.53] * p= .020	1.98[1.10;3.55] * p= .023	.40[.04;.77] * p= .032	.35[-.02;.73] p= .063	.35[-.02;.72] p= .067
Relative Neighbourhood Deprivation (least deprived decile)	1.84[1.01;3.37] * p= .047	1.68[.91;3.10] p= .098	1.56[.83;2.91] p= .163	.44[.04;.83] * p= .033	.37[-.03;.77] p= .069	.33[-.06;.73] p= .095
Caregiver Vocabulary						
Caregiver Vocabulary (Word Activity Test Score)		1.47[1.21;1.79] * * * p<.001	1.38[1.12;1.68] * * p= .002		.24[.11;.36] * * * p<.001	.20[.07;.33] * * p= .003
Cohort Member Vocabulary						
Cohort Member Vocabulary (Naming Vocabulary Score)			1.46[1.22;1.75] * * * p<.001			.19[.09;.29] * * * p<.001
R2 (%)				22.35[17.87;27.02]	23.73[18.89;28.77]	24.97[20.02;30.09]

Table S8: Predicting Educational Attainment in Northern Ireland (≥grade 4 on core subjects and average grade) (N=1,535)

	Binary Outcome (OR [95% CIs])	Continuous Outcome (β [95% CIs])

Variable	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Sociodemographic confounders						
Sex (male)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Sex (female)	1.30[.97;1.73] p= .079	1.30[.97;1.74] p= .076	1.30[.96;1.75] p= .084	.19[.06;.31] * * p= .003	.19[.07;.31] * * p= .002	.19[.07;.31] * * p= .003
Ethnicity (White)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Ethnicity (Minority)	.50[.13;1.93] p= .314	.50[.13;1.96] p= .317	.55[.13;2.27] p= .403	-.21[-.78;.36] p= .462	-.21[-.77;.36] p= .469	-.16[-.71;.40] p= .580
EAL (English only)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
EAL (another language present)	.67[.16;2.87] p= .591	.79[.18;3.50] p= .752	.89[.20;4.03] p= .878	-.06[-.67;.54] p= .834	-.01[-.60;.59] p= .986	.05[-.53;.63] p= .868
Parent Education (NVQ1)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Parent Education (None of these/overseas qualifications)	1.04[.53;2.03] p= .917	1.09[.55;2.15] p= .804	1.07[.53;2.14] p= .854	.02[-.29;.33] p= .890	.05[-.26;.35] p= .760	.03[-.27;.34] p= .819
Parent Education (NVQ2)	1.52[.79;2.94] p= .209	1.36[.71;2.62] p= .355	1.30[.67;2.55] p= .434	.16[-.14;.46] p= .293	.10[-.20;.40] p= .499	.08[-.22;.37] p= .608

Parent Education (NVQ3)	1.80[.87;3.71] p= .110	1.54[.75;3.16] p= .239	1.52[.73;3.18] p= .256	.26[-.06;.58] p= .105	.17[-.13;.48] p= .266	.17[-.14;.47] p= .282
Parent Education (NVQ4)	2.31[1.16;4.61] * p= .018	1.71[.85;3.41] p= .129	1.60[.79;3.25] p= .189	.42[.10;.74] * p= .011	.26[-.06;.58] p= .108	.23[-.09;.54] p= .157
Parent Education (NVQ5)	2.64[1.15;6.03] * p= .022	1.65[.71;3.83] p= .241	1.56[.67;3.66] p= .302	.56[.19;.93] * * p= .003	.32[-.06;.70] p= .096	.31[-.07;.68] p= .110
Income Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Income Quintile 2	1.27[.85;1.90] p= .236	1.22[.81;1.83] p= .337	1.16[.77;1.75] p= .488	.13[-.07;.32] p= .205	.10[-.10;.30] p= .316	.07[-.13;.27] p= .481
Income Quintile 3	1.66[.99;2.78] p= .055	1.57[.93;2.65] p= .091	1.44[.85;2.45] p= .173	.19[-.03;.41] p= .085	.16[-.06;.38] p= .152	.11[-.10;.33] p= .300
Income Quintile 4	2.65[1.51;4.64] * * * p<.001	2.45[1.40;4.31] * * p= .002	2.27[1.29;4.01] * * p= .005	.38[.13;.63] * * p= .003	.33[.09;.58] * * p= .008	.29[.05;.53] * p= .019
Income Quintile 5	2.41[1.09;5.33] * p= .030	2.10[.95;4.63] p= .067	1.98[.89;4.38] p= .091	.42[.14;.70] * * p= .003	.34[.07;.62] * p= .013	.30[.03;.56] * p= .031
Occupational Status (routine)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Occupational Status (unemployed)	.73[.46;1.15] p= .169	.70[.45;1.11] p= .133	.70[.44;1.11] p= .124	-.14[-.36;.07] p= .186	-.16[-.37;.05] p= .143	-.16[-.36;.05] p= .134
Occupational Status (intermediate)	1.12[.75;1.68] p= .573	1.10[.74;1.65] p= .637	1.11[.73;1.67] p= .619	.07[-.12;.26] p= .465	.06[-.13;.24] p= .553	.06[-.13;.24] p= .530

Occupational Status (higher managerial)	1.62[.95;2.78] p= .076	1.46[.85;2.50] p= .163	1.47[.85;2.53] p= .167	.36[.12;.61] * * p= .004	.31[.07;.54] * p= .013	.30[.06;.54] * p= .014
Wealth Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Wealth Quintile 2	.96[.57;1.60] p= .866	.97[.57;1.65] p= .913	.96[.56;1.63] p= .879	.00[-.18;.19] p= .984	.01[-.18;.20] p= .933	.00[-.18;.19] p= .993
Wealth Quintile 3	1.00[.62;1.62] p= .998	1.01[.62;1.66] p= .961	1.03[.62;1.68] p= .920	.03[-.15;.21] p= .724	.04[-.14;.21] p= .673	.04[-.13;.21] p= .612
Wealth Quintile 4	1.09[.67;1.78] p= .710	1.11[.68;1.82] p= .660	1.10[.67;1.82] p= .697	.07[-.13;.27] p= .510	.07[-.13;.27] p= .486	.06[-.13;.26] p= .517
Wealth Quintile 5	1.32[.72;2.40] p= .363	1.30[.70;2.40] p= .400	1.28[.68;2.41] p= .435	.21[-.01;.43] p= .063	.19[-.03;.41] p= .084	.19[-.03;.40] p= .083
Relative Neighbourhood Deprivation (most deprived decile)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Relative Neighbourhood Deprivation (10 - <20%)	1.06[.65;1.73] p= .820	1.02[.63;1.67] p= .925	1.07[.65;1.76] p= .792	-.03[-.26;.21] p= .829	-.04[-.27;.19] p= .724	-.02[-.25;.21] p= .875
Relative Neighbourhood Deprivation (20 - <30%)	.83[.48;1.44] p= .506	.83[.47;1.44] p= .495	.78[.44;1.38] p= .388	-.10[-.37;.16] p= .426	-.11[-.37;.15] p= .408	-.14[-.39;.12] p= .299

Relative Neighbourhood Deprivation (30 - <40%)	1.08[.55;2.13] p= .825	1.06[.54;2.10] p= .866	1.00[.49;2.03] p= .995	-.04[-.33;.24] p= .775	-.05[-.34;.23] p= .710	-.08[-.36;.20] p= .571
Relative Neighbourhood Deprivation (40 - <50%)	1.11[.59;2.10] p= .745	1.08[.57;2.05] p= .819	1.03[.54;1.99] p= .921	.06[-.21;.33] p= .661	.04[-.22;.31] p= .753	.02[-.24;.28] p= .881
Relative Neighbourhood Deprivation (50 - <60%)	1.46[.83;2.56] p= .184	1.35[.76;2.41] p= .300	1.31[.73;2.35] p= .363	.10[-.17;.37] p= .455	.06[-.21;.34] p= .657	.04[-.24;.31] p= .796
Relative Neighbourhood Deprivation (60 - <70%)	.83[.37;1.82] p= .632	.77[.35;1.72] p= .517	.77[.34;1.74] p= .521	-.10[-.44;.24] p= .567	-.14[-.48;.20] p= .424	-.13[-.47;.20] p= .429
Relative Neighbourhood Deprivation (70 - <80%)	1.52[.82;2.80] p= .179	1.41[.76;2.60] p= .276	1.44[.77;2.70] p= .251	.16[-.12;.43] p= .259	.12[-.16;.39] p= .398	.13[-.14;.40] p= .356
Relative Neighbourhood Deprivation (80 - <90%)	1.13[.62;2.04] p= .689	1.04[.57;1.90] p= .909	1.05[.57;1.92] p= .883	.04[-.25;.32] p= .798	-.01[-.30;.28] p= .939	-.01[-.29;.27] p= .939

Relative Neighbourhood Deprivation (least deprived decile)	1.48[.70;3.14] p= .305	1.31[.60;2.87] p= .489	1.24[.56;2.74] p= .597	.14[-.16;.43] p= .362	.07[-.22;.37] p= .629	.04[-.25;.33] p= .791
Caregiver Vocabulary		1.51[1.24;1.85] * * * p<.001	1.43[1.17;1.75] * * * p<.001			
Caregiver Vocabulary (Word Activity Test Score)					.21[.12;.30] * * * p<.001	.17[.09;.26] * * * p<.001
Cohort Member Vocabulary			1.45[1.24;1.69] * * * p<.001			
Cohort Member Vocabulary (Naming Vocabulary Score)						.18[.13;.24] * * * p<.001
R2 (%)				25.05[20.48;29.76]	27.03[22.36;31.8]	29.67[24.89;34.5]

RQ3. Is any relation between age 5 vocabulary and attainment moderated by SEC?

England

When controlling for sex, ethnicity, EAL status, country and caregiver vocabulary skill, a significant positive relation between a composite measure of SEC and the likelihood of achieving a grade 4 or above on the core subjects at the end of secondary school was observed, such that with every SD unit increase in SEC, the odds of passing this benchmark increases (OR = 1.98, 95% CIs = 1.83;2.15]). Similarly, a significant positive relation between vocabulary skill and achieving a grade 4 or above on the core subjects was observed, such that for every SD unit increase in vocabulary, the odds of passing this benchmark

increases (OR = 1.66, 95% CIs = [1.53; 1.8]). Further, the relationship between age 5 vocabulary and achieving a grade 4 or above on the core subjects at the end of secondary school is moderated by one's SEC, with an additional increase in the odds of passing the benchmark threshold with each SD unit increase of vocabulary, for each additional SD unit increase in SEC (OR = 1.1, 95% CIs = [1.03; 1.18]).

To determine the significance of the interaction term, a model with the SEC composite*age 5 vocabulary interaction term was compared to a model without this interaction term. Compared to a model controlling for sex, ethnicity, EAL status, country, and caregiver vocabulary, a model which also included an SEC composite*age 5 vocabulary score interaction term significantly increased the model fit (Dm(1, 554.05) = 9.02, p=.003), indicating that the relationship between age 5 vocabulary and the likelihood of achieving ≥ grade 4 on the core subjects is significantly moderated by early childhood SEC in England (see Figure S2).

Wales

When controlling for sex, ethnicity, EAL status, country and caregiver vocabulary skill, a significant positive relation between a composite measure of SEC and the likelihood of achieving a grade 4 or above on the core subjects at the end of secondary school was observed, such that with every SD unit increase in SEC, the odds of passing this benchmark increases (OR = 2.16, 95% CIs = 1.84;2.54]). Similarly, a significant positive relation between vocabulary skill and achieving a grade 4 or above on the core subjects was observed, such that for every SD unit increase in vocabulary, the odds of passing this benchmark increases (OR = 1.55, 95% CIs = [1.3; 1.85]). However, in Wales, the relationship between age 5 vocabulary and achieving a grade 4 or above on the core subjects at the end of secondary school is not moderated by one's SEC (OR = 1.11, 95% CIs = [0.92; 1.33]).

To determine the significance of the interaction term, a model with the SEC composite*age 5 vocabulary interaction term was compared to a model without this interaction term. Compared to a model controlling for sex, ethnicity, EAL status, country, and caregiver vocabulary, a model which also included an SEC composite*age 5 vocabulary score interaction term did not significantly increase the model fit (Dm(1, 73.8) = 1.14, p=.289), indicating that the relationship between age 5 vocabulary and the likelihood of achieving ≥ grade 4 on the core subjects is not moderated by early childhood SEC in Wales (see Figure S2).

Scotland

When controlling for sex, ethnicity, EAL status, country and caregiver vocabulary skill, a significant positive relation between a composite measure of SEC and the likelihood of achieving a grade 4 or above on the core subjects at the end of secondary school was observed, such that with every SD unit increase in SEC, the odds of passing this benchmark increases (OR = 1.93, 95% CIs = 1.61;2.31]). Similarly, a significant positive relation between vocabulary skill and achieving a grade 4 or above on the core subjects was observed, such that for every SD unit increase in vocabulary, the odds of passing this benchmark increases (OR = 1.44, 95% CIs = [1.21; 1.72]). However, in Scotland, the relationship between age 5 vocabulary and achieving a grade 4 or above on the core subjects at the end of secondary school is not moderated by one's SEC (OR = 1.03, 95% CIs = [0.85; 1.25]).

To determine the significance of the interaction term, a model with the SEC composite*age 5 vocabulary interaction term was compared to a model without this interaction term. Compared to a model controlling for sex, ethnicity, EAL status, country, and caregiver vocabulary, a model which also included an SEC composite*age 5 vocabulary score interaction term did not significantly increase the model fit (Dm(1, 63.72) = 0.1,

p=.748), indicating that the relationship between age 5 vocabulary and the likelihood of achieving ≥ grade 4 on the core subjects is not moderated by early childhood SEC in Scotland (see Figure S2).

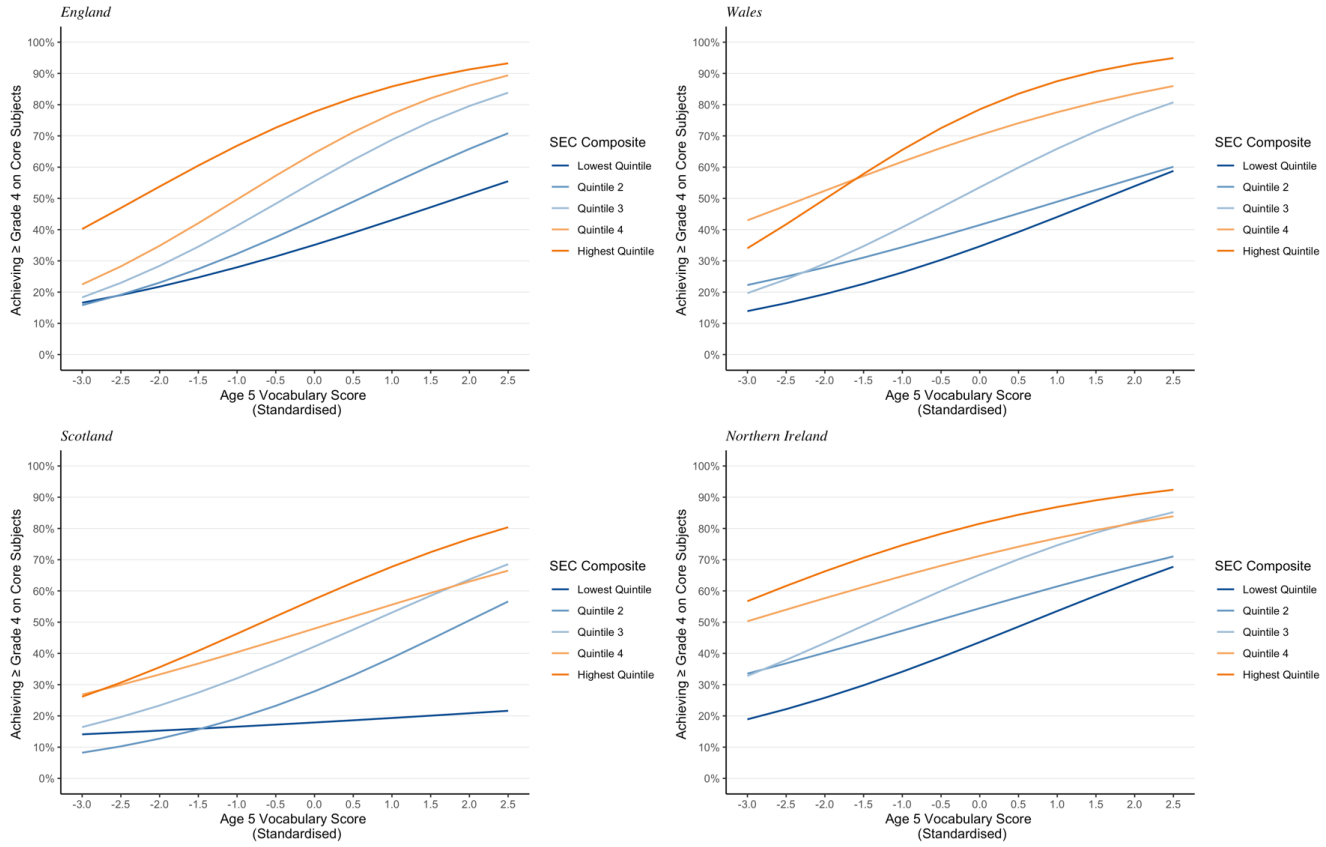
Northern Ireland

When controlling for sex, ethnicity, EAL status, country and caregiver vocabulary skill, a significant positive relation between a composite measure of SEC and the likelihood of achieving a grade 4 or above on the core subjects at the end of secondary school was observed, such that with every SD unit increase in SEC, the odds of passing this benchmark increases (OR = 1.94, 95% CIs = 1.63;2.3]). Similarly, a significant positive relation between vocabulary skill and achieving a grade 4 or above on the core subjects was observed, such that for every SD unit increase in vocabulary, the odds of passing this benchmark increases (OR = 1.44, 95% CIs = [1.23; 1.68]). However, in Northern Ireland, the relationship between age 5 vocabulary and achieving a grade 4 or above on the core subjects at the end of secondary school is not moderated by one's SEC (OR = 0.99, 95% CIs = [0.83; 1.19]).

To determine the significance of the interaction term, a model with the SEC composite*age 5 vocabulary interaction term was compared to a model without this interaction term. Compared to a model controlling for sex, ethnicity, EAL status, country, and caregiver vocabulary, a model which also included an SEC composite*age 5 vocabulary score interaction term did not significantly increase the model fit (Dm(1, 78.02) = 0, p=.947), indicating that the relationship between age 5 vocabulary and the likelihood of achieving ≥ grade 4 on the core subjects is not moderated by early childhood SEC in Northern Ireland (see Figure S3).

As can be seen from Figure S3, SEC moderates the relation between age 5 vocabulary and educational attainment in England only, therefore data from England appear to be driving the findings of our main moderation analysis. However, effect sizes are similar, so this pattern of results may be due to insufficient power in analyses of the three devolved nations.

Figure S3: Predicted probabilities of achieving the benchmark threshold for vocabulary, moderated by SEC in each country



**Predicted probabilities when categorical potential confounders (sex, ethnicity and EAL status set to reference levels and mean caregiver vocabulary score.*

Section 7: Average English grade, average maths grade and average science grade considered as separate outcomes (exploratory analysis)

Rationale

We looked at the effects of age 5 vocabulary on attainment in English, Maths and Science separately at the end of secondary school, rather than as a combined measure, to see if language affects these subjects differently, or effects one subject more than others.

Method

Details of the predictor, control variables and moderation variables can be found in Chapter 5. The same variables were used in this analysis. The outcome variables deviate from the main analysis; these are detailed below.

Analysis plan.

Full details of the analysis plan can be found in Chapter 5: the same analyses were repeated here, with average grade in each subject as continuous outcome variables considered in separate models. The moderation analyses (research question 3) were not run here, as this analysis did not include the continuous outcome variable.

Results.

English Average Grade

In an unadjusted model (i.e., not including any potential confounding variables), a significant positive relation was observed, such that higher vocabulary scores were associated with higher levels of English achievement (β = .31, 95% CIs = [.28;.33]). To test whether this relation held when potential confounding factors were included, we first tested whether two sets of potential confounding variables level of achievement on the core subjects (see Table S9). We subsequently assessed whether vocabulary explained variance over and above these variables. Compared to a model with no predictors, a model with sociodemographic confounding variables significantly improved the model fit (Dm(36, 3148.96)=73.62, p<.001). Further, compared to a model containing only sociodemographic predictors, a model that also included caregiver vocabulary significantly improved the model fit (Dm(1, 52.04) = 171.99, p<.001), indicating that caregiver vocabulary predicted variance in achieving the benchmark above sociodemographic variables. Finally, adding age 5 vocabulary scores to a model containing sociodemographic and caregiver vocabulary factors significantly improved the model fit (Dm(1, 52.09) = 183.42, p<.001), with higher vocabulary scores significantly predicting higher levels of maths achievement, above and beyond sociodemographic and caregiver vocabulary factors (β = .18, 95% CIs = [.16;.21]; see table S9).

Maths Average Grade

In an unadjusted model (i.e., not including any potential confounding variables), a significant positive relation was observed, such that higher vocabulary scores were associated with higher levels of maths achievement (β = .31, 95% CIs = [.28;.33]). To test whether this relation held when potential confounding factors were included, we first tested whether two sets of potential confounding variables level of achievement on the core subjects (see Table S9). We subsequently assessed whether vocabulary explained variance over and above these variables. Compared to a model with no predictors, a model with sociodemographic confounding variables significantly improved the model fit (Dm(36, 3315.73)=60.01,

p<.001). Further, compared to a model containing only sociodemographic predictors, a model that also included caregiver vocabulary significantly improved the model fit (Dm(1, 81.02) = 179.01, p<.001), indicating that caregiver vocabulary predicted variance in achieving the benchmark above sociodemographic variables. Finally, adding age 5 vocabulary scores to a model containing sociodemographic and caregiver vocabulary factors significantly improved the model fit (Dm(1, 67.58) = 233.5, p<.001), with higher vocabulary scores significantly predicting higher levels of maths achievement, above and beyond sociodemographic and caregiver vocabulary factors (β = .19, 95% CIs = [.16;.21]; see table S9).

Science Average Grade

In an unadjusted model (i.e., not including any potential confounding variables), a significant positive relation was observed, such that higher vocabulary scores were associated with higher levels of science achievement (β = .32, 95% CIs = [.29;.34]). To test whether this relation held when potential confounding factors were included, we first tested whether two sets of potential confounding variables level of achievement on the core subjects (see Table S9). We subsequently assessed whether vocabulary explained variance over and above these variables. Compared to a model with no predictors, a model with sociodemographic confounding variables significantly improved the model fit (Dm(36, 3042.68)=61.71, *p*<.001). Further, compared to a model containing only sociodemographic predictors, a model that also included caregiver vocabulary significantly improved the model fit (Dm(1, 50.13) = 134.77, p<.001), indicating that caregiver vocabulary predicted variance in achieving the benchmark above sociodemographic variables. Finally, adding age 5 vocabulary scores to a model containing sociodemographic and caregiver vocabulary factors significantly improved the model fit (Dm(1, 66.52) = 262.43, p<.001), with higher vocabulary scores significantly predicting higher levels of science achievement, above and beyond sociodemographic and caregiver vocabulary factors (β = .2, 95% CIs = [.17;.22]; see table S9).

Overall, age 5 vocabulary had a similar effect on achievement in English, Maths and Science subjects, highlighting the importance of a strong vocabulary for success across the curriculum, and not just in English achievement.

Table S9: Predicting Educational Attainment in English, Mathematics and Science (N=15,576)

	English (β [95% CIs])			Mathematics (β [95% CIs])			Science (β [95% CIs])		
Variable	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Sociodemographic confounders									
Sex (male)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE

Sex (female)	.38[.33;.42] * * * p<.001	.38[.33;.42] * * * p<.001	.37[.32;.41] * * * p<.001	-.01[-.05;.03] p= .618	-.01[-.05;.03] p= .552	-.02[-.06;.02] p= .257	.08[.05;.11] * * * p<.001	.08[.04;.11] * * * p<.001	.07[.03;.10] * * * p<.001
Ethnicity (White)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Ethnicity (mixed)	.08[-.03;.19] p= .139	.09[-.02;.19] p= .114	.08[-.02;.19] p= .117	.05[-.06;.15] p= .388	.05[-.05;.15] p= .348	.05[-.06;.15] p= .359	.05[-.06;.15] p= .366	.05[-.05;.16] p= .324	.05[-.05;.15] p= .337
Ethnicity (Indian)	.12[-.02;.27] p= .100	.21[.06;.36] * * p= .005	.21[.06;.35] * * p= .005	.17[.02;.32] * p= .028	.25[.10;.39] * * * p<.001	.25[.10;.39] * * p= .001	.10[-.06;.26] p= .219	.18[.02;.34] * p= .025	.18[.02;.33] * p= .026
Ethnicity (Pakistani & Bangladeshi)	.17[.05;.29] * * p= .006	.28[.15;.40] * * * p<.001	.35[.22;.47] * * * p<.001	.02[-.10;.14] p= .692	.12[-.00;.24] p= .054	.19[.07;.31] * * p= .002	.11[-.03;.24] p= .112	.20[.07;.33] * * p= .003	.28[.15;.41] * * * p<.001
Ethnicity (Black/ Black British)	.18[.06;.30] * * p= .005	.26[.14;.39] * * * p<.001	.31[.19;.44] * * * p<.001	.04[-.07;.15] p= .463	.11[.00;.23] * p= .042	.16[.05;.28] * * p= .004	.08[-.03;.20] p= .159	.16[.04;.28] * * p= .008	.21[.10;.33] * * * p<.001
Ethnicity (other incl. Chinese)	.38[.20;.56] * * * p<.001	.47[.30;.64] * * * p<.001	.52[.35;.69] * * * p<.001	.32[.14;.51] * * * p<.001	.40[.22;.59] * * * p<.001	.46[.27;.64] * * * p<.001	.31[.12;.49] * * p= .001	.39[.20;.57] * * * p<.001	.45[.26;.63] * * * p<.001
EAL (English only)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
EAL (English and another language)	.20[.10;.29] * * * p<.001	.27[.17;.36] * * * p<.001	.33[.23;.42] * * * p<.001	.23[.14;.32] * * * p<.001	.29[.20;.39] * * * p<.001	.36[.26;.45] * * * p<.001	.17[.07;.28] * * p= .002	.24[.13;.35] * * * p<.001	.30[.19;.41] * * * p<.001

EAL (only another language)	.19[.06;.32] * * p= .004	.32[.19;.45] * * * p<.001	.42[.29;.55] * * * p<.001	.25[.10;.39] * * p= .001	.36[.20;.51] * * * p<.001	.47[.32;.62] * * * p<.001	.24[.08;.40] * * p= .004	.35[.19;.52] * * * p<.001	.47[.31;.63] * * * p<.001
Country (England)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Country (Wales)	-.19[-.27;-.11] * * * p<.001	-.18[-.26;-.09] * * * p<.001	-.16[-.24;-.08] * * * p<.001	-.18[-.26;-.10] * * * p<.001	-.17[-.25;-.08] * * * p<.001	-.15[-.24;-.07] * * * p<.001	-.04[-.11;.04] p= .347	-.02[-.10;.05] p= .545	-.01[-.09;.07] p= .794
Country (Scotland)	-.08[-.14;-.01] * p= .029	-.08[-.15;-.01] * p= .023	-.09[-.15;-.02] * p= .015	-.09[-.16;-.01] * p= .018	-.09[-.16;-.02] * p= .012	-.09[-.16;-.03] * * p= .008	-.04[-.12;.04] p= .322	-.04[-.12;.03] p= .269	-.05[-.13;.03] p= .215
Country (Northern Ireland)	.17[.08;.25] * * * p<.001	.18[.10;.27] * * * p<.001	.17[.09;.25] * * * p<.001	.18[.09;.27] * * * p<.001	.19[.10;.28] * * * p<.001	.18[.09;.27] * * * p<.001	.51[.42;.60] * * * p<.001	.52[.44;.61] * * * p<.001	.51[.42;.60] * * * p<.001
Parent Education (NVQ1)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Parent Education (None of these/overseas qualifications)	.11[.00;.23] * p= .047	.14[.03;.25] * p= .016	.14[.03;.25] * p= .012	.04[-.06;.15] p= .424	.06[-.05;.17] p= .251	.07[-.04;.18] p= .198	.00[-.12;.13] p= .984	.02[-.10;.15] p= .731	.03[-.10;.15] p= .643
Parent Education (NVQ2)	.18[.07;.29] * * p= .001	.14[.04;.25] * * p= .010	.13[.02;.24] * p= .020	.14[.03;.24] * p= .010	.10[-.00;.21] p= .059	.09[-.02;.19] p= .101	.08[-.03;.18] p= .149	.04[-.06;.15] p= .430	.03[-.08;.13] p= .626
Parent Education (NVQ3)	.25[.14;.36] * * * p<.001	.18[.07;.29] * * p= .001	.16[.05;.27] * * p= .005	.21[.10;.33] * * * p<.001	.15[.04;.26] * * p= .008	.13[.02;.24] * p= .019	.15[.03;.27] * p= .012	.09[-.03;.21] p= .143	.06[-.05;.18] p= .279

Parent Education (NVQ4)	.45[.34;.57] * * * p<.001	.33[.22;.44] * * * p<.001	.29[.18;.40] * * * p<.001	.41[.30;.52] * * * p<.001	.30[.19;.41] * * * p<.001	.26[.15;.37] * * * p<.001	.39[.28;.49] * * * p<.001	.28[.16;.39] * * * p<.001	.23[.12;.35] * * * p<.001
Parent Education (NVQ5)	.72[.60;.84] * * * p<.001	.51[.38;.64] * * * p<.001	.46[.33;.59] * * * p<.001	.68[.55;.82] * * * p<.001	.50[.36;.64] * * * p<.001	.45[.31;.58] * * * p<.001	.77[.64;.91] * * * p<.001	.58[.44;.73] * * * p<.001	.53[.38;.67] * * * p<.001
Income Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Income Quintile 2	.01[-.06;.08] p= .747	-.00[-.07;.07] p= .909	-.00[-.07;.07] p= .970	.02[-.06;.09] p= .680	.00[-.07;.07] p= .966	.00[-.07;.08] p= .904	.01[-.07;.09] p= .787	-.00[-.08;.08] p= .935	-.00[-.08;.08] p= .995
Income Quintile 3	.13[.05;.21] * * p= .002	.11[.02;.19] * p= .011	.09[.01;.17] * p= .032	.10[.03;.18] * * p= .009	.08[.01;.16] * p= .031	.06[-.01;.14] p= .090	.09[.01;.17] * p= .026	.07[-.01;.15] p= .079	.05[-.03;.13] p= .195
Income Quintile 4	.19[.11;.28] * * * p<.001	.16[.07;.24] * * * p<.001	.14[.05;.22] * * p= .001	.17[.09;.25] * * * p<.001	.14[.06;.22] * * p= .001	.12[.04;.20] * * p= .005	.14[.05;.22] * * p= .002	.11[.02;.19] * p= .014	.09[.00;.17] * p= .046
Income Quintile 5	.36[.27;.45] * * * p<.001	.30[.21;.39] * * * p<.001	.27[.18;.37] * * * p<.001	.30[.21;.39] * * * p<.001	.24[.15;.33] * * * p<.001	.22[.13;.30] * * * p<.001	.30[.21;.39] * * * p<.001	.25[.16;.34] * * * p<.001	.22[.13;.31] * * * p<.001
Occupational Status (routine)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Occupational Status (unemployed)	-.05[-.12;.03] p= .239	-.05[-.13;.03] p= .191	-.03[-.11;.05] p= .454	-.04[-.11;.03] p= .240	-.05[-.12;.03] p= .203	-.02[-.10;.05] p= .507	-.03[-.11;.05] p= .420	-.04[-.12;.04] p= .365	-.01[-.09;.07] p= .752

Occupational Status (intermediate)	.12[.05;.19] * * * p<.001	.09[.02;.15] * * p= .010	.08[.01;.14] * p= .019	.10[.04;.17] * * p= .002	.07[.01;.14] * p= .032	.07[-.00;.13] p= .056	.09[.01;.16] * p= .021	.06[-.02;.13] p= .128	.05[-.02;.12] p= .191
Occupational Status (higher managerial)	.29[.23;.36] * * * p<.001	.21[.15;.28] * * * p<.001	.20[.13;.26] * * * p<.001	.30[.24;.37] * * * p<.001	.23[.17;.30] * * * p<.001	.22[.15;.28] * * * p<.001	.28[.21;.35] * * * p<.001	.21[.14;.28] * * * p<.001	.19[.12;.26] * * * p<.001
Wealth Quintile 1	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE
Wealth Quintile 2	.02[-.06;.10] p= .637	.02[-.06;.10] p= .562	.02[-.05;.10] p= .545	.04[-.04;.12] p= .363	.04[-.04;.12] p= .308	.04[-.03;.12] p= .284	.01[-.05;.08] p= .677	.02[-.05;.08] p= .603	.02[-.04;.08] p= .581
Wealth Quintile 3	.03[-.05;.11] p= .438	.03[-.05;.11] p= .470	.03[-.05;.10] p= .469	.06[-.02;.14] p= .118	.06[-.02;.13] p= .124	.06[-.01;.13] p= .112	.03[-.05;.11] p= .446	.03[-.05;.11] p= .478	.03[-.05;.10] p= .470
Wealth Quintile 4	.08[-.00;.17] p= .064	.07[-.01;.16] p= .091	.07[-.01;.15] p= .090	.10[.02;.18] * p= .015	.09[.01;.17] * p= .023	.09[.01;.17] * p= .023	.08[.00;.16] * p= .050	.07[-.01;.15] p= .073	.07[-.00;.14] p= .066
Wealth Quintile 5	.24[.16;.33] * * * p<.001	.21[.13;.30] * * * p<.001	.21[.13;.29] * * * p<.001	.23[.15;.32] * * * p<.001	.21[.13;.29] * * * p<.001	.20[.12;.28] * * * p<.001	.25[.17;.33] * * * p<.001	.22[.15;.30] * * * p<.001	.22[.14;.29] * * * p<.001
Relative Neighbourhood Deprivation (most deprived decile)	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE	REFERENCE

Relative Neighbourhood Deprivation (10 - <20%)	.07[-.01;.14] p= .081	.06[-.01;.14] p= .106	.06[-.01;.13] p= .118	.02[-.05;.10] p= .557	.02[-.06;.09] p= .625	.02[-.06;.09] p= .685	.02[-.05;.10] p= .536	.02[-.06;.10] p= .603	.02[-.06;.09] p= .660
Relative Neighbourhood Deprivation (20 - <30%)	.05[-.03;.14] p= .228	.04[-.04;.13] p= .334	.03[-.05;.12] p= .455	.05[-.04;.14] p= .259	.04[-.05;.13] p= .349	.03[-.06;.12] p= .470	.00[-.08;.09] p= .984	-.01[-.09;.08] p= .832	-.02[-.10;.06] p= .637
Relative Neighbourhood Deprivation (30 - <40%)	.04[-.05;.13] p= .371	.02[-.07;.11] p= .645	.01[-.07;.10] p= .782	.01[-.09;.10] p= .862	-.01[-.10;.08] p= .844	-.02[-.11;.08] p= .706	-.01[-.10;.07] p= .757	-.03[-.11;.05] p= .457	-.04[-.12;.04] p= .334
Relative Neighbourhood Deprivation (40 - <50%)	.06[-.02;.14] p= .139	.03[-.04;.11] p= .383	.03[-.05;.10] p= .516	.05[-.03;.13] p= .183	.03[-.05;.11] p= .424	.02[-.06;.10] p= .565	.03[-.06;.11] p= .573	.00[-.08;.09] p= .942	-.01[-.09;.08] p= .873

Relative Neighbourhood Deprivation (50 - <60%)	.04[-.04;.13] p= .333	.02[-.07;.10] p= .693	.00[-.08;.09] p= .923	.00[-.08;.09] p= .917	-.02[-.10;.07] p= .672	-.03[-.11;.05] p= .455	-.03[-.13;.07] p= .533	-.05[-.15;.04] p= .261	-.07[-.16;.03] p= .154
Relative Neighbourhood Deprivation (60 - <70%)	.10[.01;.19] * p= .030	.06[-.03;.15] p= .179	.05[-.04;.14] p= .243	.08[-.01;.17] p= .085	.04[-.05;.13] p= .329	.04[-.05;.12] p= .429	.07[-.02;.16] p= .144	.03[-.06;.12] p= .488	.02[-.07;.11] p= .624
Relative Neighbourhood Deprivation (70 - <80%)	.13[.04;.21] * * p= .003	.08[-.00;.17] p= .057	.06[-.02;.15] p= .129	.13[.04;.22] * * p= .005	.09[.00;.18] * p= .046	.07[-.02;.16] p= .108	.05[-.04;.14] p= .241	.01[-.08;.10] p= .808	-.01[-.10;.08] p= .864
Relative Neighbourhood Deprivation (80 - <90%)	.18[.09;.27] * * * p<.001	.14[.05;.23] * * p= .002	.13[.04;.22] * * p= .005	.15[.06;.23] * * p= .002	.11[.03;.20] * p= .011	.10[.01;.19] * p= .024	.10[.01;.19] * p= .028	.07[-.02;.16] p= .124	.05[-.03;.14] p= .216

Relative Neighbourhood Deprivation (least deprived decile)	.14[.06;.22] * * p= .001	.09[.01;.18] * p= .031	.07[-.01;.15] p= .091	.16[.07;.25] * * * p<.001	.12[.03;.21] * p= .011	.10[.01;.19] * p= .033	.12[.03;.22] * * p= .008	.08[-.01;.17] p= .080	.06[-.03;.15] p= .206
Caregiver Vocabulary									
Caregiver Vocabulary (Word Activity Test Score)		.21[.18;.24] * * * p<.001	.17[.14;.20] * * * p<.001		.18[.16;.21] * * * p<.001	.14[.12;.17] * * * p<.001		.19[.16;.22] * * * p<.001	.15[.11;.18] * * * p<.001
Cohort Member Vocabulary									
Cohort Member Vocabulary (Naming Vocabulary Score)			.18[.16;.21] * * * p<.001			.19[.16;.21] * * * p<.001			.20[.17;.22] * * * p<.001
R2 (%)	24.33[22.85;25.83]	26.51[24.96;28.06]	28.75[27.15;30.35]	20.33[18.98;21.71]	22.08[20.65;23.54]	24.54[22.99;26.11]	21.58[19.86;23.32]	23.42[21.72;25.14]	26.15[24.29;28.04]

Section 8: Predicted probabilities tables for moderator analyses

Table S9: Predicted Probabilities of Educational Attainment (≥grade 4 on core subjects: Yes/No) for different values of Vocabulary in each SEC group

		Age 5 Vocabulary Score (Standardised) Predicted Probability of Educational Attainment [95% CIs]				
	SEC Indicator	-2.97	-2	-0.94	0.12	2.32
Composite Quintiles	Lowest Quintile	.17[.13;.22]	.22[.18;.26]	.28[.25;.32]	.36[.32;.39]	.52[.45;.60]
	Quintile 2	.17[.12;.24]	.24[.19;.30]	.34[.30;.38]	.45[.42;.48]	.69[.62;.75]
	Quintile 3	.19[.13;.26]	.29[.23;.35]	.42[.38;.47]	.57[.54;.60]	.82[.77;.87]
	Quintile 4	.27[.19;.35]	.38[.31;.46]	.53[.48;.57]	.67[.64;.69]	.87[.84;.90]
	Highest Quintiles	.43[.32;.54]	.55[.47;.63]	.68[.63;.73]	.79[.76;.81]	.92[.89;.94]
Parent Education (NVQ)	NVQ1	.15[.08;.26]	.19[.12;.28]	.23[.17;.30]	.29[.23;.35]	.42[.30;.55]
	No qualifications/ overseas	.16[.11;.23]	.20[.15;.27]	.26[.20;.32]	.32[.26;.39]	.47[.36;.59]
	NVQ2	.11[.07;.17]	.17[.13;.23]	.26[.21;.32]	.37[.31;.44]	.64[.54;.73]
	NVQ3	.11[.07;.16]	.17[.12;.23]	.27[.22;.34]	.41[.34;.48]	.71[.61;.79]
	NVQ4	.14[.10;.20]	.21[.16;.28]	.32[.26;.39]	.45[.38;.52]	.72[.65;.79]
	NVQ5	.20[.10;.37]	.29[.18;.43]	.40[.30;.51]	.53[.43;.62]	.76[.63;.85]
Income Quintiles	Lowest Quintile	.13[.09;.18]	.17[.12;.23]	.22[.17;.29]	.29[.23;.36]	.46[.37;.56]
	Quintile 2	.10[.07;.15]	.15[.11;.21]	.23[.18;.29]	.32[.26;.39]	.57[.48;.66]
	Quintile 3	.09[.05;.14]	.14[.10;.20]	.23[.18;.30]	.36[.29;.43]	.66[.57;.74]
	Quintile 4	.10[.07;.16]	.17[.12;.23]	.26[.20;.34]	.39[.32;.47]	.69[.59;.77]

Occupational Status	Highest Quintile	.13[.08;.21]	.20[.13;.28]	.29[.22;.38]	.41[.33;.50]	.68[.57;.77]
	Routine (most deprived, ref)	.09[.06;.13]	.14[.10;.18]	.21[.16;.27]	.30[.24;.37]	.55[.47;.63]
	Unemployed	.08[.06;.11]	.12[.09;.16]	.19[.15;.24]	.28[.22;.34]	.52[.44;.60]
	Intermediate	.11[.07;.15]	.16[.12;.22]	.24[.18;.31]	.34[.27;.42]	.60[.51;.68]
	Higher Managerial (Least Deprived)	.14[.09;.20]	.20[.15;.27]	.29[.22;.37]	.41[.33;.49]	.66[.58;.74]
Wealth Quintiles	Lowest Quintile	.11[.07;.16]	.15[.11;.21]	.21[.16;.28]	.30[.24;.37]	.51[.41;.61]
	Quintile 2	.12[.07;.18]	.16[.11;.23]	.23[.18;.30]	.32[.25;.39]	.54[.43;.65]
	Quintile 3	.09[.06;.14]	.14[.10;.19]	.22[.17;.28]	.32[.25;.40]	.59[.48;.70]
	Quintile 4	.10[.06;.16]	.15[.10;.22]	.23[.17;.30]	.34[.27;.41]	.60[.48;.71]
	Highest Quintile	.09[.06;.16]	.15[.10;.22]	.24[.18;.32]	.36[.28;.45]	.65[.54;.75]
Relative Neighbourhood Deprivation	Most Deprived (ref)	.09[.06;.13]	.14[.10;.18]	.21[.16;.27]	.30[.24;.37]	.55[.47;.63]
	10 - <20%	.10[.07;.13]	.15[.11;.19]	.22[.17;.28]	.32[.26;.39]	.57[.49;.65]
	20 - <30%	.10[.07;.13]	.14[.11;.19]	.22[.17;.27]	.31[.26;.38]	.57[.49;.64]
	30 - <40%	.10[.07;.14]	.15[.11;.20]	.23[.17;.29]	.33[.26;.40]	.58[.50;.66]
	40 - <50%	.10[.07;.14]	.15[.11;.20]	.23[.18;.29]	.33[.27;.40]	.58[.50;.66]
	50 - <60%	.11[.07;.15]	.16[.12;.21]	.24[.18;.30]	.34[.27;.41]	.59[.51;.67]
	60 - <70%	.11[.08;.15]	.16[.12;.22]	.24[.19;.31]	.34[.28;.42]	.60[.52;.68]
	70 - <80%	.11[.08;.16]	.17[.12;.23]	.25[.19;.32]	.36[.28;.44]	.61[.53;.69]

80 - <90%	.14[.10;.20]	.21[.15;.28]	.30[.23;.38]	.42[.34;.50]	.67[.59;.74]
Least Deprived	.13[.09;.19]	.20[.14;.27]	.29[.22;.37]	.40[.32;.49]	.66[.57;.73]

Section 9: Moderator sensitivity analyses

Rationale

There is some concern in the literature that regression models with potential confounding variables simply being added as control variables do not properly adjust for the confounding effect of these variables on the interaction term – only on the potential confounding influence of the predictor variable (here, vocabulary) on the outcome (GCSE attainment) (Keller, 2014). To control for potential confounding effects on the *interaction term*, all potential confounders and interaction terms between the potential confounders and the predictor, and potential confounders and the moderator, must be entered into the model (Keller, 2014).

We therefore ran sensitivity analyses for our SEC* vocabulary moderations, whereby we included interaction terms between potential confounders (remaining SEC variables) and between the predictor (vocabulary) and potential confounders and the moderator (each SEC variable in turn), to ensure the confounding effect of SEC on the interaction term was accounted for.

Analysis plan.

The following models were estimated:

1. **Parent education as the moderator.** ≥ Grade 4 on the core subjects as outcome variable. Sex, ethnicity, EAL status, country, caregiver education as potential confounders. Income*age 5 vocabulary, income*parent education, occupational status*age 5 vocabulary, occupational status*parent education, wealth*age 5 vocabulary, wealth*parent education, relative neighbourhood deprivation*age 5 vocabulary, relative neighbourhood deprivation*parent education as confounding interaction terms. Parent education*age 5 vocabulary as main interaction term.
2. **Income as the moderator.** ≥ Grade 4 on the core subjects as outcome variable. Sex, ethnicity, EAL status, country, caregiver education as potential confounders. Parent education*age 5 vocabulary, parent education*income, occupational status*age 5 vocabulary, occupational status*income, wealth*age 5 vocabulary, wealth*income, relative neighbourhood deprivation*age 5 vocabulary, relative neighbourhood deprivation*income as confounding interaction terms. Income*age 5 vocabulary as main interaction term.
3. **Occupational status as the moderator.** ≥ Grade 4 on the core subjects as outcome variable. Sex, ethnicity, EAL status, country, caregiver education as potential confounders. Parent education*age 5 vocabulary, parent education*occupational status, income*age 5 vocabulary, income*occupational status, wealth*age 5 vocabulary, wealth*occupational status, relative neighbourhood deprivation*age 5 vocabulary, relative neighbourhood deprivation*occupational status as confounding interaction terms. Occupational status*age 5 vocabulary as main interaction term.

4. **Wealth as the moderator variable.** ≥ Grade 4 on the core subjects as outcome variable. Sex, ethnicity, EAL status, country, caregiver education as potential confounders. Parent education*age 5 vocabulary, parent education*wealth, income*age 5 vocabulary, income*wealth, occupational status*age 5 vocabulary, occupational status*wealth, relative neighbourhood deprivation*age 5 vocabulary, relative neighbourhood deprivation*wealth as confounding interaction terms. Wealth*age 5 vocabulary as main interaction term.
5. **Relative neighbourhood deprivation as moderator variable.** ≥ Grade 4 on the core subjects as outcome variable. Sex, ethnicity, EAL status, country, caregiver education as potential confounders. Parent education*age 5 vocabulary, parent education*relative neighbourhood deprivation, income*age 5 vocabulary, income*relative neighbourhood deprivation, occupational status*age 5 vocabulary, occupational status* relative neighbourhood deprivation, wealth*age 5 vocabulary, wealth* relative neighbourhood deprivation as confounding interaction terms. Relative neighbourhood deprivation *age 5 vocabulary as main interaction term.

For each analysis, a model with the interaction term was compared to a model without the interaction term, to establish whether there were any significant moderation effects when adjusting for confounding in this conservative way.

Results.

When interaction terms between remaining SEC indicators (income, occupational status, wealth and relative neighbourhood deprivation) and vocabulary, and remaining SEC indicators and parent education, including the interaction term between **parent education** and age 5 vocabulary did not significantly improve the model fit compared to a model without this interaction term ($Dm(5, 709.94) = 1.03$, $p = .399$).

When interaction terms between remaining SEC indicators (parent education, occupational status, wealth and relative neighbourhood deprivation) and vocabulary, and remaining SEC indicators and income, including the interaction term between **household income** and age 5 vocabulary did not significantly improve the model fit compared to a model without this interaction term ($Dm(4, 531.28) = 0.33$, $p = .859$).

When interaction terms between remaining SEC indicators (parent education, income, wealth and relative neighbourhood deprivation) and vocabulary, and remaining SEC indicators and occupational status, including the interaction term between **occupational status** and age 5 vocabulary did not significantly improve the model fit compared to a model without this interaction term ($Dm(3, 303.58) = .92$, $p = .432$).

When interaction terms between remaining SEC indicators (parent education, income, occupational status and relative neighbourhood deprivation) and vocabulary, and remaining SEC indicators and wealth, including the interaction term between **wealth** and age 5 vocabulary did not significantly improve the model fit compared to a model without this interaction term ($Dm(4, 273.52) = 0.33$, $p = .857$).

When interaction terms between remaining SEC indicators (parent education, income, occupational status and wealth) and vocabulary, and remaining SEC indicators and relative neighbourhood deprivation, including the interaction term between **relative neighbourhood deprivation** and age 5 vocabulary did not significantly improve the model fit compared to a model without this interaction term ($Dm(9, 966.76) = 1.04$, $p = .409$).

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