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Paths to literacy and numeracy problems: evidence from two British birth cohorts

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Abstract

Objective—To test a life course model linking circumstances of origin to self-reported literacy and numeracy problems in midlife, and to investigate the effects in this model of changing social circumstances in two post-war cohorts.

Methods—Based on data from men and women in the British 1946 and 1958 birth cohorts, we used the relative index of inequality and logistical regression to test associations between father's occupation, childhood cognition, educational attainment, own occupation in the 3rd decade, and a binary variable representing self-reported literacy and numeracy problems in the 4th decade.

Results—There was a lower frequency of literacy and numeracy problems in the 1958 cohort compared to the 1946 cohort. In both cohorts there were associations between father's occupation and childhood cognition, educational attainment and own occupation, a pattern that was mirrored by the associations between childhood cognition, educational attainment and own occupation to adult literacy and numeracy problems. Positive associations between childhood cognition and educational attainment, and between educational attainment and own occupation, were stronger in the 1946 cohort than in the 1958 cohort. However, inverse associations between educational attainment and literacy and numeracy problems were stronger in the 1958 cohort, possibly reflecting the expansion of secondary education in the intervening years.

Conclusions—Literacy and numeracy problems have a robust structure of life course associations, although the changing pattern of these associations may reflect important social structural changes from the early post war years to the early 1960s in the UK.

Keywords

literacy; numeracy; birth cohort; path analysis

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COMPETING INTERESTS None

INTRODUCTION

Literacy and numeracy are important functional skills in modern industrialised society, and their significance and value has increased since labour markets have moved away from traditional manufacturing industries towards a more service-based economy. Indeed, comparison of the British 1958 and 1970 birth cohorts reveals increased polarisation in labour market positions between those with and without competent literacy skills, to the extent that the latter face growing threat of social exclusion.[1] These issues are reflected in the USA, where 22% of those participating in the National Adult Literacy Survey had difficulty with tasks such as locating the expiration date on a driving licence form.[2] Understanding the principal influences on adult literacy and numeracy is therefore an important public health research goal.

In a study based on the British 1946 birth cohort, a continuous measure of literacy at age 53 years provided by the National Adult Reading Test (NART) received substantial inputs from childhood cognitive ability and education, and, indirectly through these pathways, from parental socioeconomic status (SES).[3] Since the NART is a test of word recognition, providing an abstract indication of literacy, it is important to establish whether a similar pattern of influences also occurs for self-reported literacy and numeracy problems in everyday life. The British 1946 and 1958 birth cohorts obtained self-report measures of difficulties with reading, writing and calculation at, respectively, ages 43 and 42 years, along with measures of childhood cognition, and educational and occupational attainment. Our principal hypotheses were that the path structure reported for the NART in the 1946 cohort would be broadly replicated with self-reported literacy and numeracy difficulties in the 1946 and 1958 cohorts, but that policy changes leading to the expansion of educational opportunity would favour the increased influence of education on literacy and numeracy in the 1958 cohort.

METHODS

Study samples

1946 cohort—The MRC National Survey of Health and Development, also known as the British 1946 birth cohort, initially consisted of 5,362 children of non-manual and agricultural workers and a random sample of one in four of manual workers selected from all single and legitimate births occurring in one week in March 1946 in England, Wales and Scotland. The cohort has been studied on 21 occasions since birth, including a survey at age 43 when sample size was 3,262. At this age the cohort was shown to be a representative sample, in most respects, of the UK population legitimately and singly born in the immediate post-war era. Exceptions were an over-representation among those not interviewed of socially disadvantage, medical vulnerability, and relatively poor cognitive development.[4]

1958 cohort—The National Child Development Study, also known as the British 1958 birth cohort, initially consisted of all births (17,416) occurring in one week of March 1958 in England, Wales and Scotland. The cohort was followed up on eight occasions, including a survey at 42 years, when sample size was 11,419.[5] Immigrants with the same birth week were recruited to the study during childhood, but not at subsequent adult surveys. The sample is representative, in most other respects, of the general UK population of this age, although there is a trend towards under-representation of males and those less educationally advantaged over time.[6, 7]

Ethical approval—Ethics committee approval for the age 43 and 42 year surveys of the 1946 and 1958 cohorts, respectively, was obtained from the North Thames Multi-Centre Research Ethics Committee.

Measures

Social class of origin—Social position at birth was classified by the Registrar General scale, ranging from class I (professional) to V (unskilled manual). For the 1946 cohort this was classified when the cohort member was aged 4 years, based on the father's occupation. For the 1958 cohort this was classified at birth of the survey member, based on the father's occupation if the family was intact, or on the mother's occupation if single, separated, divorced or widowed. If this was missing the maternal grandfather's class was used.

Childhood cognitive measures

1946 cohort: At eight years cohort members took tests of verbal and non-verbal ability devised by NFER,[8] and administered by teachers or other trained personnel. These tests were 1. Reading comprehension (selecting appropriate words to complete 35 sentences), 2. Word Reading (pronouncing 50 words), 3. Vocabulary (based on the same words), and 4. Picture Intelligence, consisting of a 60-item non-verbal reasoning test. The four tests are indicators of a factor representing cognitive ability at eight years of age. The factor scores were recoded into quintiles for the analysis.

1958 cohort: At seven years cohort members took tests of arithmetic, reading, and perceptual and motor skills in a school setting. Arithmetic comprised 10 problems with graded levels of difficulty. Reading skill was measured by the Southgate test,[9] requiring an appropriate word to be selected corresponding to a picture. Perceptual and motor ability was assessed by the Goodenough draw a man test.[10] For poor readers teachers read out items of the arithmetic test. A factor for cognitive ability at seven years was measured by these three tests, and recoded into quintiles.

Educational attainment—The highest educational qualification obtained by age 26 years in the 1946 cohort, and by age 23 years in the 1958 cohort, was classified into five levels: none, vocational only, ordinary (GCSE/'O' level or equivalent), advanced ('A' level or equivalent), and higher (degree/degree equivalent, higher degree).

Adult social position—Adult social position was based on occupation at 36 years in the 1946 cohort, and on current or last occupation at 33 years in the 1958 cohort, in both cases similarly classified according to the Registrar General scale.

Outcome measures: literacy and numeracy problems

1946 cohort: The outcome measure in the 1946 cohort consisted of literacy and numeracy problems at age 43 years, assessed by three questions, i.e. whether the survey member had any difficulties in day to day life with: 1. reading, 2. writing or spelling, 3. sums and calculations. Responses to items 1 and 2 questions were coded as "no difficulties"; "yes, has difficulty"; "cannot read/write at all". Responses to item 3 were coded as yes or no. An overall outcome measure was dichotomised to no difficulty vs. difficulty with at least one of reading, writing, spelling or sums and calculations.

1958 cohort: The outcome measure in the 1958 cohort consisted of literacy and numeracy problems at age 42 years, assessed by three questions, i.e. whether the survey member was able to: 1. read and understand a magazine or newspaper text, 2. write a thank-you letter, and 3. calculate change from a £10 note. Responses to these questions were coded as "yes,

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easily"; "yes, with difficulty"; "no", and an overall dichotomous outcome was created with 0 representing no difficulty with any of reading, writing or calculating change and 1 representing some difficulty with one or more of the three items.

Statistical methods

Imputation of missing data—Missing values were filled in by multiple imputations using the multiple imputation by chained equations (ICE) programs implemented in Stata by Royston.[11] Five replicates of the data were created, giving 95% efficiency.[11] The Stata program MICOMBINE was used to calculate the average regression estimates over the set of replicates, adjusting the standard errors according to Rubin's rule.[12] Full details are given in Royston. [11]

Analysis—Our hypothetical model is illustrated in Figure 1.

Statistical analysis was conducted in two stages. First, the Relative index of inequality (RII) was calculated to represent associations between variables, as depicted in Fig. 1. This consisted of four models, with associations statistically independent within each model; 1) associations from paternal occupation to childhood cognitive function; 2) from paternal occupation and childhood cognition to education attainment; 3) from paternal occupation, childhood cognition, and education attainment to own occupation; and 4) from childhood cognition, educational attainment and own occupation to the literacy/numeracy outcomes. Following the study of Richards & Sacker [3] we did not hypothesise a direct association between father's social class and literacy/numeracy problems. Associations to multiple category variables (models 1, 2 and 3) were tested using ordered logistic regression, and associations between these variables and the literacy/numeracy outcomes (model 4) were tested using standard binary logistic regression.

The Relative index of inequality summarises the differences in an outcome variable over all categories of a predictor variable.[13,14] The Relative index of inequality encapsulates the linear relationship between predictor and outcome, taking account of the distribution of the predictor, which may differ between the two birth cohorts.[15] It corresponds to differences between the extremes of the distribution of the predictor not to differences between the top and bottom categories. A Relative index of inequality = 1 means that an outcome does not vary across the categories of the predictor; an RII > 1 implies that a higher category on the outcome is more likely for the top than bottom of the predictor distribution; Relative index of inequality < 1 means that the odds of a higher category on the outcome variable are lower for the for the top than bottom of the predictor distribution. As an example, the Relative index of inequality for paternal occupation to childhood cognitive function is interpreted as the estimated odds of being one quintile higher on the childhood cognitive factor score for the most advantaged social class of origin compared to the least advantaged.

All coefficients were estimated controlling for gender. Since there was no evidence of any interactions with gender, unstratified results are presented below. For the 1946 birth cohort, inverse probability weights were applied to account for the differential sampling by social class.

Second, and to provide further information on possible non-linear associations, ordered or binary logistic regression models were re-estimated to test the form of associations between paternal occupation (6 levels), childhood cognitive ability (quintiles), educational attainment (5 levels), adult occupation (6 levels), and the binary literacy/numeracy outcome. Thus, to complement the linear effect encapsulated in the Relative index of inequality, each N-category independent variable was represented by a set of N-1 dummy variables in the models.

RESULTS

Descriptive information on the variables measured in the two cohorts, before and after data augmentation by multiple imputations, is shown in Table 1. The upward shift in the distribution of parental social class, and to a lesser extent own social class, from the 1946 cohort to the 1958 cohort is clear. Most striking, however, is the major upward shift in educational attainment over the intervening 12 years; nearly half of the 1946 cohort were without academic qualifications by early adulthood, compared to 14.3% in the 1958 cohort, and while only 5.5% of the 1946 cohort attained a university education or equivalent by this stage, this was 21.6% for the 1958 cohort. Finally, the frequency of literacy and numeracy problems was lower in the 1958 cohort ($p < 0.001$). The distribution of the variables in the augmented datasets is consistent with the profile of non-responders and drop-outs.

Associations between variables

Relative indices of inequality representing associations between variables are summarised in Figures 2 and 3, and revealed the following general pattern: first, modest positive associations, of approximately equal magnitude, from father's occupation to childhood cognition and to educational attainment independent of childhood cognition, and a weaker positive association from father's occupation to own occupation independent of childhood cognition and education; second, a strong positive association between childhood cognition and educational attainment independent of father's occupation, a relatively weak association between childhood cognition and own occupation independent of education, and a strong association between educational attainment and own occupation independent of education and father's occupation; third, independent associations, all in the protective direction, from childhood cognition, educational attainment and own occupation, to literacy and numeracy problems. However, in the 1946 cohort the association between education and literacy/numeracy problems was of low magnitude.

Associations between childhood cognition and educational attainment, and between educational attainment and own occupation, were weaker in the 1958 cohort, whereas the inverse association between educational attainment and literacy/numeracy problems was stronger in the 1958 cohort.

As hypothesised, the independent associations between father's social class and literacy/numeracy problems in either cohort were of negligible magnitude (not shown).

Ordered and binary logistic regression analyses were then used to estimate gender differences and explore possible non-linear effects. Results for each model (see Methods) are summarised in Table 2. For both cohorts females had higher childhood cognitive scores than males, independent of father's social class, yet had lower educational attainment, particularly in the 1946 cohort. Females in the 1946 cohort also had lower occupational attainment than males, although not in the 1958 cohort. Females in both cohorts were less likely than males to report literacy and numeracy difficulties, independent of their cognitive ability and educational and occupational attainments.

All remaining associations were graded in both cohorts, with the exception of that between education and literacy/numeracy problems in the 1946 cohort. There were disproportionately stronger positive effects for father's occupational class I (compared to the other five Registrar General levels) on educational attainment in the 1946 cohort, the highest quintile of childhood cognition on educational attainment in both cohorts, and higher education on occupational attainment in both cohorts. Conversely, literacy/numeracy problems appeared to be disproportionately represented in those of lowest advantage, in terms of lowest quintile

of childhood cognitive ability and lowest educational attainment (no qualifications; 1958 cohort only).

DISCUSSION

In a comparative analysis of the British 1946 and 1958 birth cohorts we found a broadly similar structure of associations linking social class of origin to adult literacy and numeracy problems via childhood cognitive ability, educational attainment, and adult occupational social class. In both cohorts there were independent associations from paternal occupation to childhood cognition, educational attainment and adult occupation, patterns that were roughly mirrored by the independent paths from childhood cognition, educational attainment and adult occupation to adult literacy and numeracy problems.

There were, however, cohort differences in the pattern of these associations. First, females in the 1946 cohort had lower educational and occupational attainment than females in the 1958 cohort, although gender effects for childhood cognition and the literacy/numeracy outcome did not differ between the cohorts. Second, associations between childhood cognition and educational attainment, and between educational attainment and own occupation, were stronger in the 1946 cohort, with disproportionately stronger effects in this cohort of those with highest ability and attainment, respectively. These effects probably reflect greater selection into education by cognitive ability in this older cohort, and relatively greater advantage, e.g. in terms of status and opportunity, attached to educational qualifications in the era during which the 1946 cohort was entering the labour force, as compared to the 1958 cohort.

Third, and most important in the present context, there was an inverse association between educational attainment and literacy/numeracy problems in the 1958 cohort, which was not evident in the 1946 cohort. While it is possible that a small proportion of literacy/numeracy problems in the older cohort are late-onset, associated with rising morbidity, this cohort difference is also likely to reflect the raising of the minimum school leaving age from 15 to 16 years in 1972, after which there was a dramatic rise from the 1946 to the 1958 cohort in the proportion of adults with qualifications.[16] It is worth noting the expansion of educational opportunities in the 12 years separating these cohorts was not reflected in higher occupational attainment in the younger cohort; in fact there were, as noted, greater labour market returns to advanced or higher education in the 1946 cohort. If so, it is all the more important to highlight our interpretation: that this expansion led to a modest reduction in the prevalence of adult literacy/numeracy problems, with the caveat that these outcomes, although highly similar, were not identical.

Four limitations of these analyses should be noted. First, there was an under-representation in both cohorts of those who were relatively disadvantaged. However, this was true of both cohorts, and in any case our use of multiple imputations was informed by the knowledge that missingness was not completely random. Imputation by chained equations estimation requires the assumption that data be missing at random, rather than the more restrictive assumption of missing completely at random, correcting for non response bias. Second, tests representing childhood cognition differed in the two cohorts. However, recent studies confirm that a factor representing general cognitive ability can be derived from test batteries of differing content.[17,18] Third, a measure of parental cognition was not available; this variable would partially explain the association between father's occupation and childhood cognition, [19] due to the heritable component of general cognitive ability. In this context the results of twin studies should be noted, which suggest that the shared environmental effects of cognitive ability decline to zero by adulthood.[20] Fourth, the absence of unmeasured confounding variables in the models may bias estimates of direct and indirect

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effects.[21] To set against these limitations, this study offers a unique opportunity to examine life course pathways to literacy and numeracy problems using prospectively obtained data, and to compare these pathways in two large population-based samples that encompass changing educational and labour market opportunities.

What are the wider implications of this study? Those with poor levels of literacy and numeracy face the prospect of increasing marginalisation in the modern state.[1] Furthermore, as people are expected to assume more responsibility for self-care in an increasingly complex information age, those with low levels of literacy and numeracy, particularly older people, face increased risk of poor health. There may also be direct health related consequences of low literacy and numeracy; a low score on a word pronunciation test was a stronger predictor of dementia - a major disease burden in later life - than poor education.[22] It is therefore important to highlight the policy implications of the present study. The UK government Skills for Life strategy was initiated in 2003 to improve adult literacy and numeracy, linked to a range of programs targeted towards those most at risk, such as Step in to Learning and the Link Up Project. However, a report by the Adult Learning Inspectorate criticised the effectiveness of this strategy, noting that it should not substitute for school-based learning.[23] Indeed, the ‘Rightstart’ programme in the USA suggests the importance of early conceptual learning.[24] The results of our study broadly support this outlook, and demonstrate that adult literacy and numeracy are significantly influenced by factors during childhood, although recent evidence in the 1946 cohort indicates that adult education and job training can augment literacy independently of prior cognition and formal schooling.[25] These results suggest that interventions to improve literacy and numeracy should be targeted at multiple phases of the life course, even though the efficacy of these interventions is likely to be highest when targeted at the school years.

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What is already known on this subject

Work based on the British 1946 birth cohort shows that midlife literacy measured by formal psychometric testing receives important influences across the life course, from social circumstances of origin, through childhood cognitive development and educational attainment.

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What this paper adds

A similar pattern of associations was shown in the British 1946 and 1958 birth cohorts, with self-reported difficulties in functional literacy and numeracy as the outcome, suggesting that these influences are robust and have practical implications for skilled activities of daily living. However, associations between educational attainment and literacy/numeracy problems were stronger in the 1958 cohort than in the older cohort, possibly reflecting an effect of the expansion of educational opportunities during the intervening 12 years.

Policy implications

Educational policy may have an important impact on literacy and numeracy problems, although intervention in adulthood may be less effective.

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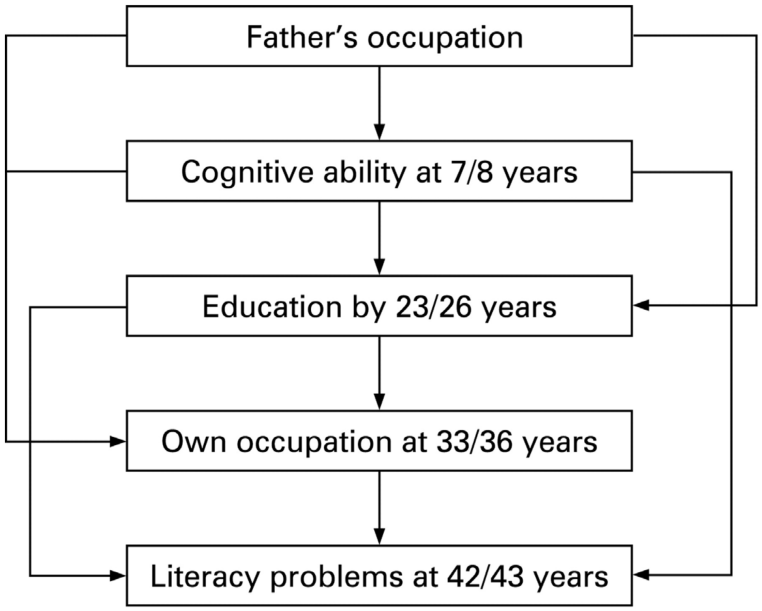

Figure 1.
Hypothetical path diagram for the model of pathways from social class of origin to adult literacy and numeracy problems.

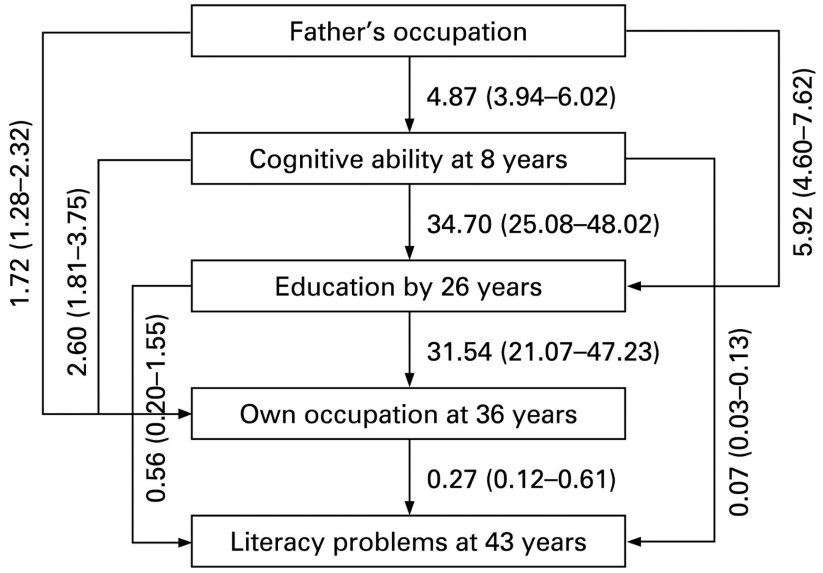

Figure 2.
Empirical path diagrams for the 1946 cohort, showing the Relative index of inequality (RII) and 95% confidence intervals in parentheses for each association in the model of pathways from social class of origin to adult literacy and numeracy problems. There are 4 mutually-adjusted blocks of associations: 1) from paternal occupation to childhood cognitive function; 2) from paternal occupation and childhood cognition to education attainment; 3) from paternal occupation, childhood cognition, and education attainment to own occupation; and 4) from childhood cognition, educational attainment and own occupation to the literacy/numeracy problems.

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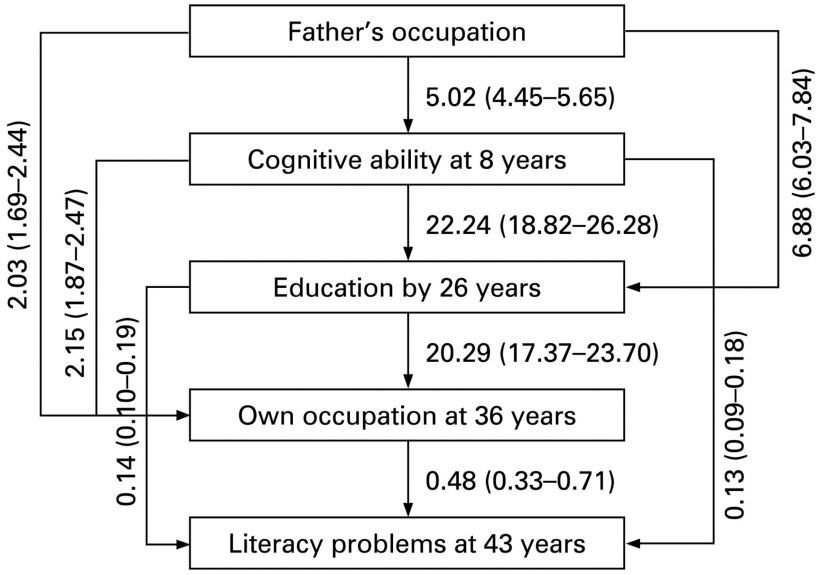

Figure 3.
Empirical path diagrams for the 1958 cohort, showing the Relative index of inequality (RII) and 95% confidence intervals in parentheses for each association in the model of pathways from social class of origin to adult literacy and numeracy problems.

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Table 1

Distribution of relevant variables over the life course in the 1946 cohort (N=4500) and the 1958 cohort (N=17016), before and after data augmentation

		1946 cohort			1958 cohort		
			Raw data*	Augmented data†		Raw data*	Augmented data†
Variable	**Categories**	**N‡**	**%§**	**%§**	**N‡**	**%§**	**%§**
Gender	Male	2355	52.45	52.45	8780	51.60	51.60
	Female	2145	45.55	45.55	8236	48.40	48.40
Father's occupation	I Professional	262	2.10	2.10	748	4.39	4.39
	II Managerial/ technical	748	5.98	5.98	2184	12.83	12.83
	IIINM skilled non-manual	824	6.59	6.59	1736	10.20	10.20
	IIIM Skilled manual	1421	45.48	45.48	8467	49.74	49.74
	IV Semi-skilled manual	943	30.18	30.18	2194	12.89	12.89
	V Unskilled manual	302	9.67	9.67	1692	9.94	9.94
Childhood cognitive ability¶	I Lowest	801	24.35	24.71	2714	19.79	20.00
	II	805	22.01	21.98	2745	20.01	20.00
	III	815	20.75	20.71	2761	20.13	20.02
	IV	817	18.37	18.16	2765	20.16	20.13
	V Highest	821	14.52	14.44	2732	19.92	19.85
Educational attainment**	None	1628	49.20	48.97	1317	12.48	14.33
	Vocational only	327	8.98	8.98	1357	13.86	13.65
	Ordinary	798	17.72	17.86	3507	33.24	32.96
	Advanced	961	18.65	18.71	1895	17.96	17.44
	Higher	388	5.47	5.48	2476	23.46	21.61
Own occupation††	I Professional	212	5.76	4.90	480	4.82	4.67
	II Managerial/ technical	814	24.99	23.88	3153	31.67	30.60
	IIINM skilled non-manual	585	21.37	22.10	2261	22.71	22.44
	IIIM Skilled manual	570	25.30	25.25	1956	19.64	19.93
	IV Semi-skilled manual	392	17.96	19.00	1648	16.55	17.34
	V Unskilled manual	92	4.61	4.87	459	4.61	5.03
Literacy/numeracy problems‡‡	No	2683	88.11	87.51	9196	91.57	90.19
	Yes	298	11.89	12.49	847	8.43	9.81

*Distributions based on available non-missing data in original dataset.

†Distributions averaged over 5 datasets with missing data replaced by imputed values.

‡Actual (unweighted) sample size; may not sum to 4500 and 17016 due to missing data.

§Percentage values are weighted to take account of the unequal sampling by social class.

¶ Assessed at age 8 years (1946 cohort) and 7 years (1958 cohort).

** Highest level of qualification by age 26 years (1946 cohort) and age 23 years (1958 cohort).

†† At age 33 years (1946 cohort) and age 33 years (1958 cohort).

‡‡ At age 43 years (1946 cohort) and age 42 years (1958 cohort).

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Table 2

Odds ratios and 95% confidence intervals for the ordered logistic regression models using the 1946 and 1958 cohorts, linking father's occupation to adult literacy and numeracy* via cognitive ability, education and own occupation

		1946 cohort		1958 cohort		Cohort difference
		Adjusted† OR	95% C.I.	Adjusted† OR	95% C.I.	p
		Model 1: Associations with childhood cognitive ability				
Male		1.00	Ref	1.00	Ref	
Female		1.25	1.11, 1.42	1.22	1.13, 1.31	0.725
Father's occupation‡	RG I	10.14	7.26, 14.18	6.33	5.04, 7.95	0.022
	RG II	5.40	4.15, 7.03	4.07	3.59, 4.61	0.056
	RG IIINM	5.24	4.03, 6.81	3.06	2.68, 3.49	0.0003
	RG IIIM	1.98	1.55, 2.52	1.99	1.80, 2.21	0.952
	RG IV	1.54	1.20, 1.98	1.45	1.28, 1.63	0.663
	RG V	1.00	Ref	1.00	Ref	
		Model 2: Associations with educational attainment				
Male		1.00	Ref	1.00	Ref	
Female		0.62	0.54, 0.71	0.80	0.74, 0.88	0.002
Father's occupation‡	RG I	14.60	9.73, 21.91	9.52	7.81, 11.61	0.064
	RG II	6.28	4.64, 8.51	5.63	4.80, 6.61	0.531
	RG IIINM	5.04	3.73, 6.81	3.22	2.74, 3.78	0.010
	RG IIIM	2.15	1.62, 2.87	2.09	1.85, 2.37	0.855
	RG IV	1.56	1.14, 2.13	1.49	1.26, 1.75	0.797
	RG V	1.00	Ref	1.00	Ref	
Childhood cognitive ability (quintiles) §	1	1.00	Ref	1.00	Ref	
	2	2.61	2.07, 3.30	2.81	2.44, 3.24	0.595
	3	5.01	3.93, 6.37	4.91	4.18, 5.78	0.901
	4	8.52	6.58, 11.04	7.71	6.74, 8.83	0.501
	Highest 5	21.16	15.68, 28.54	13.76	11.49, 16.48	0.016
		Model 3: Associations with own occupation				
Male		1.00	Ref	1.00	Ref	
Female		0.71	0.57, 0.88	0.96	0.86, 1.06	0.013
Father's occupation‡	RG I	2.33	1.45, 3.75	2.30	1.85, 2.85	0.959
	RG II	1.94	1.32, 2.86	1.74	1.42, 2.13	0.619
	RG IIINM	1.66	1.19, 2.32	1.55	1.27, 1.90	0.727
	RG IIIM	1.22	0.89, 1.67	1.21	1.04, 1.39	0.953
	RG IV	1.12	0.82, 1.54	1.07	0.93, 1.23	0.790
	RG V	1.00	Ref	1.00	Ref	
Childhood cognitive ability (quintiles) §	1	1.00	Ref	1.00	Ref	
	2	1.40	1.08, 1.82	1.31	1.06, 1.62	0.691

		1946 cohort		1958 cohort		Cohort difference
		Adjusted† OR	95% C.I.	Adjusted† OR	95% C.I.	p
	3	1.75	1.37, 2.24	1.49	1.33, 1.67	0.252
	4	1.91	1.45, 2.51	1.67	1.37, 2.05	0.449
	Highest 5	2.14	1.51, 3.05	1.92	1.66, 2.21	0.568
Educational attainment¶	None	1.00	Ref	1.00	Ref	
	Vocational only	2.17	1.56, 3.03	1.88	1.59, 2.21	0.436
	Ordinary	3.40	2.57, 4.50	3.08	2.66, 3.58	0.548
	Advanced	7.56	6.03, 9.49	5.26	4.47, 6.18	0.011
	Higher	30.74	20.14, 46.90	15.07	12.81, 17.74	0.002
		Model 4: Associations with literacy/numeracy problems				
Male		1.00	Ref	1.00	Ref	
Female		0.55	0.38, 0.79	0.57	0.46, 0.71	0.860
Childhood cognitive ability (quintiles) §	1	1.00	Ref	1.00	Ref	
	2	0.47	0.35, 0.63	0.43	0.33, 0.55	0.599
	3	0.25	0.16, 0.38	0.32	0.24, 0.42	0.335
	4	0.18	0.11, 0.29	0.27	0.21, 0.35	0.132
	Highest 5	0.15	0.06, 0.39	0.23	0.17, 0.32	0.402
Educational attainment¶	None	1.00	Ref	1.00	Ref	
	Vocational only	0.90	0.49, 1.67	0.45	0.35, 0.57	0.039
	Ordinary	0.66	0.34, 1.31	0.33	0.28, 0.39	0.049
	Advanced	0.71	0.39, 1.28	0.28	0.22, 0.36	0.005
	Higher	1.02	0.48, 2.19	0.19	0.13, 0.29	0.0001
Own occupation**	RG I	0.25	0.06, 1.04	0.54	0.28, 1.04	0.334
	RG II	0.36	0.13, 0.97	0.54	0.38, 0.78	0.436
	RG IIINM	0.46	0.20, 1.05	0.59	0.42, 0.83	0.580
	RG IIIM	0.71	0.29, 1.72	0.75	0.56, 1.01	0.892
	RG IV	0.84	0.42, 1.66	0.85	0.64, 1.12	0.977
	RG V	1.00	Ref	1.00	Ref	

*At age 43 years (1946 cohort) and age 42 years (1958 cohort).

†ORs mutually adjusted for all independent variables within each model.

‡Father's occupation defined by RG (Registrar General) categories I (professional), II (intermediate), IIINM (skilled non-manual), IIIM (skilled manual), IV (semi-skilled) and V (unskilled).

§Assessed at age 8 years (1946 cohort) and 7 years (1958 cohort).

¶Highest level of qualification by age 26 years (1946 cohort) and age 23 years (1958 cohort).

**At age 33 years (1946 cohort) and age 33 years (1958 cohort), RG (Registrar General categories as for Father's occupation).