sociological science

Filial Intelligence and Family Social Class, 1947 to 2012

Lindsay Paterson

University of Edinburgh

Abstract: Intelligence, or cognitive ability, is a key variable in reproducing social inequality. On the one hand, it is associated with the social class in which a child grows up. On the other, it is a predictor of educational attainment, labor-market experiences, social mobility, health and well-being, and length of life. Therefore measured intelligence is important to our understanding of how inequality operates and is reproduced. The present analysis uses social surveys of children aged 10 to 11 years in Britain between 1947 and 2012 to assess whether the social-class distribution of intelligence has changed. The main conclusions are that, although children's intelligence relative to their peers remains associated with social class, the association may have weakened recently, mainly because the average intelligence in the highest-status classes may have moved closer to the mean.

Keywords: intelligence; cognitive ability; parental education; social class

INTELLIGENCE, as measured by tests of cognitive ability, is related to educational attainment, to access to higher education, to success in the labor market, to social mobility, to civic participation, and to health and well-being. So inequalities of intelligence are as potentially interesting to sociology as inequalities of any other resource that can lead to a fulfilling life. Yet few modern studies have investigated changes in the social-class distribution of intelligence. A notable exception is the important work of Connelly and Gayle (2019), who found that the social-class distribution of intelligence among British children did not change between those born in 1958 and those born in 1970. The present analysis investigates the social-class distribution of intelligence over a longer period of time, covering children aged 10 to 11 years between 1947 and 2012. This length of coverage is obtained at the price of compromising on the strict comparability of measurements of both intelligence and social class. So we assess the effects of these decisions by checking the robustness of the conclusions to variation in the compromises that we have made.

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Background

Investigating intelligence has long provoked strong controversy in the study of social inequality. Marks (2014:50) notes that the sociological critique rests on the claims that intelligence is complex, that it is not stable over time, that it is a consequence rather than a cause of educational outcomes, and that intelligence tests reflect differences in socialization. Richardson (2002) exemplifies the strongly sociological view that intelligence is no more than "a nexus of sociocognitive-affective factors determining individuals' relative preparedness for the demands of the IQ test" (P. 287).

Yet, although that is probably the dominant view in sociology, other sociologists have recommended that sociology take intelligence seriously. Nash (2001) has proposed that investigators of social inequality should be interested in understanding why measured intelligence correlates strongly with the dimensions on which inequality is often measured, such as social class of upbringing, educational attainment, and social mobility. He suggested that intelligence be thought of as "cognitive socialization" (P. 190). Nielsen (1996) noted that sociological research on status attainment used to pay attention to intelligence (Blau and Duncan 1967), and a few branches of sociology routinely control for IQ—most notably, measuring the effectiveness of schools (Marks 2017) and understanding labor-market inequalities (Hanushek and Woessmann 2008).

This predictive capacity is the main reason why intelligence is relevant to sociological analysis (Deary 2012). Intelligence predicts educational attainment at all ages (Connelly and Gayle 2019; Deary et al. 2007; Feinstein 2003; Marks 2014, 2021; Nash 2001; Ritchie 2015; Schoon 2010; Strenze 2007), even in the relatively few studies that have found some weakening of its statistical effects over time (Machin and Vignoles 2004; Galindo-Rueda and Vignoles 2005). Intelligence predicts social mobility (Breen and Goldthorpe 2001; Deary et al. 2005; Johnson, Brett, and Deary 2010a; Nettle 2003; Strenze 2007), partly but not wholly because it mediates between class of origin and class of destination (Betthäuser, Bourne, and Bukodi 2020; Bourne et al. 2018; Deary et al. 2005; Johnson et al. 2010a; Marks 2020). Intelligence predicts health, well-being, and longevity (Calvin et al. 2017; Deary et al. 2010), only partly mediated by education and attained social status (Wraw et al. 2016; Wrulich et al. 2013). Intelligence predicts civic engagement and holding socially tolerant values (Carl 2014; Schoon et al. 2010). Intelligence is also stable across the lifecourse (Deary et al. 2000).

The ultimately beneficial effects of high measured intelligence do not accrue equally to people who grew up in different social circumstances because intelligence is also associated with childhood social class, a finding that is stable across cultures and periods since the early twentieth century and confirmed by a variety of ways of measuring social class (Dickerson and Popli 2016; Duff and Thomson 1923; Feinstein 2003; Haveman and Wolfe 1995; Johnson, Brett, and Deary 2010b; Lawlor et al. 2005; Letourneau et al. 2011; Marks 2014; McCulloch and Joshi 2001; Rindermann and Ceci 2018; Sullivan, Ketende, and Joshi 2013; von Stumm et al. 2010). This association, and the possibility that it might change over time, is the starting point for the present analysis, as it was for Connelly and Gayle (2019).

Reasons to expect that the class-by-intelligence association might have changed may be found in the discussion of the rise of intelligence scores throughout the twentieth century (Flynn 2007; Pietschnig and Voracek 2015; Trahan et al. 2014). Many of the explanations which have been offered for this might have had a different impact on different social groups. Pietschnig and Voracek (2015) list these explanations as relating to improvements in levels of pollution (such as lead), nutrition, health care, education, the general standard of living, and the wider social environment (such as housing and work); a more stimulating visual environment (e.g., television and computers); a more stimulating cultural environment (mainly the effect of having better educated peers); and changes in fertility (so that more children are in smaller families and thus getting a greater share of parental resources and attention). Some of these changes have probably widened the social-class differences among children reaching the end of primary school in the first decade of the present century compared with half a century earlier, for example, in nutrition (James et al. 1997; Lynn 1990), in environmental toxins (Kaufmann et al. 2014; Mitchell, Norman, and Mullin 2015), and as indicated generally by the widening social-class gaps in the incidence of infant mortality (Congdon et al. 2001; Pamuk 1988). Others may have narrowed differences, for example, the ending in Britain of nearly all grossly inadequate housing (Rodger 1989; Yelling 2000).

Of particular relevance to the effect on the social-class distribution of children's intelligence are the rising levels of education during the second half of the twentieth century (Roser and Ortiz-Ospina 2019). One possible effect of this is indirect, through a changing relationship between parental social class and parental education (von Stumm et al. 2010). Because children's intelligence is associated with parental education independently of parental class (Sullivan et al. 2013; Sullivan, Moulton, and Fitzsimmons 2021), there is scope here for changing levels of parental education to modify the relationship of children's intelligence and class. Several studies have found that children's intelligence is more strongly associated with parental education than with parental income or class (Anger 2012; Lemos, Almeida, and Colom 2011; Rindermann and Ceci 2018). The rising levels of education also might have had a direct impact because education promotes intelligence, although the association is weaker than the longitudinal association of prior intelligence with education (Ritchie and Tucker-Drob 2018). Thus any improvement in the quality of primary-school education might potentially have had a socially equalizing effect on intelligence measured at around age 11.

In short, measures of intelligence raise important questions for the study of social inequality. Our analysis here is an extension of the work of Connelly and Gayle (2019), who noted that there are very few published investigations of the changing social-class distribution of intelligence (P. 92). In their pioneering research, they used two large longitudinal investigations of British birth cohorts, the National Child Development Study (children born in 1958) and the British Cohort Study (1970). They found that, controlling for children's sex and parental education, there was no evidence of a statistically significant change between the surveys in the social-class differences in children's intelligence (Pp. 98–99). We seek to extend that analysis backward and forward in time, to children born between 1936 and 2000 to 2002. As with any long-term analysis of social change, the gain of perspective is at the price of compromises in comparability of measures, in contrast to Connelly and Gayle's careful attention to comparability over a much shorter period. So part of our analysis is various checks of robustness.

Our intention here is to describe social change, rather than to find empirical evidence for causal links, and the intention is certainly not to imply that social class or other family characteristics can explain individual differences of intelligence. In that sense, the purpose is sociological, or social-historical, rather than psychological, even though the main outcome variable is based on psychological measures of intelligence. The aim is to investigate whether a common assumption in sociological research, that intelligence is associated with social class and that social class may thus be used in statistical models as a possibly imperfect surrogate for intelligence, is valid over a long period of time.

Methods

We compare the social-class distribution of intelligence measured at around age 11 for children born in 1936, 1946, 1958, 1970, and 2000 to 2002. The sources used for 1958 and 1970 are the same as in Connelly and Gayle (2019); we explain below how our choice and coding of variables differ from theirs. The surveys from which the data come will be referred to by the date at which measures of intelligence were obtained. The sample sizes available for analysis are shown in Table 1(a) below.

Scottish Mental Survey 1947: Intelligence at Age 11 in 1947

This was conducted by the Scottish Council for Research in Education (https://archiveshub.jisc.ac.uk/data/gb248-ugc171; Deary, Whalley, and Starr 2009). Almost every 11-year-old who was at school in Scotland was tested, and a detailed sociological inquiry was made into the lives of the 1,208 children who were born on the first day of the even-numbered months and who were thus representative of the population of Scottish children born in 1936.

National Survey of Health and Development: Intelligence at Age 11 in 1957

This study has followed a socially stratified (and thus nationally representative) sample of children born in March 1946 to married parents (https://mrc.ukri.org/research/facilities-and-resources-for-researchers/cohort-directory/mrc-national-survey-of-health-and-development-cohort-1946-birth-cohort-nshd-1946bc/; Kuh et al. 2011).

National Child Development Study: Intelligence at Age 11 in 1969

This study has followed everyone born in Britain in a specific week in 1958 (https://cls.ucl.ac.uk/cls-studies/1958-national-child-development-study/).

British Cohort Study: Intelligence at Age 10 in 1980

This has followed everyone born in Britain in a specific week in 1970 (https://cls.ucl.ac.uk/cls-studies/1970-british-cohort-study/).

Millennium Cohort Study: Intelligence at Age 11 in 2012 to 2013

This has followed a sample of children born between 2000 and 2002 in all parts of the United Kingdom, stratified by deprivation level of the area of residence and, in England, by the proportion of people in that area who were from ethnic-minority groups (https://cls.ucl.ac.uk/cls-studies/millennium-cohort-study/). The statistical models allow for this stratification and for the clustered sample; weights also allow for differential nonresponse at the fifth sweep, which covered children aged 11. For brevity, we refer to this sweep as 2012, its modal year. For comparability with 1957, 1969, and 1970, we use the 2012 data from England, Wales, and Scotland.

Our main analysis uses the data from the whole of Britain where available (1957 to 2012) and from Scotland in 1947. To allow for the 1947 restriction to Scotland, we also repeat the analysis for people living in Scotland in the relevant years. We briefly use the Growing Up in Scotland Survey to comment on the validity of data from the Millennium Cohort (https://growingupinscotland.org.uk/; ScotCen Social Research 2018). It has followed a sample of children born in 2005; we use the cognitive measures taken at age 10 in 2015.

The analysis variables are measures of intelligence, sex, the social class of the child's family, and the education level of the parents. The only relatively unproblematic variable is sex, as recorded dichotomously at birth for the first four surveys and at the age-seven sweep for the 2012 survey.

For our measure of intelligence, we adopt a more pragmatic (and thus less theoretically satisfactory) approach than Connelly and Gayle (2019). The following measures are available:

- 1947: Form L of the Terman-Merrill revision of the Stanford-Binet scale, at age 11 (Deary et al. 2009)
- 1957: test of general cognitive ability at age 11 that included verbal and nonverbal items (Pigeon 1964)
- 1969: test of general cognitive ability at age 11 (Shepherd [2012:6] explains that this test consisted of 40 verbal and 40 nonverbal items and that children were tested individually by teachers. The resulting scale had a reliability of 0.94 and had a correlation of 0.92 with an "IQ-type test used for secondary school selection.")
- 1980: tests from the British Ability Scales at age 10, using the mean of the scores on the word-definitions, similarities, and matrices scales (Elliott, Murray, and Pearson 1978)
- 2012: the similarities test from the British Ability Scales at age 11

Ideally we would have had the same test on each occasion. In particular, it would have been preferable if more than one subscale from the British Ability Scales had been available in 2012; the absence of that was the main reason why Connelly and Gayle did not include the 2012 data in their analysis. However, other writers have used the available subscale from 2012 to compare with the 1958 and 1970 birth cohorts (Goisis, Özcan, and Myrskylä 2017). Each subscale may be thought of as a sample of the specific abilities that constitute general intelligence (Johnson et al. 2004; McDermott, Fantuzzo, and Glutting 1990:290). The unreliability of using only a subscale will inflate the between-person variance but not lead to bias. In practice, from the 1980 data (where other scales are available) the correlation of the similarities subscale with the overall measure was 0.87. Moreover, in that year, using the similarities subscale in a linear regression to predict the composite scale had a distribution of standardized residuals that produced an almost perfect straight line in a probability plot against a standard normal distribution. These results are reassuring that using the similarities subscale as a surrogate for the full scale would inflate error but not lead to bias. In our robustness checks below, we assess the effect of using only this subscale in 1980.

Because the tests are different in the different surveys, we standardize each of them to have mean 0 and standard deviation 1 in the sample. Goisis et al. (2017:87) did the same for the last three surveys to investigate the association between low birth weight and intelligence, noting that the standardization is equivalent to ranking the children by intelligence within cohort. Although we will continue to refer to this measure as "intelligence," it is better described as "relative intelligence," where the comparison is with peers who have the same year of birth.

For our measure of family social class, we are again constrained by what is available in surveys that span a very long stretch of time. The only measure of class that is available in the 1947 survey is the Registrar General class of the father, a classification of occupations that was used in official statistics from 1911 until the 1990s (Knight 1967). For most of the analysis, we use that measure from each of the surveys, recorded at the relevant sweep. The measure is in the archived data sets for the 1957, 1969, and 1980 surveys. For the 2012 survey, an approximation to Registrar General class was constructed from the National Statistics Socio-Economic Classification, as mapped by Table 8 of the Office for National Statistics (2004:24). This official classification replaced the older one from the 2001 census onward. In the 1947, 1957, and 1969 surveys, the measure is available only for fathers. In the 1980 and 2012 data, it is available for mothers also. For consistency in the main analysis, we use father's class in all years, but in 1980 and 2012 we substitute mother's class where information on father's class is missing. This substitution added class information for six percent of cases in 1980 and 19 percent in 2012. In the robustness checks, we also re-ran the statistical models using father's class in 1947, 1957, and 1969 and the higher of the available measure of mother's and father's class in 1980 and 2012.

The Registrar General scheme, as used here, consists of five categories mainly based on occupation but also taking account of managerial responsibilities and of self-employment. These five categories are as follows, with examples of occupation in each:

I	Professional	scientist, accountant, doctor
II	Intermediate	school teacher, production manager, nurse
III	Skilled	secretary, shop assistant, electrician
IV	Partly skilled	machine operator, waiter, gardener
V	Unskilled	laborer, caretaker, cleaner

Although class III can be subdivided after the 1960s into "non-manual" and "manual," the classification for the 1947 survey did not recognize that subdivision, and so the undivided categories are used throughout. For most of the analysis, we group categories I and II and categories IV and V to avoid very small sample sizes in I and V at the beginning or end of the period. In practice, therefore, the inequality which we are measuring may be thought of as comparing the intelligence of children in three broad categories: professional and managerial (often colloquially referred to as "middle class"), technical and supervisory, and partly skilled or unskilled ("working class").

For the surveys in 1969, 1980, and 2012, we also constructed for the robustness checks an approximation to the Goldthorpe class scheme, using socioeconomic group, which was another official socioeconomic classification of occupations that was widely used in social research until 2000 (Goldthorpe and Jackson 2007:Table 1). In 2012, socioeconomic group itself has to be approximated from the National Statistics Socio-Economic Classification (Office for National Statistics 2004:25).

Some information on parental education is available for both parents (where present, and including stepparents and adoptive parents) in each survey, but in a variety of forms—years of full-time education, stage of completing education, and highest qualification achieved. The last is available only in the 2012 data and so cannot be used for comparison. Years of full-time education is available in all but the 1957 data, where the information is recorded as whether the parent had primary education only, secondary only, or schooling along with post-school technical education or higher education. In all the surveys, a parent who was still in full-time education was treated as having missing data (fewer than 0.5 percent in each survey that recorded this category explicitly).

Even if all the measures of parental education were the same, however, there would still be a problem of how to include them in statistical models, because of change over time in the social and educational significance of each measure, as secondary and higher education expanded massively. So we record parental education in relative terms. This follows Bukodi and Goldthorpe (2016) and Connelly, Gayle, and Lambert (2016), who use relative education as a way of allowing for educational expansion in models of attainment. We do this separately for mothers and fathers (where both are available) by converting the available scales into normal scores. Thus we have a measure of the rank order of each parent's education, ranked separately within each survey year but on the same scale in each year.

We use linear regression to summarize the relationship between the measure of intelligence and the specified explanatory variables. The explanatory variables are family social class (a categorical variable), the scaled educational levels of each parent (two continuous measures), and year (categorical). We test also for sex differences. For all the analysis, we omit cases with missing data on intelligence, social class, or parental education. The last of these led to quite significant loss of data in 1969 and 2012 especially: after omitting the other missing data, the missing percentages on either or both of father's and mother's education were (for the five years, respectively) 10 percent, seven percent, 32 percent, five percent, and 19 percent. So we repeat the analysis with respect to class alone on a data set that did not exclude the cases with missing data on parental education.

The results are summarized by chi-squared tests, which summarize the strength of the evidence for a relationship between an explanatory variable and intelligence, and by predicted values at specified combinations of the explanatory variables. The modeling was done in R using the package "svyglm" to allow the stratification and clustering of the 2012 survey to be taken into account (Hansen, 2014:19–24). The tables show Type II tests (with the analysis of variance function from the "car" package in R), which are the results of dropping each term in turn from the model

Table 1: Father's social class and parental education, by year

(a) Father's social class

	Social class						Sample size
	I	II	III	IV	V	Unclassified	(=100%)
1947	2	9	54	18	17	0	1,085
1957	2	8	50	24	8	9	3,740
1969	5	17	48	16	5	9	9,603
1980	5	21	48	12	4	10	10,986
2012	5	37	33	8	2	15	8,689

(b) Parental education

	Ages at which parents left full-time education			
	Both 15 or younger	One 16, neither older	One, not both, 17	Both 17 or older
1947	92	5	3	1
1957	81	16	3	1
1969	69	14	11	5
1980	55	19	16	10
2012	2	30	35	33

Notes: Data are expressed as percentages in rows. In (a), in 1980 and 2012, cases with missing values for father's class have been given the value of mother's class. In (b), in 1957, the age at which parents left full-time education was inferred from their highest stage of education. Cases with missing data for both parents on this variable are omitted.

shown in the table. Where mean predictions are compared, the standard errors are derived from the full covariance matrix of the predictions ("vcov" in R).

Analysis

Table 1(a) shows the change over time in family social class and the sample size in each year. The change reflects the decline of the manual categories (class V at first and then also class IV) and a growth of non-manual groups. The intermediate class III declined toward the end of the period, leading to an expansion of class II. In terms of the class groups that we use in the analysis, the proportions in the two outer groups (omitting "unclassified") reversed, from 12 percent in classes I and II and 34 percent in classes IV and V to 49 percent in classes I and II and 12 percent in classes IV and V. Table 1(b) summarizes the changes in parental education (confined to cohort members for whom this information was available for at least one parent). For the 1957 cohort, and for this table only, we approximate this by equating primary education to 15 or younger, secondary education to 16, and advanced education to 17 or older. Having any parent educated to age 17 or older was rare in the 1940s and 1950s but become common in the 1980s and the norm by 2012. The fall between 1980 and 2012 in the proportion of parents who left full-time education before age 16 reflects the raising of the school-leaving age to 16 in 1973: any parent aged less than about 42 in 2000 to 2002 would have been required to stay on to age 16.

Table 2: Model of standardized intelligence in terms of year and class

(a) Chi-squared tests

Model term	Degrees of freedom	Chi-square	p value
Year	4	74	< 0.001
Class	2	2,423	< 0.001
Year:class	8	99	< 0.001
R^2	7.4%		

(b) Predicted mean standardized intelligence

Class	Year				
	1947	1957	1969	1980	2012
I and II	0.47	0.42	0.49	0.45	0.15
	(0.11)	(0.04)	(0.02)	(0.02)	(0.03)
III	0.09	−0.12	−0.05	−0.11	−0.15
	(0.04)	(0.03)	(0.01)	(0.01)	(0.03)
IV and V	−0.31	−0.41	−0.37	−0.41	−0.32
	(0.05)	(0.03)	(0.02)	(0.02)	(0.05)
Gap	0.78	0.83	0.86	0.86	0.47
	(0.12)	(0.05)	(0.03)	(0.03)	(0.05)

Notes: The colon symbol : means interactive term. Intelligence is standardized within year. Cases with missing data on social class or on parental education are omitted. Standard errors of individual means are in brackets below the means. "Gap" means classes I and II minus classes IV and V.

Table 2 is essentially a summary of the means of standardized intelligence, by year and class. The low value of R^2 (7.4 percent) shows that social class is only a small part of any explanation of individual differences of intelligence. Nevertheless, the model confirms that there are social-class patterns of intelligence. The interactive effect in Table 2(a) shows that the statistical association between class and filial intelligence changed over time, but the effect is much smaller than the main effect of class.

The details are in Table 2(b) and Figure 1, which show the means of intelligence by year and class (i.e., the predicted values from the model in Table 2(a)). Recall that the scale here is units of a standard deviation of intelligence within each year. The gap of intelligence between the high and low classes was quite stable up to 1980 (0.78, 0.83, 0.86, and 0.86) but then fell to 0.47 in 2012.

The fall of just more than one-third of a standard deviation is similar to the average difference up to 1980 between the middle and the bottom class group, or to about two-thirds of the difference between the top and the middle. The fall is also equivalent to about two decades of the rise in the average level of measured full-scale intelligence across the population as a whole (Pietschnig and Voracek 2015). The fall of inequality is thus large in substantive terms as well as being statistically significant.

That the fall in mean intelligence after 1980 in the top classes (−0.30) is more than three times as great as the increase in the bottom two (0.09; p value for the difference of the absolute differences is 0.004) suggests that the reduction of the gap

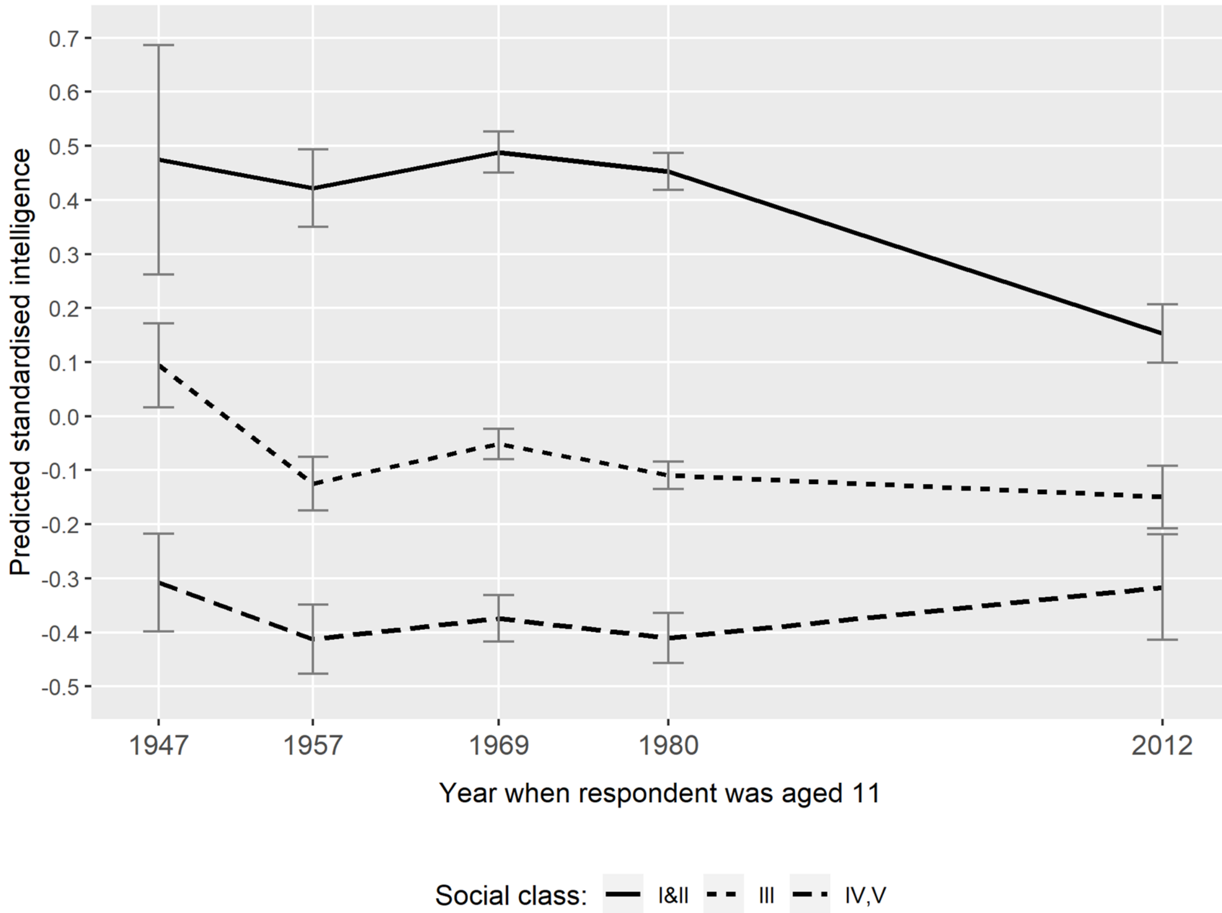

Figure 1: Predicted mean intelligence, by class and year. Error bars are 95 percent confidence intervals for individual points. Source: Table 2(b).

in 2012 is not due simply to the class measure's becoming less reliable. If that were the case, we would expect convergence of all the classes toward the middle of the distribution of intelligence, which, over the long term, is not what we observe in Figure 1.

For consistency with later tables, this analysis uses the data that excluded cases with missing data on parental education. Repeating the analysis in Table 2 but including these cases (and thus omitting only cases with missing data on intelligence or social class) gave results that, if anything, strengthened the trend in Table 2. All the predicted means were within one standard error of those shown in that table. The decline of the class gap between 1980 and 2012 was from 0.86 to 0.45, or 0.41 in place of 0.39 in Table 2(b). It is unlikely, therefore, that excluding missing data on parental education has distorted the main conclusion.

There was very little statistical effect of adding sex to the model in Table 2(a). The average effect of sex had a chi-squared value of 0.35 (1 degree of freedom), and the interactive effect with class had a chi-squared value of 0.88 (2 degrees of freedom). Sex had little effect on the change over time in the effect of class (11 on 8 degrees of freedom, $p = 0.18$). In the model with sex, the average effects of year and class, and their interactive effect, were similar to those in Table 2(b). Therefore we do not include sex in any further models.

The fall in the average intelligence of children in classes I and II in Table 2(b) reflects the greater heterogeneity of these classes as they have expanded. Following the research literature cited earlier, we might hypothesize that one source of heterogeneity would be parental education. The summary of the association of filial intelligence and parental education is in Table 3(a). Education has explained more of the variance of intelligence than class did (9.8 percent compared with 7.4 percent), similar to the findings of previous researchers as noted above. Again, the main feature is the average effects of parental education, but there is also clear evidence of a change in these effects over time. This is shown in detail in Table 3(b) for combinations of mother's and father's education within year: at their means and at one-half of a standard deviation above and below these means. The table also shows the gaps in mean intelligence with respect to mother's education, at each level of father's education. The gap does vary in some respects in the early years (notably rising in 1957 at low levels of father's education) but is lowest in 2012 at each level of father's education. Nevertheless, the decline in the statistical effect of education in 2012 (Table 3(b)) is less than the decline in the statistical effect of class (Table 2(b)).

Table 4(a) shows the result of modeling the statistical effects of class, controlling for parental education. The explanatory power has increased again, by 25 percent from the model with education only and by 65 percent from the model with class only. There is evidence that the change over time in the statistical effect of class varies by mother's education but not by father's education. Table 4(b) shows the resulting predicted mean filial intelligence for each class, holding constant father's education at its mean within year but allowing mother's education to vary. At each level of mother's education, the decline in the class gap from 1980 to 2012 is less than the decline in the class gap in the model without parental education (0.39 in Table 2(b); 0.26, 0.27, and 0.27 in Table 4(b)): that is, parental education has explained about one-third of the decline in the class gap.

Before we draw conclusions, we summarize the effect of four of the decisions that we made in defining the statistical models. Full details are in the online supplement.

Use of Scotland-Only Data in 1947

The model in Table 2 and Figure 1 was re-run using only the Scottish data for all the surveys. The general pattern was similar. In particular, there was a clear decline in the class gap in filial intelligence mainly due to a fall in mean intelligence in grouped classes I and II.

Choice of Intelligence Measure

There are two aspects. The main one is the use of the only available subscale of the British Ability Scales in 2012, the similarities test. We assess the effect of this on the

Table 3: Model of standardized intelligence in terms of year and parental education

(a) Chi-squared tests

Model term	Degrees of freedom	Chi-square	p value
Year	4	29	< 0.001
Father's education	1	543	< 0.001
Mother's education	1	760	< 0.001
Year:father's education	4	48	< 0.001
Year:mother's education	4	34	< 0.001
Father's education:mother's education	1	15	< 0.001
Year:father's education:mother's education	4	40	< 0.001
R^2	9.8%		

(b) Predicted mean standardized intelligence

Father's education	Mother's education	Year				
		1947	1957	1969	1980	2012
0.5 s.d. below mean	0.5 s.d. below mean	−0.22	−0.39	−0.21	−0.25	−0.20
		(0.04)	(0.02)	(0.01)	(0.01)	(0.03)
	Mean	−0.12	−0.21	−0.13	−0.14	−0.10
		(0.04)	(0.02)	(0.01)	(0.01)	(0.03)
	0.5 s.d. above mean	−0.02	−0.02	−0.05	−0.03	−0.01
		(0.05)	(0.04)	(0.02)	(0.02)	(0.03)
Gap		0.20	0.36	0.16	0.22	0.19
		(0.05)	(0.04)	(0.02)	(0.02)	(0.02)
Mean	0.5 s.d. below mean	−0.16	−0.21	−0.10	−0.16	−0.15
		(0.04)	(0.02)	(0.01)	(0.01)	(0.03)
	Mean	−0.03	−0.05	−0.02	−0.04	−0.05
		(0.03)	(0.02)	(0.01)	(0.01)	(0.03)
	0.5 s.d. above mean	0.09	0.10	0.06	0.08	0.04
		(0.04)	(0.03)	(0.01)	(0.01)	(0.03)
Gap		0.25	0.31	0.16	0.25	0.19
		(0.05)	(0.03)	(0.01)	(0.01)	(0.01)
0.5 s.d. above mean	0.5 s.d. below mean	−0.09	−0.04	0.01	−0.08	−0.10
		(0.05)	(0.04)	(0.02)	(0.02)	(0.03)
	Mean	0.05	0.10	0.09	0.06	0.00
		(0.04)	(0.03)	(0.01)	(0.01)	(0.03)
	0.5 s.d. above mean	0.20	0.23	0.17	0.19	0.09
		(0.04)	(0.03)	(0.01)	(0.01)	(0.03)
Gap		0.29	0.26	0.16	0.27	0.19
		(0.05)	(0.03)	(0.01)	(0.01)	(0.01)

Notes: The colon symbol : means interactive term. Intelligence is standardized within year, and parental education is ranked within year. Cases with missing data on parental education are omitted. Standard errors of individual means are in brackets below the means. "Gap" means 0.5 standard deviation (s.d.) above mean minus 0.5 s.d. below.

Table 4: Model of standardized intelligence in terms of year, class, and parental education

(a) Chi-squared tests

Model term	Degrees of freedom	Chi-square	p value
Year	4	66	< 0.001
Class	2	852	< 0.001
Father's education	1	237	< 0.001
Mother's education	1	521	< 0.001
Class:father's education	2	3.2	0.21
Class:mother's education	2	7.1	0.03
Year:class	8	49	< 0.001
Year:father's education	4	27	< 0.001
Year:mother's education	4	24	< 0.001
Year:class:father's education	8	3.3	0.92
Year:class:mother's education	8	19	0.02
R^2	12.2%		

(b) Predicted mean standardized intelligence

Mother's education	Class	Year				
		1947	1957	1969	1980	2012
0.5 s.d. below mean	I and II	0.04	0.17	0.29	0.14	−0.02
		(0.15)	(0.05)	(0.03)	(0.03)	(0.06)
	III	−0.01	−0.21	−0.10	−0.18	−0.22
		(0.05)	(0.03)	(0.02)	(0.02)	(0.03)
	IV and V	−0.34	−0.36	−0.40	−0.42	−0.31
		(0.05)	(0.05)	(0.03)	(0.03)	(0.03)
Gap		0.38	0.53	0.69	0.56	0.30
		(0.16)	(0.08)	(0.04)	(0.04)	(0.06)
Mean	I and II	0.17	0.21	0.33	0.24	0.06
		(0.12)	(0.05)	(0.02)	(0.02)	(0.03)
	III	0.10	−0.05	−0.03	−0.07	−0.13
		(0.04)	(0.02)	(0.01)	(0.01)	(0.03)
	IV and V	−0.27	−0.22	−0.32	−0.34	−0.25
		(0.05)	(0.05)	(0.02)	(0.03)	(0.05)
Gap		0.44	0.43	0.65	0.58	0.31
		(0.13)	(0.07)	(0.03)	(0.03)	(0.05)
0.5 s.d. above mean	I and II	0.30	0.25	0.38	0.35	0.14
		(0.13)	(0.05)	(0.03)	(0.02)	(0.03)
	III	0.21	0.12	0.04	0.05	−0.03
		(0.05)	(0.03)	(0.02)	(0.02)	(0.03)
	IV and V	−0.20	−0.07	−0.23	−0.25	−0.19
		(0.06)	(0.07)	(0.03)	(0.04)	(0.06)
Gap		0.50	0.32	0.61	0.60	0.33
		(0.15)	(0.09)	(0.04)	(0.04)	(0.06)

Notes: The colon symbol : means interactive term. Father's education is at mean within year. Intelligence is standardized within year, and parental education is ranked within year. Cases with missing data on social class or parental education are omitted. Standard errors of individual means are in brackets below the means. "Gap" means classes I and II minus classes IV and V. "s.d." means standard deviation.

models by restricting the 1980 measure of intelligence to that subscale as well. The result showed, in 1980, an attenuation of 13 percent compared with Table 2(b) in the gap between the predicted means for classes I and II and classes IV and V, much less than the 45 percent reduction from 1980 to 2012 in Table 2(b). So the reduction is unlikely to be due to attenuation.

The other aspect of the choice of intelligence is whether a measure of general intelligence (as we have used) might have a different relationship to class from the relationship with class of more specific types of cognitive ability. A range of other measures were available from these surveys—testing reading and arithmetic, verbal intelligence, nonverbal intelligence, and vocabulary. All but one of the correlations were within 10 percent of the correlation of general intelligence, the exception being verbal intelligence in 1947, which was 15 percent lower. So our choice of intelligence measure has probably not biased the results.

Measurement of Social Class

There are again two aspects. One is whether to use both parents to measure family class. Using both where information is available on each (in 1980 and 2012) had little effect on the results.

The other is the choice of Registrar General class (because it was the only measure that was available in all the surveys). We re-ran the analysis using the more sociologically valid Goldthorpe scheme in 1969, 1980, and 2012. As in Table 2, the results showed a fall in the gap between high and low classes, mainly due to a fall in the mean intelligence in the higher classes.

Choice of Millennium Cohort Study

We compared the class differences for 2012 with the Growing Up in Scotland study (ScotCen Social Research 2018), which assessed intelligence at age 10 in 2015 by the "Listening Comprehension" subtest of the Wechsler Individual Achievement Tests. The results suggested that inequality of intelligence as measured by the two surveys was similar.

Conclusions

The strength of this analysis is in the quality of the surveys used and the length of time which they cover. No previous study has attempted to measure the change in the association of childhood intelligence with parental social class over such a long period. The surveys have given us valid and reliable measures of intelligence for a period of 64 years, much longer than in any previous research. During this time the social structure of Britain changed profoundly, and the education of parents grew radically. We are thus able to calculate credible estimates of whether these changes led to a change in the social-class distribution of children's intelligence. To achieve this length of coverage, the analysis has had to take risks with the validity and comparability of measures, and so we have also tried to estimate how robust the conclusions are. On the whole, the analysis in the online supplement concluded that the results are robust.

Our analysis has shown that filial relative intelligence was correlated with family social class and parental education in each year, even while the class structure changed from being predominantly working class to the opposite, and as the distribution of parental education shifted upward as a result of a century of educational expansion. But, although the association with class was stable from the 1940s to the 1980s through these large changes, it had weakened by 2012, mainly because of a fall in the mean relative intelligence of children in the highest classes.

Our data do not provide an explanation of this change, partly because we have no access to information on a crucial pathway between parental social class and filial intelligence, namely, parental intelligence (Marks 2014:57–60, 2021). That confounding is partly because parental socioeconomic status is associated with parental intelligence and partly because both of these are influenced by other parental characteristics that are also associated with filial intelligence, notably some of the genetic sources of both parental and filial intelligence (Knopik et al. 2017:167–91). There are no long-term time series that would allow an assessment of whether the role of parental intelligence in these respects has changed. If parental socioeconomic status were coming to be less strongly associated with parental intelligence, then we might expect to see a weakening of the association between socioeconomic status and filial intelligence.

Nevertheless, although we have not had access to information on parental intelligence, we do have measures of parental education. This control partly explained the decline in the class gap in children's intelligence. Because parental education is a strong correlate of filial intelligence, this suggests that perhaps the explanation may lie in a weakening of the link between parental education and parental social class at an early point in parents' occupational careers when their children were young, and thus, in this respect, a greater heterogeneity of the highest class. This would be a reversal of the process that von Stumm et al. (2010:209) speculated might explain the rise in the association of parental socioeconomic status and childhood intelligence between children born in the 1920s and in the 1950s, as meritocratic recruitment into the labor market grew. If parental occupational attainment has become less meritocratic in recent decades, as some writers have suggested (Jackson, Goldthorpe, and Mills 2005:7–10; Wooldridge 2021:306–28), then the association of parental education with childhood intelligence would no longer be so strongly captured by the association of parental education with parental occupation. That our parental-education variables have explained only a part of the decline may be due to these variables' being quite crude measures, merely years of full-time education rather than more finely differentiated scales, and might also be due to a less-than-perfect correlation between parental education and parental intelligence.

These findings have implications for how we interpret the social-class distribution of opportunity. The very fact of there being some change in the social-class differences of measured intelligence raises questions about the sociological theories of intelligence that we cited earlier. Just as changing class inequalities of educational attainment lead to doubts that class strongly limits some children's potential (Goldthorpe 1996), so, too, do changes of class inequality in measured intelligence require new sociological explanations of how class relates to intelligence that go beyond earlier claims that intelligence tests straightforwardly reflect social class.

This question matters further because promoting opportunity for children in low social classes has long been a goal of policy. Recent research has noted, for example, some reduction of class inequality in entry to higher education (Harrison 2018), and in policy debates this is often celebrated as an achievement for lower-class young people. But our findings raise doubts about that interpretation. The change of inequality with respect to class of origin of entry to higher education may be a consequence, not of any increase in opportunity for children of low social classes, but rather of a reduction of opportunity for people in higher classes, a reduction brought about by their falling mean relative intelligence. Such new questions will become more extensive as the children in our youngest cohort reach adulthood. If intelligence remains more strongly a predictor of adult outcomes than class of origin—thus continuing to be consistent with the research cited earlier—then the causal role of intelligence, independent of origin class, will have been clarified. But if the weakening of the correlation between intelligence and class of origin leads to a relative strengthening of class-of-origin effects on adult outcomes, then the primacy of intelligence over origin class will be brought into question.

Ethics

The research used only secondary data and was conducted according to the ethical guidelines of the British Educational Research Association. The original data collection obtained informed consent of the parents or guardians of the children (who were aged 10 to 11 years).

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Lindsay Paterson: School of Social and Political Science, University of Edinburgh. E-mail: lindsay.paterson@ed.ac.uk.