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The Effects of Social Origins and Cognitive Ability on Educational Attainment: Evidence from Britain and Sweden

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Abstract

In previous work we have shown that in Britain and Sweden alike parental class, parental status and parental education have independent effects on individuals' educational attainment. In this paper we extend our analyses, first, by including also measures of individuals' early-life cognitive ability and, second, by bringing our results for Britain and Sweden into direct comparative form. On the basis of extensive birth-cohort data for both countries, we find that, when cognitive ability is introduced into our analyses, parental class, status and education continue to have significant, and in fact only moderately reduced and largely persisting, effects on the educational attainment of members of successive cohorts. There is some, limited evidence for Britain, but not for Sweden, that cognitive ability has itself a declining effect on educational attainment, and a further cross-national difference is that in Britain, but not in Sweden, some positive interaction effects occur between advantaged social origins and high cognitive ability in relation to educational success. Overall, though, cross-national similarities are most apparent, and especially in the extent to which parental class, status and education, when taken together, create wide disparities in the eventual educational attainment of individuals who in early life were placed at similar levels of cognitive ability. Some wider implications of these findings are considered.

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Introduction

In previous work (Bukodi and Goldthorpe, 2012; Erikson, 2012) we have shown that across successive birth cohorts, in Britain and Sweden alike, parental class, parental status and parental education have independent and in some degree distinctive effects on individuals' levels of educational attainment. This means that parental class, status and education should not be seen as 'interchangeable indicators' (cf. Lazarsfeld, 1939) of social origins. They have, rather, to be recognised as three different components of social origins that need to be considered together if the effects of social origins on individuals' educational attainment – and changes in these effects – are not to be misconstrued.[1]

In the present paper, we extend our analyses, first, by including also measures of individuals' cognitive ability; and, second, by bringing together results for Britain and Sweden in comparative form. Our focus on these two countries is largely dictated by considerations of data. So far as we are aware, they are the only countries for which data are available for a series of birth cohorts that include measures of cohort members' cognitive ability taken at a fairly early age, as well as data of high quality relating to their social origins and educational histories. It is, though, of further interest that Britain and Sweden have often been contrasted, over the historical period we cover, as regards differences in both inequality of condition and opportunity. At least up to the 1990s, Sweden had distinctively low levels of economic inequality associated with its social-democratic political economy and welfare state (see e.g. Parkin, 1971; Scase 1977; Esping-Andersen, 1990). And at the same time, Sweden might be

[1] In our previous work we found that parental income exerts an additional independent effect on children's educational attainment over and above those of parental class, status and education. We do not consider parental income in the body of present paper, since we do not have relevant data for the British 1946 cohort and also doubt the comparability of those for the 1958 and 1970 cohorts (Erikson and Goldthorpe, 2010) but in *Appendix 2* we report results from some analyses including parental income and consider their implications.

thought exceptional in the degree to which educational reforms have been carried out with the 'explicit aim' (Erikson and Jonsson, 1996: 2) of reducing social inequalities in attainment – through the ending of early selection, mixed ability teaching, the elimination of 'dead-end' tracks, generous financial support for higher education and extensive adult education programmes.

We wish our motivations for introducing cognitive ability into our analyses to be clearly understood. It is regularly found that young children's cognitive ability, as measured by standard tests, is highly correlated with their subsequent levels of educational attainment (for a major meta-analysis, see Strenze, 2007). At the same time, though, if children's social origins – however treated – are also taken into account, it is no less regularly found that their effect on educational attainment still remains significant, controlling for cognitive ability (for Britain, see e.g. Galindo-Rueda and Vignoles, 2005; Richards, Power and Sacker, 2009; Schoon, 2010; and for Sweden, Erikson and Jonsson, 1993: ch. 7; Erikson and Rudolphi, 2010; Mood, Jonsson and Bihagen, 2012). This persisting effect of social origins is then of obvious interest, from both academic and policy standpoints, and it is our primary concern to explore it further. More specifically, we wish to take up the following questions.[2]

First, if, as in our previous work, we decompose social origins into parental class, status and education, is it the case that these components still have independent effects on individuals'

[2] One question that we do not address is that of the *relative importance* of social origins versus cognitive ability in regard to educational attainment. Crucial to any answer must of course be the way in which these variables, and especially social origins, are conceptualised and measured. From the meta-analysis of the relevant literature – mainly from the work of psychologists – referred to in the text above, Strenze (2007) concludes that parental 'socioeconomic status' and cognitive ability are of roughly equal importance. We would regard this as a very probable over-estimate of the part played by cognitive ability since, from the position we here take up, social origins in the literature reviewed would appear for the most part to be inadequately treated.

educational attainment over and above the effect of cognitive ability, and, if so, do these effects still operate across cohorts in similar or different ways in Britain and Sweden?

Second, when controlling for our three components of social origins, does the effect of cognitive ability on educational attainment itself show any change across cohorts, and, if so, in similar or different ways in Britain and Sweden?

Third, are there interaction effects between our three components of social origins and cognitive ability in regard to educational attainment, and, if so, is their extent and pattern similar or different in Britain and Sweden?

Fourth, and finally, how far do parental class, status and education, when taken together, create disparities in the educational attainment of individuals, whose early-life cognitive ability was at a similar level, and is the extent and pattern of these disparities similar or different in Britain and Sweden?

In pursuing these questions, the much debated issue of the relative importance of genetic and environmental influences in the determination of cognitive ability inevitably arises. While our present research does not address this issue, it can scarcely be avoided in our own – or others' – interpretation of the results we present. The following is therefore a brief statement of the position we take up.

Claims, deriving primarily from twin studies, that population variance in measured cognitive ability is largely genetic in origin - to which some sociologists (e.g. Saunders, 2010; Lucchini, Della Bella and Pisati, 2013; Nielsen and Roos, 2012) would give much weight -have of late become problematic as a result, somewhat ironically, of the establishment of the human genome. Such claims would lead to the expectation that molecular genetic variation should be identifiable that has a significant association with cognitive ability. But, so far, attempts to

find such variation have produced few reliably positive results (Chabris et al., 2012), and even these show associations of only a very weak kind (see e.g. Jerrim et al., 2013).[3] It may then be that heritability estimates from twin studies are exaggerated - for example, in depending on the assumption that exogenous environments are not more similar for monozygotic than for dizygotic twins. At the same time, though, the possibility also remains that cognitive ability is a highly polygenic trait, in regard to which common genetic variants play, individually, only very small parts and in ways that will require much further research to unravel. For the present, therefore, it would seem that there is little place for dogmatism of any kind - and including that involved in rejecting a priori (e.g. Dorling, 2010: 112-15) *any* role for genetic factors in the determination of cognitive ability.

Further, though, we are aware that research in the field of epigenetics especially may be leading to a virtual paradigm shift that would render the traditional nature/nurture opposition largely obsolete. Insofar as genes, or rather whole networks of genes, can be shown to differ significantly in their expression across different environments, then to seek a simple additive partitioning of genetic and environmental effects on variance in a phenotypical trait, such as cognitive ability, becomes highly problematic (cf. Heckman, 2007, 2013). It would appear far more relevant to envisage complex gene-gene and gene-environment interactions operating continuously in developmental processes from the womb onwards (see e.g. Jablonka and Lamb, 2006: chs. 2 and 4; Carey, 2012).

Given this position, we would wish to proceed pragmatically. As we have indicated, our interest centres on how far social origins, as indicated by parental class, status and education,

[3] This problem of 'missing heritability' is not confined to cognitive ability. The failure to find specific molecular variants that could account for the substantial genetic influences claimed on the basis of twin studies extends across a wide range of medical and psychological phenotypes (Manolio *et al.*, 2009).

have an effect on individuals' educational attainment over and above that of cognitive ability. But this does not imply that we regard cognitive ability as being itself uninfluenced by social origins. To the contrary, we have little doubt that it is – although to a degree and in ways that, for the present, are by no means fully understood. We therefore concentrate on the research questions set out above, to which we believe it is possible for us to give reasonably reliable answers, but with the clear recognition that in treating children's early-life cognitive ability as in effect a 'given', we shall be underestimating the effects of our social origin variables on educational attainment insofar as they *also* figure among the environmental factors that are involved in the development of cognitive ability.

Data and variables

Our data for Britain come from three birth cohort studies: the Medical Research Council Survey of Health and Development, the National Child Development Study and the British Cohort Study, which aim to follow through their life-courses children born in Britain in one week in 1946, 1958 and 1970, respectively (see further Ferri, Bynner and Wadsworth eds., 2003: Appendix 1). In each cohort we restrict our attention to cohort members on whom we have complete information on all variables discussed below. Given what is known about the nature of cohort attrition, this is likely to lead to some under-representation of individuals from disadvantaged social backgrounds.

Our data for Sweden relate to four cohorts of pupils in Swedish schools born in 1948, 1953, 1967 and 1972 who were the subjects of research by the Department of Education at Gothenberg University (Härnqvist, 2000). Ten per cent systematic samples were drawn of all pupils born in these years when they had reached Grade 6 – i.e. when almost all were 13 years

of age. We again work with complete cases but non-response rates are very low, ranging across cohorts from 1.8 to 7.4% plus some further cases where results from cognitive ability tests are missing chiefly because of children's absence from school. Data on the education and occupations of these pupils' parents were then taken from Censuses between 1960 and 1990 and from an Education Register that started in 1985, and data on pupils' own subsequent educational attainment were also obtained from this Register.

The dependent variable of our analyses is the highest level of educational attainment of members of the cohorts studied. In the case of Britain, this is determined by the highest level of formal qualification obtained by age 26 for the 1946 cohort and by age 34 for the 1958 and 1970 cohorts according to eight ordered categories of both academic and vocational qualifications ranging from 'no qualifications' to 'higher degree'. In Sweden, where, especially in secondary education, formal qualifications do not play the same role as in Britain, educational attainment is treated in terms of the highest level of education reached – in this case by age 32-40, and again according to eight ordered categories that range from 'compulsory only' to 'postgraduate'.

In *Tables 1* and *2* we show the corresponding distributions of cohort members. In both Britain and Sweden the proportion of those with minimal educational attainment can be seen to decline more or less steadily across the cohorts; but while in Britain a steady increase occurs in those with higher-level qualifications, in Sweden a comparable increase is apparent only with the most recent cohort, reflecting a period of slow growth in tertiary education following an earlier expansion. A further point of cross-national similarity that can be observed is that rising levels of educational attainment are more marked among women than among men.

Table 1: Educational attainment of cohort members, Britain

	1946 cohort		1958 cohort		1970 cohort	
Level of qualification	Men	Women	Men	Women	Men	Women
1. No qualifications	33.2	41	15.5	18.7	16	14.9
2. Below O-level or GCSE, NVQ 1 (sub-secondary)	4.6	11.8	14.9	15	9.9	12.6
3. 1-4 O-level or GCSE passes, NVQ2 (secondary –low performance)	20.1	23.7	21.1	22.7	21.6	23.1
4. 5+ O-level or GCSE passes or 1 A-level pass, NVQ 3 (secondary - high performance)	17.4	13.6	19.9	16.5	17.8	16.7
5. 2+ A-level passes (higher secondary)	1.6	0.9	3.8	3.5	3.2	3.6
6. Tertiary sub-degree qualification, NVQ 4 (lower tertiary)	14.9	6.3	12.5	14.2	13.7	11.6
7. Degree, NVQ5 or 6 (higher tertiary)	7.2	2.6	10.9	8.6	14	14.8
8. Postgraduate	1.1	0.1	1.4	0.9	3.8	2.7
Total	100.0	100.0	100.0	100.0	100.0	100.0
N	1879	1705	4182	4071	4075	4236

Table 2: Educational attainment of cohort members, Sweden

	1948 cohort		1953 cohort		1967 cohort		1972 cohort	
Level of education	Men	Women	Men	Women	Men	Women	Men	Women
1. Compulsory only	23.3	17.6	23.0	14.0	9.9	6.1	8.0	5.4
2. Lower secondary	12.1	21.7	7.1	15.7	5.7	11.3	7.6	13.0
3. Vocational upper secondary	22.8	17.0	23.3	16.8	39.8	26.1	36.8	22.2
4. Long upper secondary	5.3	7.0	8.2	12.2	5.0	6.6	1.9	1.9
5. Academic upper secondary	13.2	7.8	15.6	10.6	14.6	13.5	10.6	10.5
6. Post-sec., lower tertiary	6.4	12.2	8.3	15.7	11.9	17.9	17.6	19.0
7. Higher tertiary	15.9	16.1	13.6	14.7	12.2	18.1	16.3	27.1
8. Postgraduate	1.0	0.6	0.9	0.3	1.0	0.5	1.1	0.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
N	4037	3903	3785	3736	3489	3388	3308	3095

The independent variables of our analyses are parental class, parental status and parental education plus cognitive ability – all referring to members of the British cohorts at age 10-11 and to members of the Swedish cohorts at age 12-13.

Parental class is represented for Britain by the National Statistics Socio-Economic Classification (Office for National Statistics, 2005) and for Sweden by the Erikson-Goldthorpe-Portocarero schema (Erikson, Goldthorpe and Portocarero, 1979; Erikson and Goldthorpe, 1992), which has a very similar theoretical basis to NS-SEC. In the Swedish case EGP Classes V and VI cannot be distinguished. In the interests of comparability, we therefore work with a six-fold collapse of the two classifications, as shown in *Appendix 1*. In cases where cohort members were living with two employed parents the dominance method of class allocation (Erikson, 1984) was used.

Parental status is measured for Britain by the Chan-Goldthorpe status scale (Chan and Goldthorpe, 2004), which is based on the occupational structure of close friendship, and for Sweden by the CAMSIS scale (Prandy and Lambert, 2003), which is based on the occupational structure of marriage partners, and which we would interpret as a scale of status. These two scales are found generally to correlate at around 0.9. Where parents had different status scores, the higher score was taken, and in both national cases a 0-1 conversion of the scale scores was made.

As regards parental education, the available data are not sufficiently detailed to allow the same categories to be used as for cohort members' own education. British parents are allocated to seven ordered categories that relate to both parents' educational qualifications considered in combination, while Swedish parents are allocated to seven ordered categories of level of education according to whichever partner attained the higher level. When education is taken as an explanatory variable, and especially in analyses extending over a period in which

the distribution of education changed substantially, we believe it preferable to treat education in *relative* rather than absolute terms. We therefore score each parental category according to the proportion of parents *falling below that category* in the cumulative distribution for their children's cohort. Given the very small number of parents with the highest levels of education in our cohorts from the 1940s, these scores essentially vary between 0 and 1.

Finally, as regards cognitive ability, this is measured in the British case by the first principal component scores derived from analyses of results from the somewhat different verbal and non-verbal tests that were administered to children in the three birth cohorts (cf. Schoon, 2010). In the Swedish case, cognitive ability is measured as the sum of scores on three tests focused on verbal, spatial and reasoning capacities, which were administered to children in each cohort alike. While the scores we use could be taken as giving a close approximation to IQ scores referring to the general, latent (*g*) factor in intelligence, we prefer to treat them in a relative rather than an absolute sense: that is, as allowing us to place each individual within the distribution of cognitive ability for his or her own cohort. We therefore allocate cohort members to cohort-specific cognitive ability quintiles, in this way controlling for 'Flynn effects' – the tendency for IQ scores to increase over time (Flynn, 1987) – and also allowing any non-linear effects on educational attainment to show up.

Full information on the class, status and educational distributions of cohort members' parents is given in *Appendix 1*.

While all the variables that we distinguish are measured in ways that we would regard as providing an adequate degree of construct validity, it is evident from the foregoing that they are still measured in somewhat different ways for our two national cases. In interpreting the results of the analyses that we report, we shall therefore give major emphasis to cross-national

similarities that show up, while being cautious in claiming cross-national variation unless this is marked and in some way systematic.

Results

An overview

To provide an overview, we first of all undertake an OLS regression exercise, with cohort members' highest level of educational attainment being the dependent variable and parental class, status, and education and early-life cognitive ability being the independent variables. For this purpose, we scale our ordered educational categories from 1-8, and we reduce our six-category parental class variable to a four-level scale[4] scored 0-1, while also including a dummy variable for self-employment. In *Table 3* we show the results we obtain for men and in *Table 4* for women.

Under baseline Model 0 in these tables, we simply replicate our earlier findings that parental class, status and education have independent effects on individuals' educational attainment. With Model 1 we then introduce cognitive ability into the analysis. As would be expected, this has in both Britain and Sweden and for men and women alike a large effect on educational attainment. However, what can further be seen – and with direct relevance to our first research question – is that still under Model 1 the effects of parental class, status and education remain significant. Moreover, the coefficients for these effects *are not all that greatly reduced*. As may be calculated from Tables 3 and 4, they fall in most cases, and with a notable degree of cross-national similarity, by only around a third.

[4] I.e. for Britain, we collapse Classes 3, 4 and 5, and for Sweden, Classes III, IV and V+VI.

Table 3: OLS regression of educational attainment on cohort, parental class, status and education, and cognitive ability, men

	Britain						Sweden					
	Model 0			Model 1			Model 0			Model 1		
	B	t	sig.	B	t	sig.	B	t	sig.	B	t	sig.
Cohort												
1946 / 48	0.00	0.06		-0.02	-0.39		0.00	0.10		-0.06	-1.50	
1958 / 53 (ref.)												
1967							-0.02	-0.49		0.09	2.30	*
1970 / 72	0.16	3.73	**	0.11	2.82	**	0.12	2.70	**	0.27	6.71	**
Parental class (0-1)	**0.64**	7.79	**	**0.42**	5.55	**	**1.13**	14.75	**	**0.74**	10.65	**
Parental self-employment (0-1)	**-0.19**	-3.13	**	**-0.20**	-3.64	**	**-0.47**	-10.64	**	**-0.43**	-10.77	**
Parental status (0-1)	**1.14**	11.51	**	**0.71**	7.72	**	**1.45**	10.42	**	**0.97**	7.64	**
Parental education (0-1)	**1.45**	25.07	**	**0.93**	16.99	**	**1.11**	20.15	**	**0.81**	16.21	**
Cognitive ability quintiles												
bottom				**-1.23**	-24.84	**				**-0.93**	-21.36	**
2nd				**-0.50**	-10.10	**				**-0.40**	-8.99	**
3rd (ref.)												
4th				**0.41**	8.12	**				**0.66**	15.06	**
top				**1.12**	21.41	**				**1.40**	31.33	**
Constant	2.42	53.85	**	2.96	55.68	**	2.45	49.29	**	2.73	51.09	**
R^2	0.15			0.28				0.18			0.33	

* p < 0.05; ** p < 0.01

Table 4: OLS regression of educational attainment on cohort, parental class, status and education, and cognitive ability, women

	Britain						Sweden					
	Model 0			Model 1			Model 0			Model 1		
	B	t	sig.	B	t	sig.	B	t	sig.	B	t	sig.
Cohort												
1946 / 48	-0.55	-13.71	**	-0.60	-16.09	**	-0.18	-4.14	**	-0.19	-4.74	**
1958 / 53 (ref.)												
1967							0.12	2.67	**	0.15	3.59	**
1970 / 72	0.23	5.92	**	0.36	9.96	**	0.35	7.44	**	0.43	9.94	**
Parental class (0-1)	**0.92**	12.27	**	**0.65**	9.42	**	**1.13**	14.31	**	**0.71**	9.83	**
Parental self-employment (0-1)	**-0.04**	-0.66		**-0.06**	-1.08		**-0.05**	-1.05		**-0.06**	-1.50	
Parental status (0-1)	**1.10**	12.12	**	**0.72**	8.67	**	**1.37**	9.46	**	**1.09**	8.22	**
Parental education (0-1)	**1.34**	25.08	**	**0.89**	17.80	**	**1.04**	18.18	**	**0.75**	14.29	**
Cognitive ability quintiles												
bottom				**-1.00**	-21.53	**				**-1.15**	-25.09	**
2nd				**-0.48**	-10.49	**				**-0.46**	-10.21	**
3rd (ref.)												
4th				**0.47**	10.26	**				**0.54**	11.71	**
top				**1.16**	24.57	**				**1.21**	25.51	**
Constant	2.21	53.63	**	2.56	52.71	**	2.71	51.96	**	3.09	55.10	**
R^2	0.23				0.35			0.17			0.31	

* $p < 0.05$; ** $p < 0.01$

It is of further interest to find considerable cross-national similarity also in the relative importance of different effects, as indicated by the t-values that we report.[5] With men, cognitive ability appears to have a somewhat greater effect on educational attainment in Sweden than in Britain (cf. Sorjonen et al., 2012) and – more surprisingly – advantaged class backgrounds also seem to count for more; but with women no such differences are apparent. Moreover, so far as our three components of social origin are concerned, we can say that in both countries and for men and women alike parental education has a greater effect on children's educational attainment than does either parental class or status.

To investigate possible changes over time, we then introduce cohort interaction terms into Model 1, with the results that are reported in *Table 5*.

As regards changes in social origin effects, in the British case these show up on essentially the same lines, though somewhat less strongly, as in previous analyses in which cognitive ability was not included (Bukodi and Goldthorpe, 2012: Tables 4 and 5): i.e. for both men and women there is no change in parental class effects, parental status effects weaken between the 1958 and 1970 cohorts, while parental education effects are weakest for the 1958 cohort.[6] In the Swedish case, significant changes are fewer and less systematic. For women in the 1972 cohort parental class effects become weaker while parental education effects become stronger;

[5] Bring (1994) shows that the squared t-value for a factor in a regression model is directly related to the increase in R^2 when this factor is added as the last one in the model. T-values cannot be used in estimating the relative importance of factors that have negative coefficients, such as the dummy variable for self-employment in our models. But the presence of such factors does not invalidate estimates for factors with positive coefficients. In the case of dichotomous variables, like that for employed/self-employed, mirroring the factor by setting the value for self-employment to 0 rather than 1 would, of course, lead to positive coefficients and t-values of the same absolute value.

[6] This result comes about chiefly in that there is a weakening of parental education effects between the 1946 and 1958 cohorts at lower and intermediate qualification levels but then a strengthening of these effects between the 1958 and 1970 cohorts at intermediate and higher levels (Bukodi and Goldthorpe, 2012: 10).

but these findings are not replicated for men – only the effect of parental education might have increased among Swedish men. We could then say – in further response to our first research question – that in neither country do the components of social origins that we distinguish show any consistent overall tendency to increase or decrease in their effects on individuals' educational attainment.

As regards possible changes in the effect of cognitive ability – the concern of our second research question – there is again no clear pattern of change in either country. In earlier research for Britain, based on the same birth-cohort data as we use, a generally declining effect of cognitive ability on educational attainment has been claimed both between the 1946 and 1958 cohorts (Richards, Power and Sacker (2009) and between the 1958 and 1970 cohorts (Galindo-Rueda and Vignoles (2005). However, our results support these claims only to the extent that for the 1970 cohort significant and positive interaction effects with cognitive ability are shown for men and women *in the bottom ability quintile* (and, for men, in the next-to-bottom quintile also). That is to say, for these individuals low ability would appear to have *less damaging* consequences for their educational attainment than for their counterparts in the 1958 reference cohort.[7] This finding could be taken as lending some support to the suggestion of Galindo-Rueda and Vignoles that the move during the 1960s from a selective to a comprehensive system of secondary education was of particular benefit to those who would otherwise have been at risk of losing out through early educational selection in which tests of cognitive ability played an important part – although, as can be seen, we find no indication of any comparable decline in the effect of cognitive ability on educational attainment for Sweden, where a comprehensive form of secondary education was introduced during the 1950s and the early 1960s.

[7] It is relevant to note that the measurement of social origins in the earlier research referred to is far more limited than in ours.

Table 5: Interaction effects on educational attainment of cohort by parental class, status and education, and cognitive ability

	Men				Women			
	Britain		Sweden		Britain		Sweden	
Parental class*cohort								
1946 / 48	-0.176		-0.055		-0.309		0.039	
1967			-0.369				-0.409	
1970 / 72	-0.282		-0.030		-0.303		-0.445	*
Parental self-employment*cohort								
1946 / 48	0.121		-0.016		-0.150		-0.180	
1967			0.199				-0.181	
1970 / 72	0.032		0.086		0.128		-0.309	*
Parental status*cohort								
1946 / 48	-0.142		0.295		0.150		0.338	
1967			0.171				-0.324	
1970 / 72	-0.588	**	-0.142		-0.737	**	0.321	
Parental education*cohort								
1946 / 48	0.670	**	0.206		0.616	**	-0.063	
1967			0.421	**			0.308	*
1970 / 72	0.664	**	0.242		0.637	**	0.387	*
Cognitive ability quintiles*cohort								
1946 / 48								
bottom	-0.066		0.189		0.357	**	0.267	*
2nd	0.032		0.038		0.022		0.027	
4th	-0.093		-0.014		-0.085		0.337	*
top	0.012		0.318	*	-0.092		0.337	*
1967								
bottom			0.264	*			0.234	
2nd			0.168				0.225	
4th			-0.176				0.225	
top			-0.142				-0.041	
1970 / 72								
bottom	0.517	**	0.073		0.398	**	0.130	
2nd	0.301	*	-0.071		0.147		0.030	
4th	-0.141		-0.197		0.003		0.030	
top	-0.004		-0.229		0.010		-0.262	
R^2	0.28		0.34		0.35		0.32	

* $p < 0.05$; ** $p < 0.01$

Note: Reference categories are the same as in Tables 3 and 4.

Two educational thresholds

While our OLS analyses give us an overall view, it is possible that they may obscure features of the relations among social origins, cognitive ability and educational attainment that exist at particular educational thresholds. We wish therefore to focus our attention on two such thresholds that are generally regarded as being of major importance in the context of individuals' educational careers: first, that which divides a high level of attainment at secondary level (at least) from any lower attainment – i.e. that existing between categories 1-4 and 5-7 of our educational scales; and second, that which divides a high level of attainment at tertiary level from any lower attainment – i.e. that existing between categories 1-6 and 7-8.

In this case, we carry out binomial logistic regression analyses in which the dependent variable is whether a cohort member did, or did not, attain a particular threshold, and the independent variables are as previously except that we now use our parental class variable in its full categorical form. (We investigated the possibility of using ordinal logistic regression which would constrain the effects of independent variables to be the same across the two thresholds but the required assumptions were not met.) We show the results we obtain for men and women in *Tables 6* and *7* respectively.

Table 6: Binary logistic regression of attaining (or not) two educational thresholds, on cohort, parental class, status and education, and cognitive ability, men (average marginal effects)

	Britain		Sweden	
	Higher secondary or higher vs. lower	Degree vs. lower	Academic upper secondary or higher vs. lower	Higher tertiary vs. lower
Cohort				
1946 / 48	0.024 **	-0.010	-0.011	0.029 **
1958 / 53 (ref.)				
1967			-0.028 **	-0.037 **
1970 / 72	0.031 **	0.027 **	0.014	-0.007
Parental class				
6, 7 / VII (ref.)				
5 / V+VI	0.042 **	0.008	0.049 **	0.025 *
4 / IV	0.008	0.012	0.021	0.020
3 / III	0.049 **	0.028 **	0.084 **	0.043 **
2 / II	0.037 **	0.028 **	0.126 **	0.051 **
1 / I	0.073 **	0.048 **	0.210 **	0.109 **
Parental status (0-1)	0.126 **	0.064 **	0.183 **	0.151 **
Parental education (0-1)	0.159 **	0.127 **	0.151 **	0.077 **
Cognitive ability quintiles				
bottom	-0.243 **	-0.170 **	-0.235 **	-0.129 **
2nd	-0.092 **	-0.053 **	-0.090 **	-0.049 **
3rd (ref.)				
4th	0.071 **	0.051 **	0.126 **	0.068 **
top	0.178 **	0.125 **	0.268 **	0.148 **

* $p < 0.05$; ** $p < 0.01$

Table 7: Binary logistic regression of attaining (or not) two educational thresholds, on cohort, parental class, status and education, and cognitive ability, women (average marginal effects)

	Britain				Sweden			
	Higher secondary or higher vs. lower		Degree vs. lower		Academic upper secondary or higher vs. lower		Higher tertiary vs. lower	
Cohort								
1946 / 48	-0.143	**			-0.025	**	0.029	**
1958 / 53 (ref.)								
1967					0.024	*	0.001	
1970 / 72	0.044	**	0.078	**	0.091	**	0.080	**
Parental class								
6,7 / VII (ref.)								
5 / V+VI	0.013		0.004		0.015		0.004	
4 / IV	0.038	**	0.020		0.058	**	0.026	*
3 / III	0.040	**	0.016		0.074	**	0.024	
2 / II	0.070	**	0.040	*	0.117	**	0.052	**
1 / I	0.117	**	0.080	**	0.173	**	0.080	**
Parental status (0-1)	0.100	**	0.052	*	0.185	**	0.113	**
Parental education (0-1)	0.145	**	0.118	**	0.154	**	0.107	**
Cognitive ability quintiles								
bottom	-0.160	**	-0.136	**	-0.245	**	-0.149	**
2nd	-0.079	**	-0.043	**	-0.093	**	-0.060	**
3rd (ref.)								
4th	0.058	**	0.063	**	0.119	**	0.050	**
top	0.153	**	0.138	**	0.263	**	0.144	**

* $p < 0.05$; ** $p < 0.01$

It turns out that these results are in fact on generally the same lines as those obtained from our OLS analyses. For both countries and for men and women in each country, our three components of social origins each have significant effects, over and above the effects of cognitive ability, on whether or not cohort members reach the two thresholds considered. Moreover, the results that we obtain when we introduce cohort interaction terms into our

logistic regression models also turn out to be on much the same lines as those obtained from our OLS analyses. That is to say, they indicate little systematic, directional change in social origin effects on whether or not individuals attain the two educational thresholds that we distinguish. However, the decline in the effects of cognitive ability previously seen with the 1970 British cohort now shows up only with men, and not with women, in the two lowest ability quintiles, and only in regard to the secondary, and not the tertiary, threshold. We do not present these results here because of space limitations (they are available on request) but instead take our threshold analyses as the basis for addressing our third and fourth research questions.

In the case of the third question, that of whether interaction effects occur between our social origin variables and cognitive ability, we need to simplify our analyses in order to avoid problems of unduly small numbers. We therefore reduce our class categories to four – i.e. we collapse Classes 1 and 2 and 3 and 5 for Britain and Classes I and II and III and V+VI for Sweden – and we also collapse the bottom and the next-to-bottom ability quintiles. The results of our analyses are shown in *Tables 8* and *9*.

Table 8: Interaction effects on attaining two educational thresholds of parental class, status and education by cognitive ability, men

	Britain		Sweden	
	Higher secondary or higher vs. lower	Degree vs. lower	Acad. upper secondary or higher vs. lower	Higher tertiary vs. lower
Parental class*cognitive ability quintiles				
3,5 / III, V+VI*				
bottom-2nd	0.044	0.000	0.009	-0.033
3rd (ref.)				
4th	0.037	0.036	0.031	0.010
top	0.061	0.032	-0.030	-0.016
4 / IV*				
bottom-2nd	-0.045	-0.026	0.043	-0.060
3rd (ref.)				
4th	-0.021	-0.006	0.080	0.014
top	0.012	0.008	-0.013	0.010
1,2 / I, II*				
bottom-2nd	0.022	0.005	-0.066	-0.016
3rd (ref.)				
4th	-0.038	0.041	0.037	-0.060
top	0.096 *	0.129 **	-0.059	0.060
Parental status*Cognitive ability quintiles				
bottom-2nd	-0.052	-0.049	-0.023	-0.049
3rd (ref.)				
4th	0.023	-0.072	0.020	-0.017
top	0.050	0.013	0.042	0.127
Parental education*Cognitive ability quintiles				
bottom-2nd	0.001	-0.041	0.036	0.127
3rd (ref.)				
4th	0.047	0.061 *	0.019	0.031
top	0.078 *	0.066 *	0.005	0.029

* $p < 0.05$; ** $p < 0.01$

Table 9: Interaction effects on attaining two educational thresholds of parental class, status and education by cognitive ability, women

	Britain		Sweden	
	Higher secondary or higher vs. lower	Degree vs. lower	Acad. upper secondary or higher vs. lower	Higher tertiary vs. lower
Parental class*cognitive ability quintiles				
3,5 / III, V+VI*				
bottom-2nd	-0.038	0.017	0.031	0.006
3rd (ref.)				
4th	-0.013	0.045	0.042	0.046
top	-0.006	0.053	-0.039	0.035
4 / IV*				
bottom-2nd	-0.010	0.050	0.041	0.008
3rd (ref.)				
4th	-0.001	0.062	0.061	0.055
top	0.043	0.125	-0.026	0.058
1,2 / I, II*				
bottom-2nd	-0.090 *	-0.026	0.020	0.009
3rd (ref.)				
4th	0.010	0.078	0.062	0.108 *
top	0.000	0.099 *	-0.073	0.080
Parental status*cognitive ability quintiles				
bottom-2nd	-0.039	-0.082	-0.014	-0.014
3rd (ref.)				
4th	-0.033	-0.055	-0.082	-0.073
top	0.050	-0.074	-0.089	0.015
Parental education*cognitive ability quintiles				
bottom-2nd	-0.027	-0.026	0.009	-0.032
3rd (ref.)				
4th	0.030	0.067 *	-0.020	-0.024
top	0.102 *	0.131 **	0.057	0.012

* $p < 0.05$; ** $p < 0.01$

Two points of interest emerge from these tables. First, while some significant interaction effects occur in the British case, they are almost entirely absent in the Swedish.[8] Second, in the British case these effects are, with one exception, positive, and they occur most systematically in that, again with just one exception, being in the highest ability quintile tends to combine with having parents in Classes 1 or 2 and with high levels of education so as to increase the chances of men and women alike of attaining both of the educational thresholds in question.

It is, then, in this respect that perhaps the most important cross-national difference emerges from our analyses. For reasons that call for further investigation, in Britain, but not in Sweden, being of advantaged social origins enables individuals of high cognitive ability to translate this ability yet more effectively into high levels of educational attainment.

Turning now to our fourth research question – that of the extent to which the effects of parental class, status and education *taken together* differentiate individuals' educational attainment controlling for their cognitive ability – we need, first of all, to combine our three social origin variables. We do this, in the way indicated in *Table 10*, by collapsing each of these variables to three levels and by then deriving from these levels three groups of parents: those most advantaged, those least advantaged and a residual, intermediate group. The most advantaged group can be taken as comprising parents in mainly salaried professional and managerial or at all events white-collar employment with at least secondary education, while the least advantaged group comprises parents in mainly wage-earning, blue-collar employment with only low educational attainment. It may be noted from the distributions of

[8] It is of course possible that somewhat different results would emerge with a different reference category but we believe that the middle ability quintile is that which it is most appropriate to take in the present context if only because one might expect that it would be with individuals of around average ability that social origins effects would be strongest.

these groups across cohorts, as also reported in Table 10, that while the British distributions show a clear 'upward' shift, the Swedish are more stable. This chiefly reflects the fact that already in the earliest Swedish cohort only a little over a third of parents fall in the least advantaged group, as compared with over a half in the British.

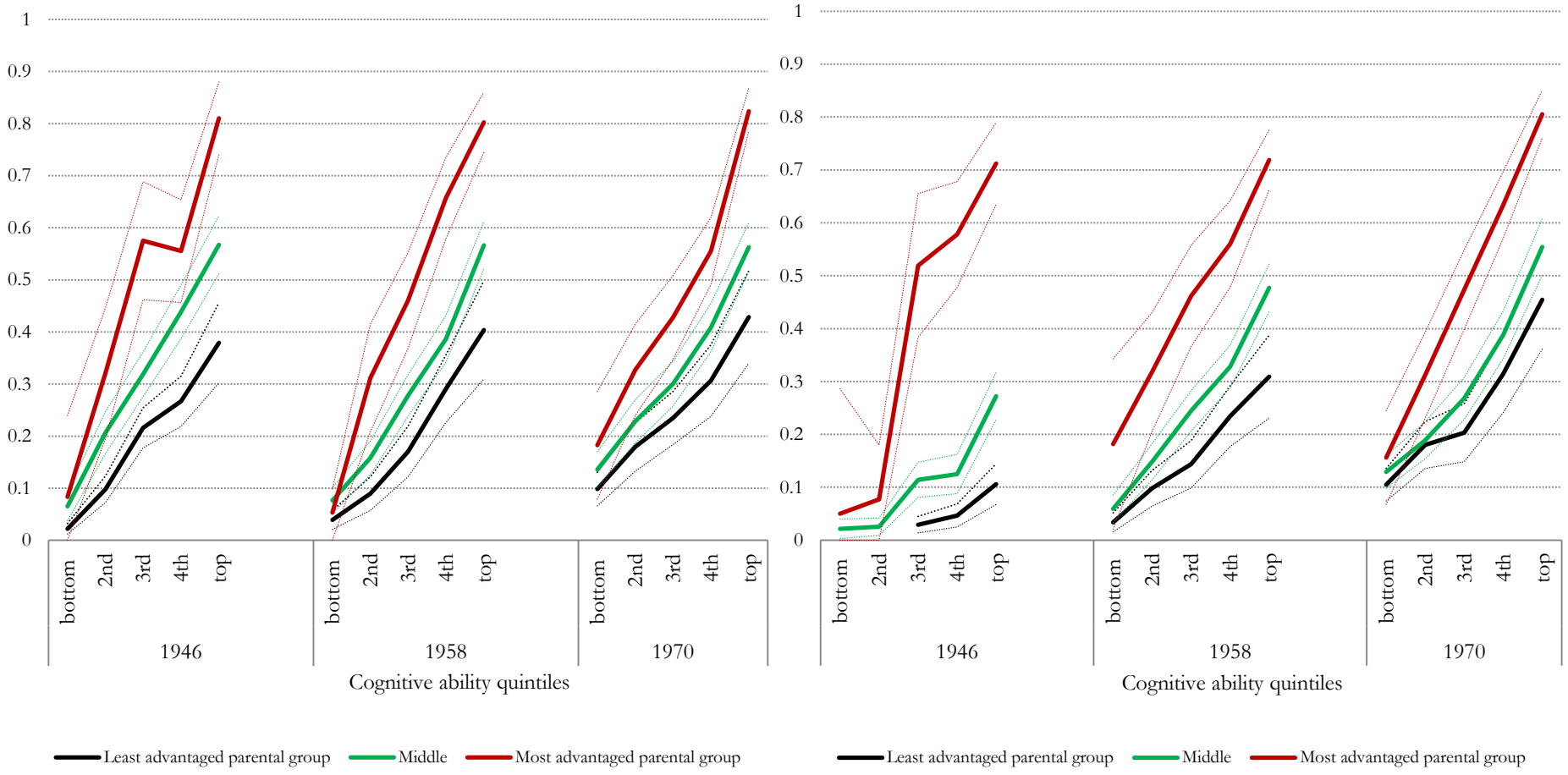
Because of space limitations, we report here only the results we obtain for the secondary educational threshold. Those for the tertiary threshold (available on request) are on essentially the same pattern except in one respect that we note.

We again work with a binary regression model with the dependent variable being the attainment (or not) of the threshold, but now we have as independent variables the threefold parental grouping, as described above, plus cognitive ability and we also include interaction effects between the parental groups and cognitive ability. We fit our model separately for men and women in each cohort in both Britain and Sweden and then calculate the probabilities under the model of the threshold being attained. We present our results in graphical form in *Figure 1* for Britain and *Figure 2* for Sweden.

Table 10: Derivation of most advantaged and least advantaged parent groups and distributions across cohorts

	Parental class		Parental status		Parental education	
	Britain	Sweden	Britain	Sweden	Britain	Sweden
Level 1	1, 2		top third		degree	higher tertiary
Level 2	3, 4, 5		middle third		below degree qualifications	lower tertiary and secondary
Level 3	6, 7		bottom third		no qualification	compulsory only

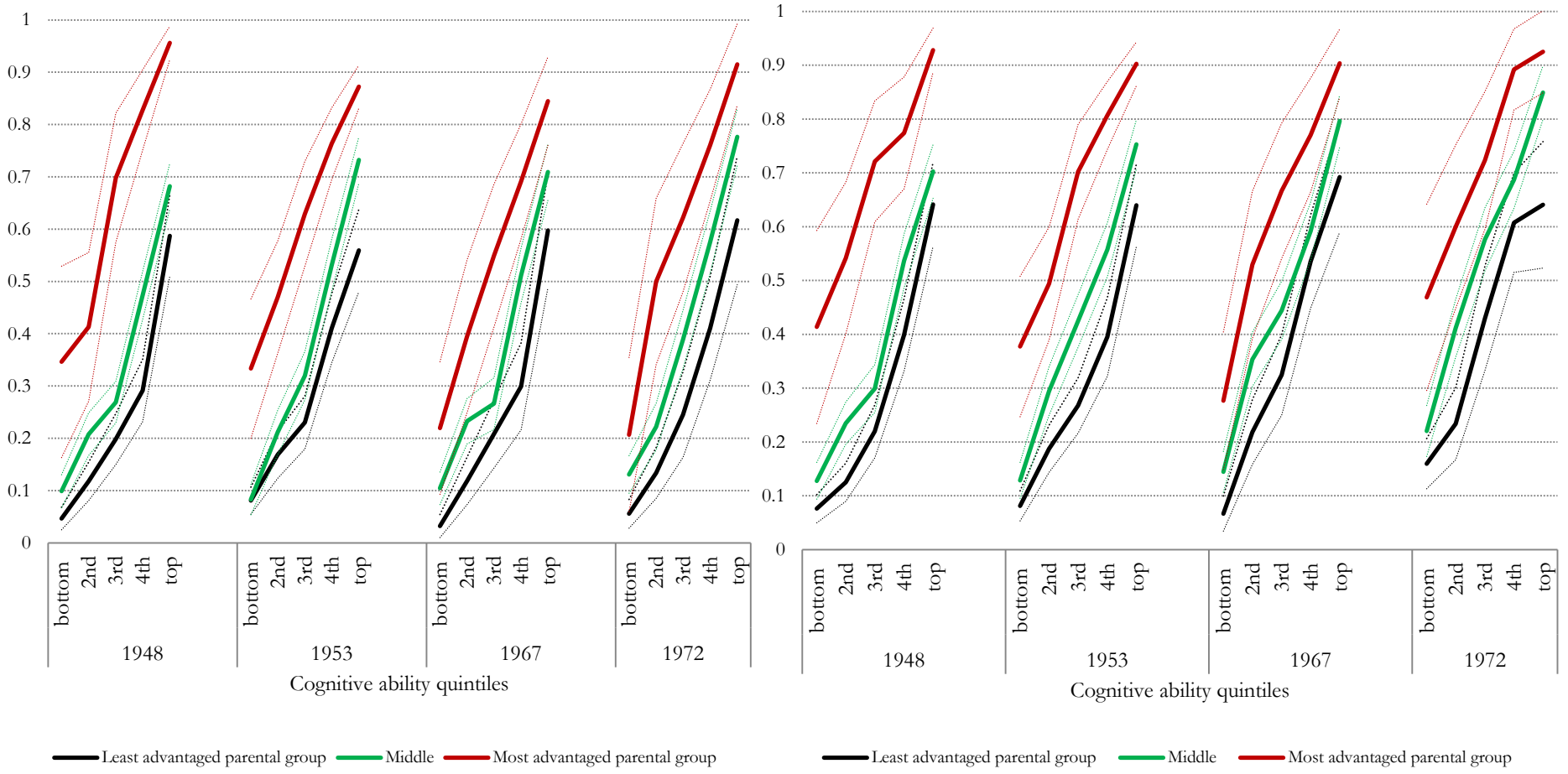
	Most advantaged (%) [2 or 3 level 1, no level 3]		Intermediate (%) [other]		Least advantaged (%) [2 or 3 level 3, no level 1]	
	Britain	Sweden	Britain	Sweden	Britain	Sweden
1946 / 48	7.8	9.9	40.2	54.3	52.1	35.8
1958 / 53	14.1	16.1	55.2	49.6	30.7	34.3
1967		10.5		60.7		28.8
1970 / 72	21.9	10.8	51.2	60.1	27.0	29.2



Men

Women

Figure 1: Probabilities of attaining upper secondary threshold by cohort, cognitive ability quintiles and parental group, Britain



Men Women

Figure 1: Probabilities of attaining upper secondary threshold by cohort, cognitive ability quintiles and parental group, Britain

To begin with British men, Figure 1 brings out two points of main interest. First, those who fall in the bottom cognitive ability quintile have only a very poor chance of high educational attainment at secondary level, regardless of their social origins. In the first two cohorts, the probability of such attainment for men in this quintile from all three parent groups alike is less than 10% and is still less than 20% in the third cohort. Second, moving from lower to higher ability quintiles, the importance of social origins steadily increases. Thus, in the case of men in the top ability quintile, it can be seen that the disparity in the chances of reaching the threshold in question between those of most and of least advantaged origins is in all three cohorts alike around 40 percentage points: i.e. an approximately 80% chance as against a 40% chance.

For British women, Figure 1 shows that, in much the same way as for men, the importance of social origins for educational success increases with ability. However, the graphs for women differ from those for men in two ways. First – and consistently with the results of Table 1 – they indicate a fairly general tendency across the cohorts for the chances of high secondary attainment to improve for women of all ability levels and parent groups alike. And second, they show that disparities in this respect between the chances of women of similar ability but differing social origins narrow across the cohorts – although being initially clearly wider than with men. For women in the highest ability quintile in the 1946 cohort the difference between the chances of success of those of most and of least advantaged origins is clearly over 60 percentage points: i.e. women in the highest ability quintile and of most advantaged origins have a 70% chance as against a more or less negligible chance for equally able women of least advantaged origins. However, by the 1970 cohort this disparity has fallen to 35 percentage points – if anything rather smaller than with men.

Turning then to Sweden, the graphs in Figure 2 most obviously contrast with the corresponding graphs for Britain in showing a less marked tendency for the effects of social origins on the chances of attaining the secondary threshold to increase with ability.[9] For those in the highest ability quintile, disparities in chances of success related to parent group are generally lower than in the British case. The strongest social origin effects – i.e. the widest gaps between the curves – are more often found with men and women in the middle ability quintiles. But what is perhaps most notable is that men and women who are of low ability but of advantaged social origins are far more likely than their British counterparts to reach the secondary threshold. And while with men, this difference does in fact weaken somewhat across the cohorts, this is less clearly the case with women. What may, at least in part, be reflected here is the fact that in the Swedish case, as earlier noted, educational attainment is measured by educational level rather than, as in the British case, by actual qualifications. A tendency may then exist – one more persistent with girls than with boys – for those of low ability but from advantaged social backgrounds to be 'kept on' to higher levels of secondary education even if, perhaps, their performance there is not especially good. In the corresponding graphs that we have produced for the tertiary threshold the Swedish curves are in fact generally more similar to the British.

However, what should also be noted from the Swedish graphs is that, with both men and women, disparities in the chances of attaining the secondary threshold for those of similar ability but differing social origins show no consistent tendency to narrow across the cohorts considered. In response to our fourth research question, we can then say that, in Britain and Sweden alike, men and women whose early-life cognitive ability is at a similar level still for

[9] Differences on these lines are ones that might be expected in view of our previous finding that positive interaction effects between advantaged social origins and ability are found for Britain but not for Sweden. However, it should be noted that while our models are linear in the logit, they are not, with or without interactions, linear in the probability scale.

the most part have very different – very unequal – chances, depending on their social origins, of high attainment in secondary education.

Conclusions

In this paper we have built in two main ways on our previous work aimed at a providing a more comprehensive treatment of the effects of social origins on individuals' levels of educational attainment. We have included in our analyses, in addition to measures of parental class, status and education, measures of early-life cognitive ability, which is known also to have a strong effect on later-life educational attainment. And we have brought our British and Swedish analyses together on a comparative basis. Our primary focus of interest has been on the extent to which social origin effects on individuals' educational attainment persist even when early-life cognitive ability is taken into account. In this regard, we posed four research questions, to which our answers, in their main content, can be summarised as follows.

First, when we include early-life cognitive ability in our analyses, parental, class, status and education continue to have significant, independent effects on educational attainment; and it can further be seen from our overall OLS analyses that the resulting reduction in the effects of these social origin variables is only rather modest – in fact, with a notable degree of regularity, by around a third, for men and for women in Britain and Sweden alike. A further regularity to emerge is that the effect of parental education appears generally stronger than that of either parental class or parental status. Finally, neither our OLS analyses nor our subsequent logistic regression analyses of the chances of individuals passing two major

educational thresholds indicate any tendency for the different social origin effects that we distinguish to weaken in any uniform way across cohorts.[10]

Second, as regards changes in the effects of cognitive ability on educational attainment, our OLS analyses provide some evidence of a declining effect in Britain as between the 1958 and 1970 cohorts; but rather than this decline being a general one – as supposed in earlier research – it appears limited to individuals in the lower ability quintiles. Moreover, it would also appear to be most marked at lower educational levels. At the secondary educational threshold that we distinguish it is significant only with men, and at the tertiary threshold it no longer shows up. In the Swedish case, cognitive ability effects would seem to be generally stable.

Third, in investigating whether interaction effects occur between cognitive ability and social origins, in relation to individuals' reaching or not reaching the secondary and tertiary educational thresholds, we obtain results that show greater cross-national divergence than in other respects. For Sweden, there is little evidence of any systematic interaction effects; but for Britain positive interaction effects occur in that being in the highest ability quintile combines with having parents in advantaged class positions and with high levels of education so as to significantly boost individuals' chances of educational success.

Fourth, in considering how far social origin effects taken together influence the educational attainment of individuals of similar ability, we find that, so far as the chances of attaining the secondary – and also the tertiary – educational threshold are concerned, these effects are for the most part substantial. For example, if we take men and women in the highest ability quintile, the difference in the probability of those with the most and with the least advantaged

[10] Earlier studies (Erikson and Jonsson, 1996; Breen and Jonsson, 2007) have shown some decline in the association between parental social class and children's educational attainment in Sweden. However, these studies also find that the decline mostly occurred with cohorts born before 1948. Our results need not therefore be regarded as out of line with those of this earlier research – apart from the fact that we treat social origins in a more comprehensive way.

parents reaching the secondary threshold is at least 30 percentage points in all cohorts in Britain and Sweden alike. And disparities of this kind do not show any consistently declining trend except in the case of British women where in the earliest cohort they were quite extreme. The main difference between Britain and Sweden is that a clear tendency in the British case for the importance of social origins for educational success to increase with ability is not evident in the Swedish, except to some extent for men in the later cohorts and at the tertiary threshold.

What, then, are the wider implications of these findings?

To begin with, they underline the need to investigate social inequalities in educational attainment on the basis of a more comprehensive view of social origins than is found in much previous research. Taking into account the effects of parental class, status and education helps to show still more clearly than before that the introduction of cognitive ability into the analysis does not massively diminish the effects of social origins on educational attainment. To the contrary, we would regard as particularly notable the extent to which the effects of parental class, status and education alike are maintained. In turn, it follows that even if one were to suppose that variance in early-life cognitive ability is in large part genetically determined, educational attainment would still have to be seen as also strongly associated with environmental factors deriving from individuals' home and family backgrounds. And insofar as variance in such ability is taken as being itself determined by a complex interaction of genetic and environmental factors, then the importance of the latter is of course enhanced.

Further, it also follows that if cognitive ability is to be viewed as a leading criterion of merit – despite the philosophical difficulties of so doing and especially to the extent that such ability is put down to genetic chance – then both the British and the Swedish educational systems must be regarded as falling some way short of a meritocratic ideal. Of particular significance

here is the extent to which even individuals at the highest ability levels are unable to transcend the effects of their social origins so far as their educational attainment is concerned – together with the fact that, overall, social origin effects show no clearer tendency to diminish in the case of such high ability individuals than of others. In this way an issue is again highlighted that was far more prominent in public discussion several decades ago than at the present time: that is, the issue of the implied wastage – the failure to exploit – substantial reserves of talent. It is of course possible that individuals of high cognitive ability may find means of expressing this ability in other ways than via education; but the fact remains that many such individuals of disadvantaged social origins appear to be denied the opportunity of realising their potential within their national educational systems.

Finally, we would attach significance to the large extent to which our findings reveal cross-national similarities: in particular, in the persisting importance for individuals' educational attainment of parental class, status and education even when cognitive ability is taken into account and in the absence of any consistently weakening tendency in these social origin effects. The only clear cross-national difference that shows up, at least at the secondary level, is that while the Swedish educational system appears more responsive to cognitive ability relative to social origins in that advantaged social origins *do less to reinforce high ability*, the British system appears more responsive in that advantaged social origins *do less to compensate for low ability*. In the light of these results, it would then be difficult to claim that the Swedish educational system is significantly more egalitarian in its outcomes than is the British – despite reforms being carried out, as earlier noted, with the 'explicit aim' of reducing social inequalities in attainment. And the question does then arise of how far it is possible for changes made simply in the institutional forms of educational systems to counteract social processes generating inequality that are grounded in the stratification of the societies within which educational institutions have to function.

References

Blanden, J., Goodman, A., Gregg, P. and Machin, S. (2004) 'Changes in intergenerational mobility in Britain' in M. Corak ed., *Generational Income Mobility in North America and Europe*. Cambridge: Cambridge University Press.

Bring, J. (1994) 'How to standardize regression coefficients', *The American Statistician*, 48: 209-13.

Breen, R. and Jonsson, J.O. (2007) 'Explaining change in social fluidity: educational equalization and educational expansion in twentieth-century Sweden', *American Journal of Sociology*, 112: 1775-810.

Bukodi, E. and Goldthorpe, J. H. (2012) 'Decomposing social origins: the effects of parents' class, status and education on the educational attainment of their children', *European Sociological Review*, DOI:10.1093/esr/jcs079.

Carey, N. (2012) *The Epigenetics Revolution: How Modern Biology is Rewriting Our Understanding of Genetics, Disease, and Inheritance.* New York: Columbia University Press.

Chabris, C. F. et al. (2012) 'Most reported genetic associations with general intelligence are probably false positives', *Psychological Science*, 23: 1314-1323.

Chan, T.-W. and Goldthorpe, J. H. (2004) 'Is there a status order in contemporary British society? Evidence from the occupational structure of friendship', *European Sociological Review*, 20: 383-401.

Dorling, D. (2010) *Injustice.: Why Social inequality Persists*. Bristol: Policy Press.

Erikson, R. (2012) 'Can different measures of social origins be used interchangeably? Dimensions of social background and educational attainment', Swedish Institute of Social Research, Stockholm.

Erikson, R. and Goldthorpe, J. H. (1992) *The Constant Flux*. Oxford: Clarendon Press.

Erikson, R. and Goldthorpe, J. H. (2010) 'Has social mobility in Britain decreased? Reconciling divergent findings on income and class mobility', *British Journal of Sociology*, 61: 211-30.

Erikson, R. and Jonsson, J. O. (1993) *Ursprung och Utbildning*. Stockholm: Statens Offentliga Utredningar.

Erikson, R. and Jonsson, J.O. (1996) 'The Swedish context: educational reform and long-term change in educational inequality' in R. Erikson and J. O. Jonsson eds., *Can Education be Equalized*? Boulder, Col.: Westview Press.

Erikson, R. and Rudolphi, F. (2010) 'Change in social selection to upper secondary school – primary and secondary effects in Sweden', *European Sociological Review*, 26: 291-305.

Erikson, R., Goldthorpe, J. H. and Portocarero, L. (1979) 'Intergenerational class mobility in three western European societies', *British Journal of Sociology*, 30: 415-41.

Esping-Andersen, G. (1990) *The Three Worlds of Welfare Capitalism*. Cambridge: Polity Press.

Ferri, E., Bynner, J. and Wadsworth, M. (2003) *Changing Britain, Changing Lives*. London: Institute of Education.

Flynn, J. R. (1987) 'Massive IQ gains in 14 nations: What IQ tests really measure', *Psychological Bulletin,* 101: 171-91.

Galindo-Rueda, F. and Vignoles, A. (2005) 'The declining relative importance of ability in predicting educational attainment', *Journal of Human Resources,* 40: 335-53.

Härnqvist, K. (2000) 'Evaluation through follow-up: A longitudinal program for studying education and career development' in C.-G. Jansson, ed., *Seven Swedish Longitudinal Studies in Behavioral Science*. Stockholm: Forskningsrådsnämnden.

Heckman, J. J. (2007) 'The economics, technology, and neuroscience of human capability formation', *Proceedings of the National Academy of Sciences,* 104(3): 13250-5.

Heckman, J. J. (2013) *Giving Kids a Fair Chance.* Cambridge, Mass.: MIT Press.

Jablonka, E. and Lamb, M. J. (2006) *Evolution in Four Dimensions*. Cambridge, Mass.: MIT Press.

Jerrim, J., Vignoles, A. , Lingham, R. and Friend, A. (2013) ' The socio-economic gradient in children's reading skills and the role of genetics'. Department of Quantitative Social Science, Institute of Education, London.

Lazarsfeld, P. F. (1939) 'Interchangeability of indices in the measurement of economic influences, *Journal of Applied Psychology*, 23: 33-45.

Lucchini, M., Della Bella, S. and Pisati, M. (2013) 'The weight of the genetic and environmental dimensions in the inter-generational transmission of educational success', *European Sociological Review*, 29: 289-301.

Manolio, T. A. et al. (2009) 'Finding the missing heritability of complex diseases', *Nature*, 461: 747-753.

Mood, C., Jonsson, J. O. and Bihagen, E. (2012) 'Socioeconomic persistence across generations: Cognitive and non-cognitive processes' in J. Ermisch, M. Jäntti and T. Smeeding eds., *From Parents to Children*. New York: Russell Sage Foundation.

Nielsen, F. and Roos, J. (2011) 'Genetics of educational attainment and the persistence of privilege at the turn of the 21st century'. Paper presented at the 2012 Southern Sociological Society: New Orleans, Louisiana, March 21-24 2012.

Office of National Statistics (2005) *The National Statistics Socio-economic Classification: User Manual*. London: National Statistics and Palgrave Macmillan.

Parkin, F (1971) *Class Inequality and Political Order*. London: McGibbon and Kee.

Prandy, K. and Lambert, P. S. (2003) 'Marriage, social distance and the social space: an alternative derivation and validation of the Cambridge scale', *Sociology*, 37: 397-411.

Richards, M., Power, C. and Sacker, A. (2009) 'Paths to literacy and numeracy problems: evidence from two British birth cohorts', *Journal of Epidemiology and Community Health*, 63: 239-44.

Saunders, P. (2010) *Social Mobility Myths*. London: Civitas.

Scase, R. (1977) *Social Democracy in Capitalist Society*. London: Croom Helm.

Schoon, I. (2010) 'Childhood cognitive ability and adult academic attainment: evidence from three British cohort studies', *Longitudinal and Life-Course Studies*, 1: 241-58.

Sorjonen, K., Hemmingsson, T., Lundin, A., Falkstedt, D. and Melin, B. (2012) 'Intelligence, socio-economic background, emotional capacity, and level of education as predictors of attained socioeconomic position in a cohort of Swedish men', *Intelligence,* 40: 269-77.

Streze, T. (2007) 'Intelligence and socioeconomic success: A meta-analytic review of longitudinal research', *Intelligence,* 35: 401-26.

Appendix 1

Table A1.1: Distribution of cohort members by parental characteristics, Britain

	1946 cohort	1958 cohort	1970 cohort
Parental class (%)			
1: higher managerial and professional occupations	4.3	5.5	11.5
2: lower managerial and professional occupations	8.1	17.8	20.9
3: intermediate occupations	8.6	16.8	8.6
4: small employers and own account workers	8.3	5.3	12.2
5: lower supervisory and technical occupations	17.9	27.7	19.2
6-7: routine and semi-routine occupations	52.9	26.9	27.6
Parental status			
Mean	0.30	0.45	0.50
s.d.	0.24	0.23	0.24
Parental education			
Mean	0.27	0.34	0.39
s.d.	0.33	0.33	0.33

Table A1.2: Distribution of cohort members by parental characteristics, Sweden

	1948 cohort	1953 cohort	1967 cohort	1972 cohort
Parental class (%)				
I: higher salariat	6.5	7.1	11.4	16.3
II: lower salariat	11.0	15.0	20.0	23.1
III: routine non-manual employees	12.4	12.4	18.0	17.0
IV: small employers and own account workers	21.5	18.0	13.2	7.2
V+VI: lower supervisory and skilled manual workers	24.3	24.6	20.1	17.9
VII: non-skilled manual workers	24.2	22.8	17.4	18.6
Parental status				
Mean	0.37	0.39	0.46	0.48
s.d.	0.16	0.16	0.15	0.15
Parental education				
Mean	0.24	0.28	0.38	0.39
s.d.	0.37	0.37	0.32	0.31

Appendix 2: Parental income as a further component of social origins

As explained in note 1, while our previous work indicated that parental income has an additional effect on children's educational attainment over and above that of parental class, status and education, it has not been included in the main analyses of our paper because of limitations of the British data. Here, however, we extend our OLS analyses so as to include for Britain a measure of *family income* derived from Blanden *et al.* (2004) which is available for the 1958 and 1970 cohorts (though of doubtful comparability between them), and for Sweden a measure of *parental earnings* based on Tax Register data. As a convenient compromise, we will refer to these measures subsequently as one of parental income.

Tables A2.1 and *A2.2* show the results of our analyses for Britain and *Tables A2.3* and *A2.4* for Sweden. As can be seen from these tables, Model 0 includes only parental income and cognitive ability as independent variables relative to the dependent variable of educational attainment according to our 8-point scales. Model 1 is the same as Model 1 from Tables 3 and 4, including parental class, status and education together with cognitive ability as independent variables (the results differ slightly from those previously reported because now only cases with data on parental income are included and only two British cohorts are covered). Model 2 then adds parental income to Model 1. Our interest centres on the comparison of results under Models 0 and 1 with those under Model 2.

For Britain, it can be seen that in moving from Model 0 to Model 2, the coefficient for parental income is more than halved for men and women alike. One may suppose, therefore, that under Model 0 the parental income variable is to a considerable extent picking up effects of parental class, status and education via their association with income. In some contrast, in moving from Model 1 to Model 2, the coefficients for parental class, status and education are only very modestly reduced, indicating that they have substantial effects independently of

parental income. And it can further be seen that, to judge from the t-values under Model 2, while parental income is of around the same relative importance as parental class and parental status, its importance is less than that of parental education.

In the Swedish case, it would appear that parental income has a stronger effect on educational attainment than in the British – as a result, we would believe, in at least some part, of better measurement. However, for both men and women the coefficients for parental income under Model 0 fall under Model 2 to a still greater extent than with Britain, and as between Model 1 and Model 2 the coefficients for parental class, status and education are, if anything, still less reduced. Moreover, while for Swedish men the t-values are on a similar pattern to that found for British men and women, for Swedish women the relative importance of parental income falls not only below that of parental education but also below that of parental class and status.

In sum, we can confirm our previous finding that parental income does have a further effect on children's educational attainment over and above those of the other components of social origins that we have distinguished. And we can therefore in turn say that in the analyses that we have presented in the body of this paper we will to some extent be underestimating social origin effects. At the same time, though, we can also say that a much greater underestimation is likely to occur, and also a misspecification of the effects involved, if social origins are treated – as is often the practice among economists – in terms of some measure of parental income alone.

Table A2.1: OLS regression of educational attainment on cohort, parental class, status, education and income, and cognitive ability, British men

	Model 0			Model 1			Model 2		
	B	t	sig.	B	t	sig.	B	t	sig.
Cohort									
1958 (ref.)									
1970	0.28	5.48	**	0.23	4.38	**	0.24	4.65	**
Parental class (0-1)				**0.40**	3.45	**	**0.33**	2.84	**
Parental self-empl. (0-1)				**-0.28**	-2.71	**	**-0.27**	-2.64	**
Parental status (0-1)				**0.65**	4.62	**	**0.56**	4.01	**
Parental education (0-1)				**0.69**	8.11	**	**0.60**	7.01	**
Parental income (0-1)	**0.92**	10.20	**				**0.45**	4.68	**
Cognitive ability quintiles									
bottom	-1.27	-15.79	**	-1.18	-14.80	**	-1.17	-14.62	**
2nd	-0.55	-6.85	**	-0.50	-6.27	**	-0.49	-6.23	**
3rd (ref.)									
4th	0.54	6.80	**	0.49	6.27	**	0.48	6.14	**
top	1.33	16.80	**	1.20	15.08	**	1.18	14.87	**
Constant	3.25	43.62	**	3.07	39.44	**	2.93	35.26	**
R^2	0.23			0.25			0.25		

* $p < 0.05$; ** $p < 0.01$

Table A2.2: OLS regression of educational attainment on cohort, parental class, status, education and income, and cognitive ability, British women

	Model 0			Model 1			Model 2		
	B	t	sig.	B	t	sig.	B	t	sig.
Cohort									
1958 (ref.)									
1970	0.56	11.51	**	0.45	9.09	**	0.46	9.34	**
Parental class (0-1)				**0.68**	6.24	**	**0.60**	5.50	**
Parental self-empl. (0-1)				**0.04**	0.46		**0.06**	0.60	
Parental status (0-1)				**0.65**	4.91	**	**0.57**	4.29	**
Parental education (0-1)				**0.69**	8.57	**	**0.61**	7.51	**
Parental income (0-1)	**0.97**	11.40	**				**0.41**	4.47	
Cognitive ability quintiles									
bottom	-1.28	-16.25	**	-1.16	-14.85	**	-1.14	-14.60	**
2nd	-0.49	-6.34	**	-0.42	-5.60	**	-0.42	-5.52	**
3rd (ref.)									
4th	0.63	8.37	**	0.56	7.54	**	0.56	7.53	**
top	1.40	18.32	**	1.22	16.14	**	1.22	16.11	**
Constant	2.89	40.02	**	2.64	35.19	**	2.51	31.46	**
R^2	0.25			0.28			0.28		

* $p < 0.05$; ** $p < 0.01$

Table A2.3: OLS regression of educational attainment on cohort, parental class, status, education and income, and cognitive ability, Swedish men

	Model 0			Model 1			Model 2		
	B	t	sig.	B	t	sig.	B	t	sig.
Cohort									
1948	-0.08	-2.00	*	-0.04	-1.00		-0.04	-0.94	
1953 (ref.)									
1967	0.08	1.81		0.10	2.43	*	0.02	0.58	
1972	0.54	13.16	**	0.28	6.80	**	0.31	7.51	**
Parental class (0-1)				**0.75**	10.78	**	**0.70**	9.96	**
Parental self-empl. (0-1)				**-0.43**	-10.19	**	**-0.24**	-5.16	**
Parental status (0-1)				**0.95**	7.48	**	**0.82**	6.42	**
Parental education (0-1)				**0.81**	16.05	**	**0.76**	14.94	**
Parental income (0-1)	**4.43**	23.55	**				**1.85**	8.54	**
Cognitive ability quintiles									
bottom	-1.09	-23.89	**	-0.95	-21.62	**	-0.95	-21.49	**
2nd	-0.47	-10.08	**	-0.41	-9.24	**	-0.41	-9.23	**
3rd (ref.)									
4th	0.74	16.20	**	0.64	14.41	**	0.64	14.45	**
top	1.62	35.27	**	1.37	30.42	**	1.37	30.44	**
Constant	0.22	1.51		2.74	50.97	**	1.41	8.58	**
R^2	0.28			0.33			0.33		

* $p < 0.05$; ** $p < 0.01$

Table A2.4: OLS regression of educational attainment on cohort, parental class, status, education and income, and cognitive ability, Swedish women

	Model 0			Model 1			Model 2		
	B	t	sig.	B	t	sig.	B	t	sig.
Cohort									
1948	-0.24	-5.79	**	-0.19	-4.82	**	-0.19	-4.78	**
1953 (ref.)									
1967	0.19	4.22	**	0.15	3.53	**	0.11	2.55	**
1972	0.67	15.37	**	0.43	9.86	**	0.44	10.21	**
Parental class (0-1)				**0.72**	9.83	**	**0.69**	9.40	**
Parental self-empl. (0-1)				**-0.08**	-1.79		**0.02**	0.33	
Parental status (0-1)				**1.10**	8.28	**	**1.04**	7.73	**
Parental education (0-1)				**0.75**	14.04	**	**0.72**	13.39	**
Parental income (0-1)	**3.10**	15.47	**				**0.98**	4.23	**
Cognitive ability quintiles									
bottom	-1.33	-27.91	**	-1.14	-24.75	**	-1.14	-24.76	**
2nd	-0.56	-11.76	**	-0.46	-10.02	**	-0.46	-10.04	**
3rd (ref.)									
4th	0.61	12.73	**	0.54	11.65	**	0.54	11.63	**
top	1.41	28.91	**	1.20	25.08	**	1.19	25.06	**
Constant	1.68	10.74	**	3.08	54.60	**	2.38	13.60	**
R^2	0.26			0.31			0.33		

* $p < 0.05$; ** $p < 0.01$