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Do sibling correlations in skills, schooling, and earnings vary by socioeconomic background? Insights from Sweden^a

by

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Abstract

Family background shapes individual outcomes throughout life. While the existing literature documents how the importance of family background, typically measured by the degree of sibling correlation in socioeconomic outcomes, varies across countries, less is known about heterogeneities across social groups within a country. Using Swedish register data, we compare sibling correlations in skills, schooling, and earnings across fine-grained groups defined by parental socioeconomic status (SES). We find that sibling correlations generally decline in parental SES. This pattern holds for skills, schooling, and earnings, and is robust to alternative definitions of parental SES. These results align with theories suggesting that parental investments reinforce disparities, although other mechanisms such as complementarities between parental investments and child ability could also be at play. While the exact mechanisms behind the observed socioeconomic gradient in sibling similarity are hard to identify, the results suggest that life is more formed by individual endowments and considerations for children from high SES backgrounds as compared to their low SES counterparts.

Keywords: sibling correlations, education, earnings, skills, parental socioeconomic status
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1 Introduction

Family background can shape an individual's life trajectory. There are strong correlations in socioeconomic outcomes between parents and children, and between siblings (e.g., Solon 1999; Björklund and Jäntti 2009; Björklund and Jäntti 2020; Chetty et al. 2014; Behrman and Taubman 1989; Vosters and Nybom 2017; Adermon, Lindahl, and Palme 2021; Mazumder 2011). But is life more formed by family background in certain groups than in others? Cross-country heterogeneity in the importance of family background is well documented. For example, sibling correlations¹ – a comprehensive measure of family influence – in education are higher in developing countries (e.g., Dahan and Gaviria 2001; Ahsan et al. 2022). However, there is also variation among industrialized countries. Nordic countries, for instance, are often documented to have relatively low sibling correlations in earnings and educational attainment (e.g., Björklund, Jäntti and Lindquist 2009; Björklund and Jäntti 2020). Nonetheless, little is known about heterogeneities across the socioeconomic spectrum *within* a country.

Two societies where the importance of family background *as a whole* is similar can differ in terms of the distribution of this importance across social groups within a society.² In one society, sibling differences in socioeconomic outcomes may primarily arise in families with high socioeconomic status (SES), whereas in the other society, sibling differences may remain relatively constant across groups with different SES. Although there might be disagreement over which society is preferred, documenting the relationship between sibling similarity and parental SES arguably offers a richer picture of the equality of opportunity in a society.

An individual's (perceived) options in life, and thereby the possibilities of differentiating him/herself from their siblings, are potentially affected by the family's resources, preferences, and expectations, all of which may vary by SES. There is a theoretical discussion linking a potential socioeconomic gradient in sibling similarity to parental strategies for investing in their children. While several different mechanisms could give rise to differences in sibling similarity by parental SES³, parents' decisions on whether to reinforce or compensate for initial ability differences between siblings have been emphasized in the literature (Becker and Tomes 1976; Griliches 1979; Behrman, Pollak and Taubman 1982). Griliches (1979), for instance, argues that

¹ Björklund, Lindahl, and Lindquist (2010) describe the sibling correlation as “an omnibus measure of the importance of family background and community effects. It includes anything shared by siblings: parental income and parental influences such as aspirations and cultural inheritance, as well as things not directly experienced in the home, such as school, church and neighborhood effects” (p. 4).

² Just as the importance of family background can be different in two societies with the same cross-sectional inequality (see discussion in Solon 1999).

³ For instance, children of low SES parents might attend different schools than children of high SES parents and the schools might be different in terms of how they benefit children with different endowments. In addition, the degree of complementarity between child endowments and parental inputs could also matter for the relationship between parental SES and sibling similarity.

parents want to compensate for initial ability differences and that high SES parents have more resources to make such investments. Smaller sibling differences in high SES families would result in higher sibling correlations in these groups. Given this long-standing theoretical interest, this question has received surprisingly little empirical attention.

A key empirical challenge in answering this question is the availability of data on both generations and on a scale that would allow constructing granular groups of differing socioeconomic affluence. There is a small but growing set of studies on this question, mainly based on data from the U.S., Germany, and Sweden. Collectively, the evidence these papers offer on social gradients in sibling similarity is inconclusive.⁴ Many papers use relatively small survey-based samples, while others construct broad SES groups. Both approaches, however, may limit the possibility to detect gradients and non-linearities in the relation between sibling similarity and parental SES.

In this paper, using population-wide Swedish register data spanning multiple generations, we provide one of the most comprehensive examinations yet on sibling similarity across the socioeconomic spectrum. In particular, we compare sibling correlations in skills, schooling, and earnings⁵ across fine-grained groups defined by parental education and earnings. The register data contain information on mid-life earnings and years of schooling for the parent generation (born 1940–1950) as well as the child generation (born 1965–1982). For men in the child generation, the dataset also includes measures of cognitive and non-cognitive skills from the military conscription assessments made at age 18–19.⁶

In contrast to existing work, the register data allows us to construct fine-grained groups by parental education and earnings. It is important to use fine-grained groups rather than, e.g., divisions by the median, because the degree of homogeneity in the different groups matters for the comparison of the sibling correlations. For example, the variation in years of schooling and income is typically much higher above the median than below. Consequently, families in the group below the median will be more homogeneous than families above the median. Since the sibling correlation is the ratio of the between-family variation to the total variation, this will lead to a lower sibling correlation in the below-median group even if the within-family variation is the same across the two groups (Solon et al. 1991). Since we, in this paper, are not interested in the

⁴ For the US, see Conley and Glauber (2007), Conley and Glauber (2008), and Conley, Pfeiffer and Velez (2007); for Germany, see Anger and Schnitzlein (2017); Grätz (2018), and Baier (2019); and for Sweden, see Grätz et al. (2021), Grätz and Kolk (2022), and Hällsten and Thaning (2022).

⁵ In the paper, we sometimes use the term income rather than earnings, but in both cases it is labor income we refer to.

⁶ The ability measures from the military conscription have previously been used by, e.g., Lindqvist and Vestman (2011), Edin et al. (2022) and Grätz et al. (2021). Lindqvist and Vestman (2011) and Edin et al. (2022) have shown that these measures are strong predictors of labor market performance.

between-family variation per se, we want to avoid this. Lastly, a finer division is better equipped to detect gradients and non-linearities in the data.⁷

A more granular division tends to equalize the between-family variation in the different groups, so that any differences in sibling correlations across groups are more likely to reflect differences in within-family variation, which is arguably of higher interest and more related to the parental investment theories discussed above. Hence, we also directly compare this within-family variation across groups as suggested by Breen and Ermisch (2021). An alternative approach would be to focus solely on the within-family variation. However, this measure would then never be put in relation to the overall variation, which could be misleading. Therefore, we generally show both the sibling correlation and the underlying variance components, paying particular attention to differences in sibling correlations across social groups that are driven by differences in the within-family variance.

Our results show a clear and consistent pattern. Sibling correlations generally decrease with parental SES. For years of schooling, mid-life earnings, and cognitive skills, sibling correlations decline almost monotonically with both the education and earnings of the parents. In comparison, sibling correlations in non-cognitive skills only decrease with parental earnings.

The socioeconomic gradient we find is substantive. Moving from the 5th to the 15th ventile of parental income, for instance, sibling correlations in income and cognitive skills decline by over 20% and 7%, respectively. The corresponding relative decline for the sibling correlation in non-cognitive skills is 14%.

The decline in sibling correlations for education and income with parental SES is mainly driven by an increase in within-family variation, indicating that siblings are more similar to each other in families with low SES (i.e., contrary to the prediction by Griliches 1979). In contrast, the decrease in sibling correlations in skills is driven by a relative decrease in between-family variation.

Our main results are based on male siblings due to the lack of data on skills for women. However, reassuringly, the pattern for sibling correlations in years of schooling and earnings remains very similar when women are included in the sample. Lastly, we show that these patterns are robust to measuring income at different ages and are not driven by differences in family structure (such as the number of siblings and age differences between them) across the socioeconomic spectrum.

⁷ Figure A3–Figure A6 in the Appendix substantiate this point, presenting results in an ascending order of granularity. Furthermore, our replication of Hällsten and Thaning (2022) in Section 7.1 offers a concrete example.

We contribute to three strands of the literature. First, we add to a small set of papers documenting variations in sibling similarity across different demographic groups.⁸ As mentioned earlier, these papers often rely on small samples or create broad groups that might not be sufficient to detect meaningful inter-group differences in sibling correlations. Using population-wide administrative data covering multiple generations in Sweden, which enables us to create granular subsets of the population with varying SES, we provide one of the first pieces of evidence of a robust negative relationship between parental SES and sibling correlations in skills, earnings and, education.⁹

It is particularly interesting to discuss the findings in Grätz et al. (2021), Grätz and Kolk (2022), and Hällsten and Thaning (2022) since they also use Swedish register data. Grätz et al. (2021) focus on cognitive ability, school grades, and educational attainment, finding higher sibling correlations among low SES families defined by parental occupation, with less consistent results when defined by parental education. Grätz and Kolk (2022) observe similar sibling correlations in total earnings over ages 18–60 across three SES groups based on parental occupation. Lastly, Hällsten and Thaning (2022) analyze data on education, occupation, income, and wealth for both the child and parent generation and estimate sibling correlations for each outcome in groups defined by parental SES quintiles. They generally find higher correlations in high SES families, especially when defined by wealth. We replicate some of Hällsten and Thaning's findings and provide suggestive evidence that these patterns are sensitive to variations in the granularity with which we measure SES.

The evidence we generate also relates to the theoretical literature on the role of parental inputs in inter-sibling differences in human capital formation and earnings. Parents might be averse to inequality and attempt to compensate for ability differences across their children. On the other hand, efficiency considerations might lead them to reinforce these ability differences. The magnitude of such reinforcing investments would, however, depend on the resources a family has

⁸ The results in these papers are mixed, with positive, negative, and non-existent associations between sibling similarity and parental SES being reported. To some extent, this variation may be explained by the different outcomes and definitions of SES used across studies. However, even within countries, and for similar outcomes, consistent patterns are hard to discern. For example, in Germany, Baier (2019) finds that the sibling correlation in cognitive ability is higher in low SES families than in high SES families while Grätz (2018), who studies cognitive ability and educational attainment, finds no differences by parental SES. In addition, Anger and Schnitzlein (2017) observe that high SES families display a higher sibling correlation in non-cognitive ability. There are also indications that the relationship between sibling similarity and parental SES can be non-linear. Karhula et al. (2019), studying education and labor market outcomes in Finland, identify a U-shaped pattern between sibling similarity and parental SES.

⁹ Since papers estimating intergenerational parent-child correlations in socioeconomic outcomes typically find stronger associations among high SES families (e.g., Acciari, Polo, and Violante 2022; Bratberg et al. 2017), our finding of an opposite-signed relationship with respect to sibling correlations might seem somewhat surprising. However, sibling correlations and parent-child associations have different interpretations, with the latter being a narrower measure of family influence. In fact, Solon (1999) derives that $\text{Sibling Correlation} = (\text{Child-Parent Correlation})^2 + \text{other shared factors}$. Using this relationship, Björklund and Jäntti (2020), for instance, show that these “other shared factors” are substantially more important in their relative contribution to the sibling correlation.

to begin with. Our results are therefore consistent with a scenario where parents generally reinforce ability differences across their children, with higher SES parents having greater capacity to do so more effectively. However, we acknowledge that the observed socioeconomic gradient in sibling similarity could arise even under compensating parental investments if there are sufficiently strong complementarities between parental investments and child ability. Nevertheless, this scenario arguably relies on stronger assumptions compared to the scenario with reinforcing investments.

Finally, we add to a large body of literature that uses the sibling correlation as a measure of the importance of family background in shaping children's socioeconomic outcomes. This strand of literature often uses this measure to compare different countries or broad groups within a country (e.g., males vs females; Björklund and Jäntti 2020). Our paper undertakes an in-depth study of how sibling correlations vary across the socioeconomic spectrum within a country, thereby offering a more nuanced portrayal of the country's opportunity landscape.

The paper is organized as follows: In section 2, we discuss theories and previous empirical evidence concerned with parental investment strategies and child-rearing principles and discuss what they imply in terms of sibling differences across social groups. Section 3 describes the data, whereas Section 4 outlines the empirical approach. Results are presented in Sections 5 and 6. Section 7 provides a discussion of the results, and section 8 concludes.

2 Conceptual framework

The theoretical literature on a potential socioeconomic gradient in sibling similarity dates to the 1970s. In the model proposed by Becker and Tomes (1976), parents have incentives to reinforce initial ability differences between siblings for efficiency reasons. Siblings with poorer endowments are compensated later in life with monetary transfers. Given that parents with high SES have more resources, they can make larger reinforcing investments. Thus, according to this theory, sibling differences in human capital and earnings would tend to be larger in more well-off families leading to lower sibling correlations.

On the other hand, Griliches (1979) and Behrman, Pollak and Taubman (1982) suggest that parents have equity concerns, not only regarding consumption levels of their children, but also regarding the human capital levels. A key conclusion is that parents may prioritize making compensating investments even if it's more efficient to reinforce initial abilities. Therefore, sibling differences would instead be smaller, and sibling correlations higher, in families with high SES if the influence from the equity concern dominates.¹⁰

¹⁰ It should also be noted that the nature of marginal returns to investments in children can play a role for the predictions. Arguably, parents with higher SES generally invest more in the children and so potential differential investments in the

Clearly, the direction of the models' predicted socioeconomic gradient in sibling similarity depends on whether parents make reinforcing or compensatory investments. This question has received substantial empirical attention (e.g., Fan and Porter 2020; Savelyev et al. 2022; Yi et al. 2015; Frijters et al. 2013; Hsin 2012; Restrepo 2016; Grätz and Torche 2016; Rosenzweig and Wolpin 1988; Rosenzweig and Zhang 2009; Behrman, Rosenzweig and Taubman 1994). The evidence from these studies is mixed, but reinforcing investments are slightly more common than compensating investments (see, e.g., the review and discussion in Almond and Mazumder 2013).

Importantly, parental responses to endowment differences between siblings may vary by SES. Hsin (2012), Restrepo (2016), and Grätz and Torche (2016) study this question. Despite the fact that they all analyze US data and use birth weight as an indicator of the child's endowment, they reach different conclusions. Hsin (2012) and Restrepo (2016) find that low-educated mothers spend more time with children who have a higher birth weight (i.e., reinforce), whereas high-educated mothers spend more time with children who have a lower birth weight (i.e., compensate). In contrast, Grätz and Torche (2016) generally find small parental responses to differences in birth weight that do not vary by SES. In addition, using a measure of cognitive ability at age 4, they find that parents with high SES provide more cognitive stimulation to higher-ability children, whereas parents with low SES do not react adjust to ability differences. Thus, the socioeconomic gradient in parental responses to endowment differences between siblings appears to be complex with varying patterns across different types of child endowments. Consequently, this research offers limited guidance on what to expect for the relationship between sibling differences in socioeconomic outcomes and family SES.

Baier (2019) introduces another perspective, suggesting that sibling outcome differences might be larger in high SES families due to their child-rearing strategies. High SES parents are better equipped to provide tailored inputs based on the child's individual talents and interests (e.g., play music with a child that displays musical talent/interest and do math with a child that displays mathematical talent/interest). In contrast, low SES parents tend to provide more generic inputs to all their children. This hypothesis suggests that sibling outcome differences in high SES families are expected to be larger than in low SES families.

A couple of recent papers highlight a weaker association between potential educational attainment (measured by a polygenic score¹¹) and actual educational attainment among

children occur at a higher baseline level compared to parents with lower SES. If the return to investments is decreasing, which is often assumed, a given differential investment will matter less for outcomes if the baseline investment level is higher. With this perspective, it could be argued that it actually is harder for high SES parents to compensate or reinforce. However, Becker et al. (2018) challenge the assumption of decreasing marginal returns to investments in children and argue that the returns might actually be increasing instead.

¹¹ Some specific genetic variants are highly associated with educational attainment. The polygenic score for educational attainment is obtained by combining these known associations with individual level DNA information.

individuals from low SES families. This has been shown in the US (Papageorge and Thom 2020) and Denmark (Ronda et al. 2022). These findings not only suggest wasted potential in society but also indicate that sibling differences in educational attainment can be lower in low SES families, as differences in endowments are less likely to translate into differences in actual educational outcomes. These results align with Becker and Tomes (1976), who proposed that low SES parents may lack resources necessary for reinforcing investments.

Other papers explore parental responses to variations in public investments in children (Das et al. 2013; Pop-Eleches and Urquiola 2013; Fredriksson, Öckert and Oosterbeek 2016). Fredriksson, Öckert, and Oosterbeek (2016) find that high-income parents of children in larger classes provide more assistance with homework, whereas no corresponding pattern is observed for low-income parents. Such substitutability between public and private investments in children from high SES families suggests that sibling outcome similarity may increase with family SES.

In conclusion, the relationship between sibling similarity in socioeconomic outcomes and family socioeconomic status (SES) is multifaceted. Early models suggest that parental reinforcement of initial ability differences could lead to larger disparities in well-off families, while others propose that equity concerns may drive compensatory investments, potentially reducing differences in high SES families. Empirical evidence presents a mixed picture, with varied parental responses to endowment differences by SES. Moreover, recent findings suggest that educational attainment differences may be lower in low SES families due to constrained resources, echoing earlier insights. Overall, the intricate interplay between parental investment strategies, socioeconomic context, and public policies underscores the complexity of this relationship.

3 Data

We combine multiple Swedish registers covering the population. These registers have been compiled by Statistics Sweden and include pseudonymized personal identifiers, making it possible to collate information from different registers. A key data source is the multigenerational register which links children with parents for children born 1932–2019. This information allows us to identify siblings in the data. Each row in our dataset represents a child, and for each child we include data on their skills, schooling, and earnings, as well as information about their parents.

For skills, we observe results on cognitive and non-cognitive ability tests taken during the military conscription at age 18–19. The test of cognitive ability, which is a written test, is similar to a standard intelligence test (Carlstedt 2000; Carlsson et al. 2015), whereas non-cognitive ability is assessed by a trained psychologist on the basis of an interview with the conscript (Mood et al.

2012). This information is only available for men and covers cohorts born 1950–1980. The test results are standardized within test cohorts.

Data on years of schooling come from the *LISA* register, which includes all individuals aged 16–65 residing in Sweden in a given year. This register is available since 1985 and contains annually updated information on the highest level of education. Annual income data is also available from 1985, and we use this data to average income over key mid-life years for both children and parents.

For children, we approximate life-time earnings with the average annual earnings for the ages 35 to 37 years.¹² We then perform a percentile rank of the income measure by birth year. Thus, the sibling correlations in income are measured as rank-rank correlations. Education is measured at age 30. If education data is missing at age 30, we use the next available observation after age 30.

To rank parents along the socioeconomic spectrum, we use two different measures of socioeconomic status: income and education. For parents, we define individual life-time income as the average income for the ages 45 to 50 years and calculate parental income as the total of maternal and paternal incomes. We then divide these parental incomes into ventiles by the average birth year of the two parents.¹³ Similarly, for education, we take the average of the two parents' years of education and divide them into ventiles by the average birth year of the parents.

The sample is limited to parents born between 1940 and 1950, and children born between 1965 and 1982. The appendix includes results when applying the cohort restrictions only to children and extending the parent cohorts by using income data from 1968¹⁴ (Figure A12 and Figure A13).¹⁵ Skills data are only available for men. The results in the main body of the paper are therefore limited to only include male siblings to keep the sample harmonized across outcomes. However, the appendix includes results where both men and women are included (Figure A1 and Figure A2). Table 1 describes our analysis samples and shows summary statistics for the outcomes.¹⁶

¹² Our conclusions remain similar if we instead use average earnings between ages 25–30 (see Figure A11 in the appendix). Böhlmark and Lindquist (2006) have shown that earnings during ages 35–37 are strongly linked to total life-time earnings.

¹³ A ventile represents 5% of the underlying population.

¹⁴ We observe earnings data for the years 1968, 1970, 1971, 1973, 1975, 1976, 1979, 1980, 1982 and annually for 1985–2019.

¹⁵ The results are not sensitive to these parent cohort variations.

¹⁶ Almost 50% of the children in the male sample are the only child in their family *within the sample*. The main results are virtually unchanged when we drop these singletons from the estimation sample.

Table 1 Analysis samples, descriptive statistics

Outcomes	Male sample			Male and female sample		
	Children (N)	Families (N)	Mean	Children (N)	Families (N)	Mean
Income	441,644	322,943	319,924	858,061	460,594	266,948
Education	410,782	304,204	12.7	798,383	438,422	12.9
Cognitive ability	357,435	273,334	0.061			
Noncognitive ability	357,435	273,334	0.068			

Note: This table describes our main samples. Education represents years of schooling. Income represents average annual labor income during ages 35–37 in 2018 SEK. Ability measures are standardized by test year.

4 Estimation

We compare sibling differences in socioeconomic outcomes across groups by estimating sibling correlations separately by outcome and group. Following the literature (see, e.g., Björklund, Lindahl, and Lindquist 2010), we estimate mixed-effect models of the type specified in Equation (1) below.¹⁷ The subscripts i and j denote family and child respectively, and the control vector includes gender (where applicable) and birth-year dummies.

$$y_{ij} = \mathbf{x}_{ij}\boldsymbol{\beta} + a_i + b_{ij} \quad (1)$$

From this model, we obtain estimates of the within-family variation (σ_b^2) and the between-family variation (σ_a^2). We can then estimate the sibling correlation as follows:

$$\rho = \frac{\sigma_a^2}{\sigma_a^2 + \sigma_b^2} \quad (2)$$

Thus, the sibling correlation amounts to the share of total variation that is due to between-family variation. Alternatively, the sibling correlation can be thought of as the correlation in the outcome between randomly drawn pairs of siblings. Note, however, that all families, no matter the number of siblings, are included in the analysis sample.¹⁸ Since the sibling correlation depends on both the between-family variation and the within-family variation in the studied outcome, it is crucial

¹⁷ We use restricted maximum likelihood estimation (reml). The analyses are performed using the *mixed* command in Stata.

¹⁸ All observations are given the same weight, i.e., we do not let weights vary by family size.

to understand the relative importance of the two components. Throughout the paper, we therefore present estimates of the variance components alongside estimates of the sibling correlations.

To investigate how the sibling correlations in skills, earnings, and education vary by parental SES, we do separate estimations for each ventile of parents' SES, where parents' SES is defined by either education or income.

5 Main results: sibling correlations by parental earnings

This section presents estimates of sibling correlations, stratified by ventiles of parents' earnings, for the following outcomes: income, education, cognitive skills, and non-cognitive skills.

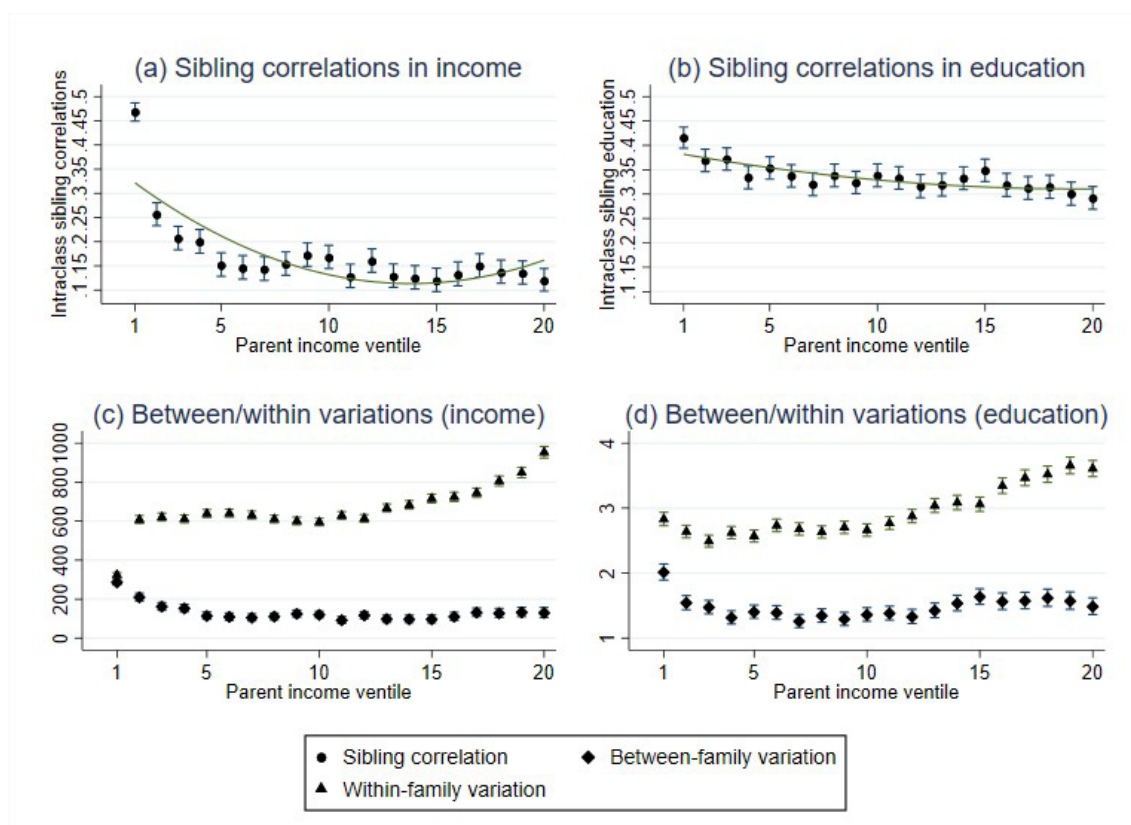
5.1 Sibling correlations in income and education by parental income

We start by documenting sibling correlations in income and years of schooling by ventiles of parental income (Figure 1). The left and right panels show sibling correlations in income and education, respectively. Both figures show a decline in sibling correlation with parents' income.¹⁹ In other words, siblings in families with low parental income are more similar to each other in terms of both income and education compared to siblings in families with parents who earn more. The decline is particularly salient for income in both absolute and relative terms. For instance, moving from the 1st to the 20th ventile of parental income, the sibling correlation in income declines by more than 0.3 (or by over 70%; please see Table 2).²⁰ The corresponding decline for education is 0.12 (30%). In both cases, the differences are statistically significant at the 1% level. Figure 1 includes male siblings only, but the pattern holds when we expand the sample to comprise both men and women (results are reported in Figure A1).

¹⁹ Figure A3 and Figure A4 show that the negative relation between sibling correlations and parental income is more pronounced with a more granular division of parental quantiles. This is particularly true for education.

²⁰ The results for the first ventile should be interpreted with some caution as some parents with very low (or zero) labor income might in practice be well-off individuals who receive income via capital investments rather than labor. The first ventile could therefore potentially be more diverse than the other ventiles. We do also see slightly higher between-family variation in this group (see Figures 1c and 1d). Still, the very high sibling correlation in income in ventile 1 (Figure 1a) is primarily driven by a markedly lower within-family variation (Figure 1c).

Figure 1 Sibling correlations in earnings and education by parental income ventiles



Note: The figure shows sibling correlations in earnings and years of schooling for male siblings by parental income ventiles. The green line shows a second-order polynomial fitted line for the sibling correlations. The lower panels show the variance components that underlie the sibling correlation.

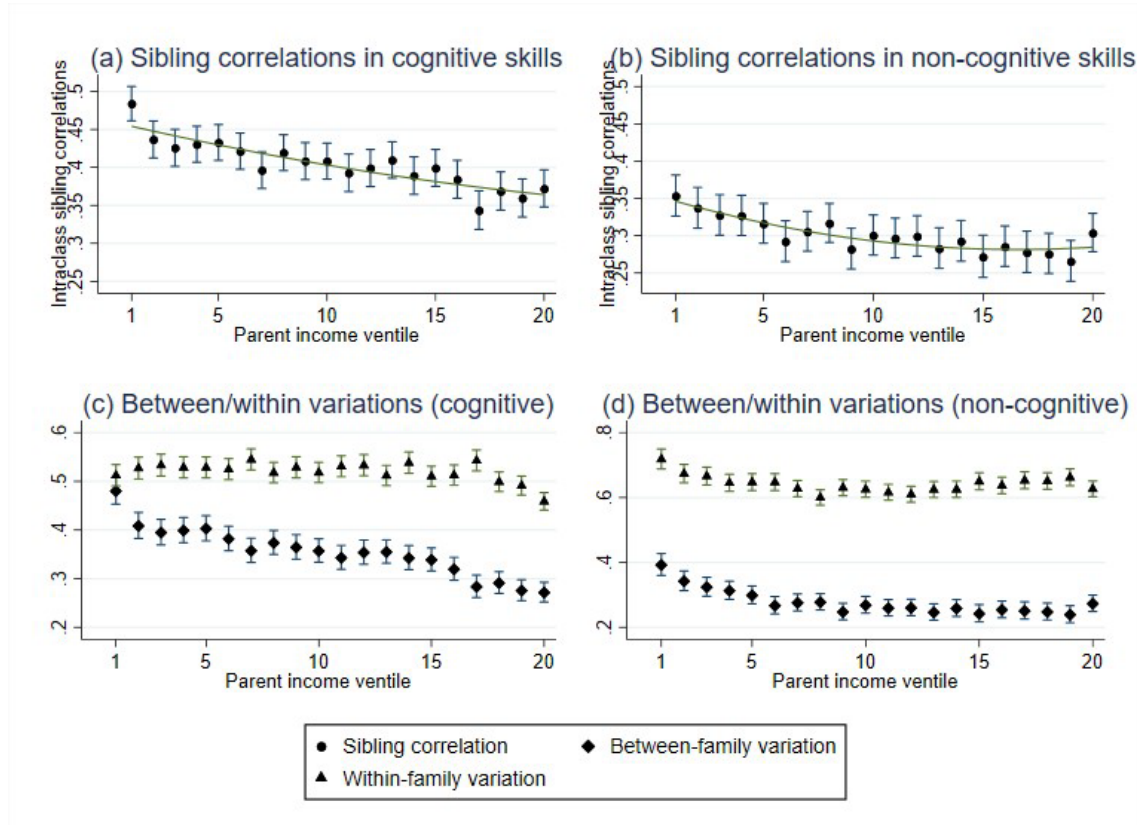
What drives this decline in sibling correlations with parents' socioeconomic status: within-family (σ_b^2) or between-family (σ_a^2) variation? *Ceteris paribus*, higher within-family variation leads to lower sibling correlation whereas the correlation increases monotonically with between-family variation. Both for earnings and education, Figure 1 shows an increase in within-family variation with parental income, especially on the right tail of the parental income distribution (i.e. contrary to the prediction by Griliches 1979). This indicates that the decrease in sibling correlations by parental SES is mainly driven by an increase in within-family variation. The results look similar when the sample is limited to families with two children with an age gap of four years or less (see Figure A7), suggesting that the decline is not driven by differences in family structure by SES.

5.2 Sibling correlations in cognitive and non-cognitive skills by parental income

Figure 2 reports sibling correlations in cognitive and non-cognitive skills by parental income. These skills can complement years of schooling as a measure of human capital investment. While compulsory education policies might place a lower bound on completed years of schooling, this may not be the case for these measured skills. However, these skills are measured at an earlier

age, namely when the individuals are 18–19 years old, whereas completed years of schooling is measured at age 30 or later.

Figure 2 Sibling correlations in cognitive and non-cognitive skills by parental income ventiles



Note: The figure shows sibling correlations in cognitive and non-cognitive ability for male siblings by parental income ventiles. The green line shows a second-order polynomial fitted line for the sibling correlations. The lower panels show the variance components that underlie the sibling correlation.

Consistent with the results for income and education, sibling similarity in both cognitive and non-cognitive skills tends to decline with increasing parental income.^{21,22} However, in contrast to the result for education and income, this decline in sibling correlations seems to be driven by a decline in between-family variation rather than an increase in within-family variation.

²¹ Again, while the negative relation is always present, it is less clear when parents are grouped by the median income, quintiles, or deciles (Figure A5 and Figure A6).

²² The results look similar when the sample is limited to families with two children with an age gap of four years or less (see Figure A8 in the appendix).

Table 2 Differences in sibling correlations between different parental income ventiles

Outcome:	Income	Education	Cognitive skills	Non-cognitive skills
Panel A. Comparison between parental income ventiles 5 and 15				
Ventile 5	0.151	0.353	0.433	0.316
Ventile 15	0.119	0.348	0.399	0.272
Difference	0.032*	0.005	0.034*	0.044**
Panel B. Comparison between parental income ventiles 1 and 20				
Ventile 1	0.468	0.416	0.484	0.353
Ventile 20	0.119	0.292	0.372	0.304
Difference	0.349***	0.124***	0.112***	0.049***

Note: This table presents sibling correlations estimated for parental income ventiles 1, 5, 15 and 20, and the difference between these correlations for ventiles 5 and 15 and 1 and 20, respectively. ***/*** refers to statistical significance at the 10/5/1 percent level.

6 Robustness: sibling correlations by parental education

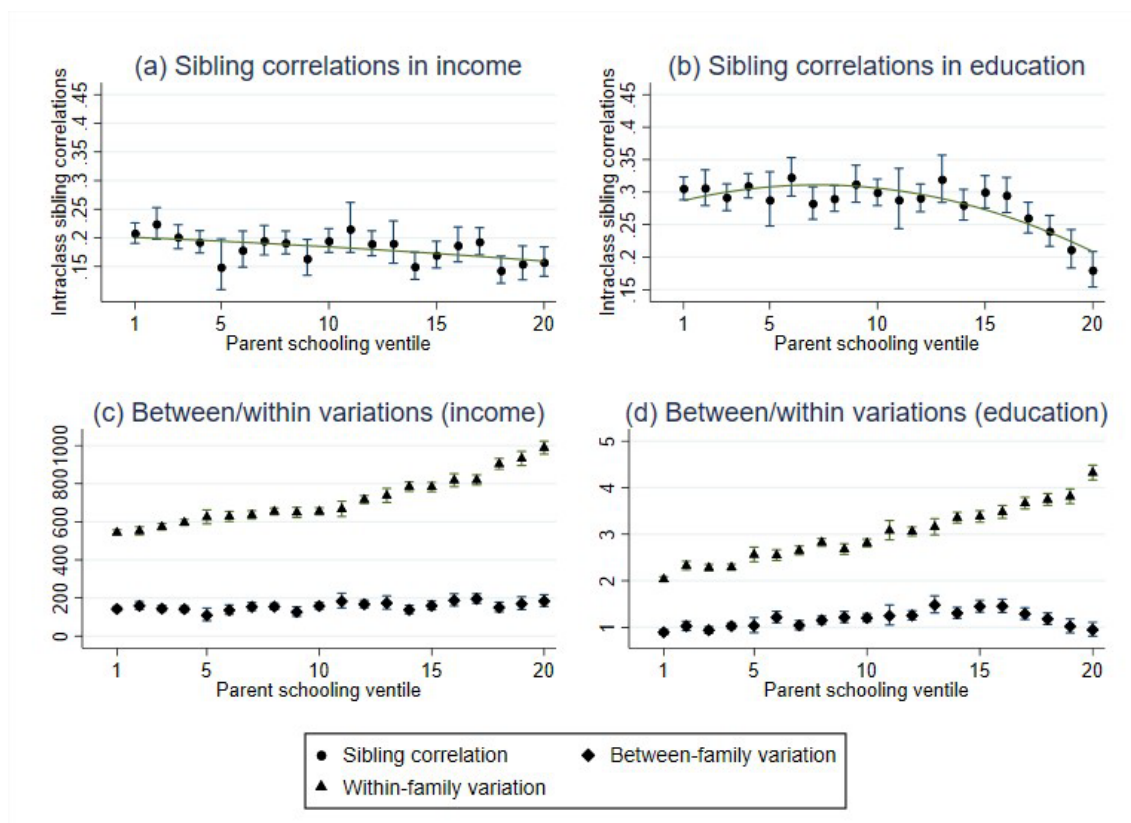
This section replicates the analyses above, by using parental education, instead of income, to define SES. Note, however, that, compared to parental income, education is measured more coarsely in our dataset. In addition, as mentioned before, compulsory education policies constrain the variation in this measure, especially on the left tail. For these reasons, we view parental income as our main measure of parental SES, while parental education serves as an alternative measure.

6.1 Sibling correlations in income and education by parental education

Figure 3 shows how sibling correlations in income and education vary with parental education. Consistent with previous results, we see a decline in sibling correlation in education at higher ventiles, driven by rising within-family variations. However, the corresponding pattern for income looks weaker. Similar results are found when female siblings are included (Figure A2).

Although the pattern of decreasing sibling correlations by parents' SES holds whether this status is measured in terms of parental education or income, some differences exist. When parents' SES is defined by education, the decline in sibling correlations is steeper at the end of the distribution (particularly for education). In contrast, when parents' SES is measured as income, the decrease in sibling correlations is more pronounced on the left tail of the parental income distribution (particularly for income).

Figure 3 Sibling correlation in income and education by parental education ventiles

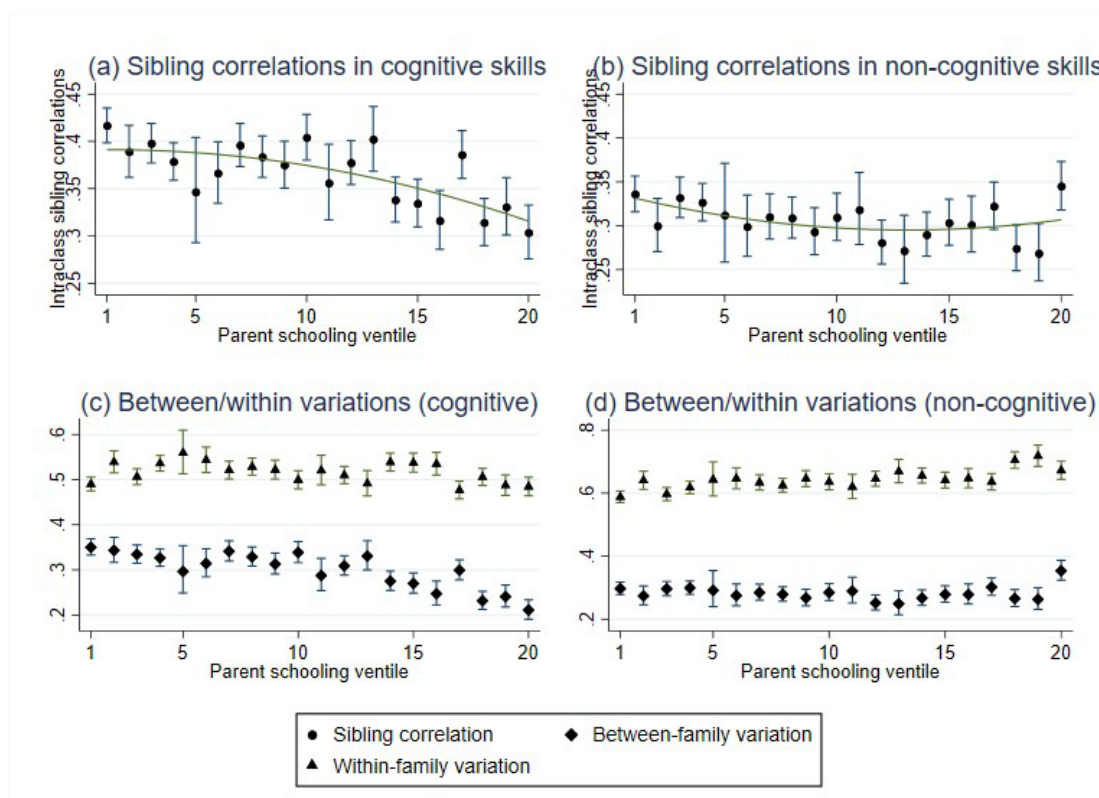


Note: The figure shows sibling correlations in income and years of schooling for male siblings by parental education ventiles. The green line shows a second-order polynomial fitted line for the sibling correlations. The lower panels show the variance components that underlie the sibling correlation.

6.2 Sibling correlations in skills by parental education

Figure 4 replicates Figure 3 for sibling correlations in cognitive and non-cognitive skills. The negative gradient we found earlier for cognitive skills in Figure 2 appears to hold. However, the decline is less salient for the correlations in non-cognitive skills. One reason is that the correlation goes up sharply at ventile 20. Also note that the negative relationship between the sibling correlation in cognitive skills and parental education is driven by a decrease in between-family variation at the right tail of the SES distribution, rather than an increase in within-family variation. For non-cognitive skills, on the other hand, we find a somewhat positive relationship between within-family variation and parental schooling ventile.

Figure 4 Sibling correlation in skills by parental education ventiles



Note: The figure shows sibling correlations in cognitive and non-cognitive ability for male siblings by parental education ventiles. The green line shows a second-order polynomial fitted line for the sibling correlations. The lower panels show the variance components that underlie the sibling correlation.

7 Discussion

7.1 Comparison with previous estimates

How do our findings compare to those in existing studies, particularly those using similar data from Sweden? The closest paper of interest is Hällsten and Thaning (2022), especially their results on sibling correlations in education by parental education²³, which we can attempt to replicate with similar data. However, in the absence of a replication package, we cannot ensure that our analysis is exactly the same as theirs.²⁴

Figure A9 is an attempt to replicate their analysis of sibling similarities in education across parental education quintiles. We find a somewhat positive gradient similar to their estimates. As we increase the granularity of the parental education groups by creating twenty ventiles, this positive slope disappears (see Figure A10). Instead, consistent with our results (see panel b of

²³ This is what we study in panel b of Figure 3.

²⁴ In similarity with Hällsten and Thaning (2022), we limit the sample to children born between 1945 and 1976 and parents born between 1930 and 1939. We measure children's education in ranks. To determine parents' socioeconomic status, we follow Hällsten and Thaning (2022) by defining their status on the basis of their education, dividing it into five quintiles.

Figure 3), we see a marked decline in sibling correlations at the right tail of the parental education distribution. This exercise further strengthens the argument that creating granular SES groups is critical to discerning how sibling similarity might vary with family background.

7.2 Implications for theories about parental investments

Our results relate to the theoretical literature on the role of parental inputs in inter-sibling differences in human capital formation and earnings (Becker and Tomes 1976; Griliches 1979; Behrman, Pollak and Taubman 1982). Parents might be averse to inequality and attempt to compensate for ability differences across their children. Efficiency considerations, on the other hand, might lead them to reinforce these ability differences. High SES parents have more resources to make compensating or reinforcing investments, and thus we expect smaller sibling differences (and larger sibling correlations) in high SES families if the inequality concern dominates and larger sibling differences (and smaller sibling correlations) in high SES families if the efficiency concern dominates.

Since we generally find smaller sibling correlations in high SES families, the results are consistent with the theory that parents reinforce endowment differences between siblings. However, this evidence is indirect and does not conclusively prove parental reinforcement. The observed pattern can stem from various other factors. In fact, there could be smaller sibling correlations in high SES families even if parents generally make compensating investments if there are strong complementarities between parental inputs and child endowments.

Still, on balance, we believe that our results are more consistent with reinforcing parental inputs than compensating. Interestingly, this interpretation aligns well with the conclusion in Almond and Mazumder (2013) that reinforcing investments are slightly more prevalent than compensating ones. It has proven difficult to directly document reinforcing or compensating behavior in a compelling way and the results in this literature are mixed. Thus, the indirect evidence we provide can complement earlier studies.

8 Conclusion

A person's (perceived) possibilities in life, and consequently, the opportunities to distinguish themselves from siblings, can be influenced by the family's resources, preferences, and expectations. These factors may vary depending on the family's socioeconomic status (SES). Hence, to understand the opportunity landscape within a society, it is critical to assess, for instance, if life is more formed by individual endowments and considerations in families with better access to resources. In other words, are outcome differences between siblings greater in high SES families compared to low SES families?

In this paper, we have conducted one of the most comprehensive examinations yet on sibling similarity in skills, schooling, and earnings across granular groups defined by parental SES. Using sibling correlations as a measure of similarity, our results reveal a consistent pattern. Sibling correlations generally *decrease* in the SES of the parents. Specifically, we find that sibling correlations for years of schooling, mid-life earnings, and cognitive ability decrease with both parental education and income levels. In contrast, correlations for non-cognitive ability decrease only with parental income.

The main results are based on male siblings due to the absence of skill data for women. However, when women are included in the sample, the patterns for sibling correlations in years of schooling and earnings remain very similar. Our results differ from earlier studies in Sweden, notably Hällsten and Thaning (2022). We attribute these disparities to differences in cohorts, specific outcome measures used, and the granularity of the SES classification. Importantly, we are able to replicate the findings of Hällsten and Thaning with respect to sibling correlations in education across parental educational levels. We further show that the positive relationship between the sibling correlation and parental SES documented by Hällsten and Thaning becomes more similar to our results (i.e. more negative) when using the same detailed SES groupings as in our study.

Since the sibling correlation depends on both the between-family variation and the within-family variation in the studied outcome, it is crucial to understand the relative importance of these two components for the observed social gradient in sibling outcome similarity. *Ceteris paribus*, higher within-family variation leads to lower sibling correlation whereas the correlation increases with between-family variation. We show that the decline in sibling correlations for income and education is driven by an increase in within-family variation by parental SES. In contrast, the decline in sibling correlations for skills is driven by a decline in between-family variation. Thus, the interpretation of the skills results is not straightforward, as they do not consistently point toward lower sibling similarity in the upper part of the socioeconomic spectrum. It is interesting to note that within-family variation in education and earnings is increasing in parental SES, whereas the relationship is relatively flat for skills. This means that it is *not* larger within-family differences in skills that give rise to the larger differences in education and earnings among the high SES families. One possible explanation is that high-ability children from low SES families may face barriers that prevent them from achieving their full potential in terms of earnings and educational attainment, potentially leading them to have outcomes closer to their lower-ability siblings. This explanation is also supported by the results in Papageorge and Thom (2020), and Ronda et al. (2022)

Finally, while more research is required to uncover the mechanisms behind the observed social gradient in sibling similarity, our results suggest that life is more formed by individual endowments and considerations for individuals from high SES backgrounds as compared to individuals from low SES backgrounds. In essence, children from low SES homes not only experience worse average socioeconomic outcomes compared to those from high SES homes, but they also appear to have worse possibilities to develop individually. We argue that this is an important aspect of inequality in a society that largely has been overlooked. Lastly, we document a robust negative relationship between parental SES and sibling correlations in Sweden, a welfare state in which sibling correlations generally tend to be lower than in most other industrialized countries. Future studies from other countries, using similar levels of SES granularity as in our study, would therefore be valuable.

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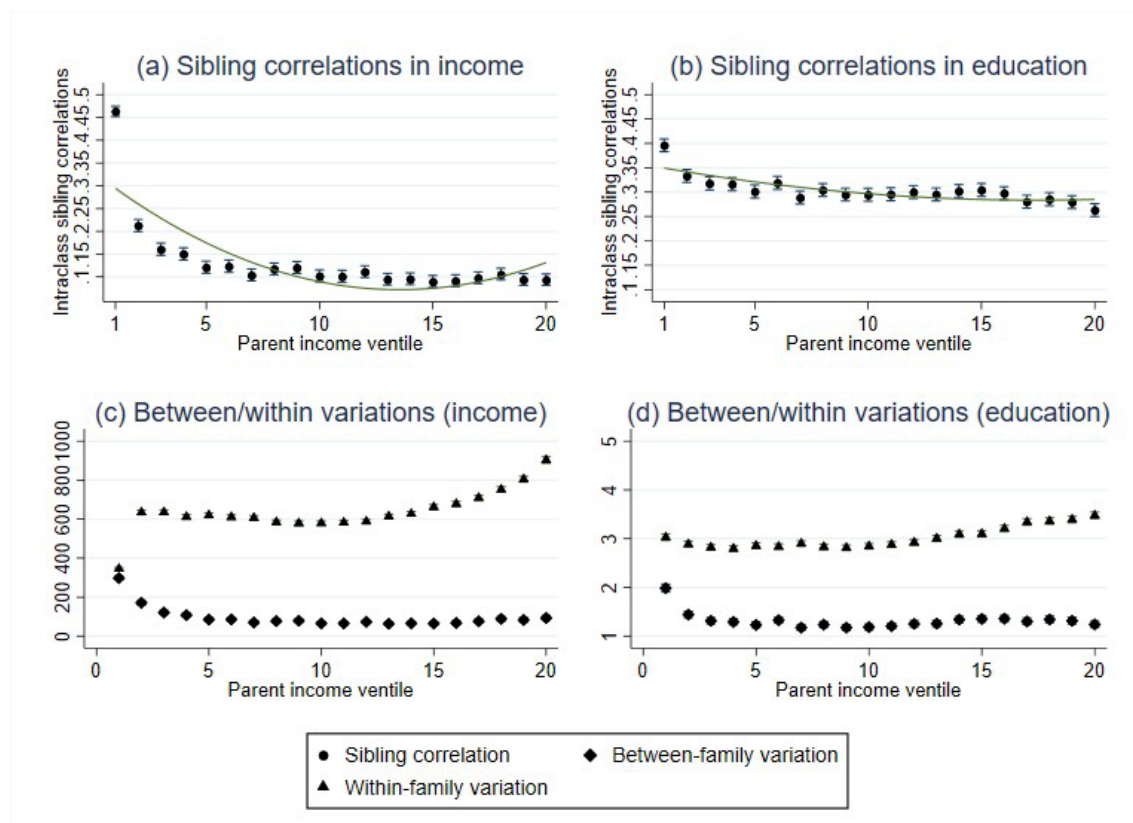
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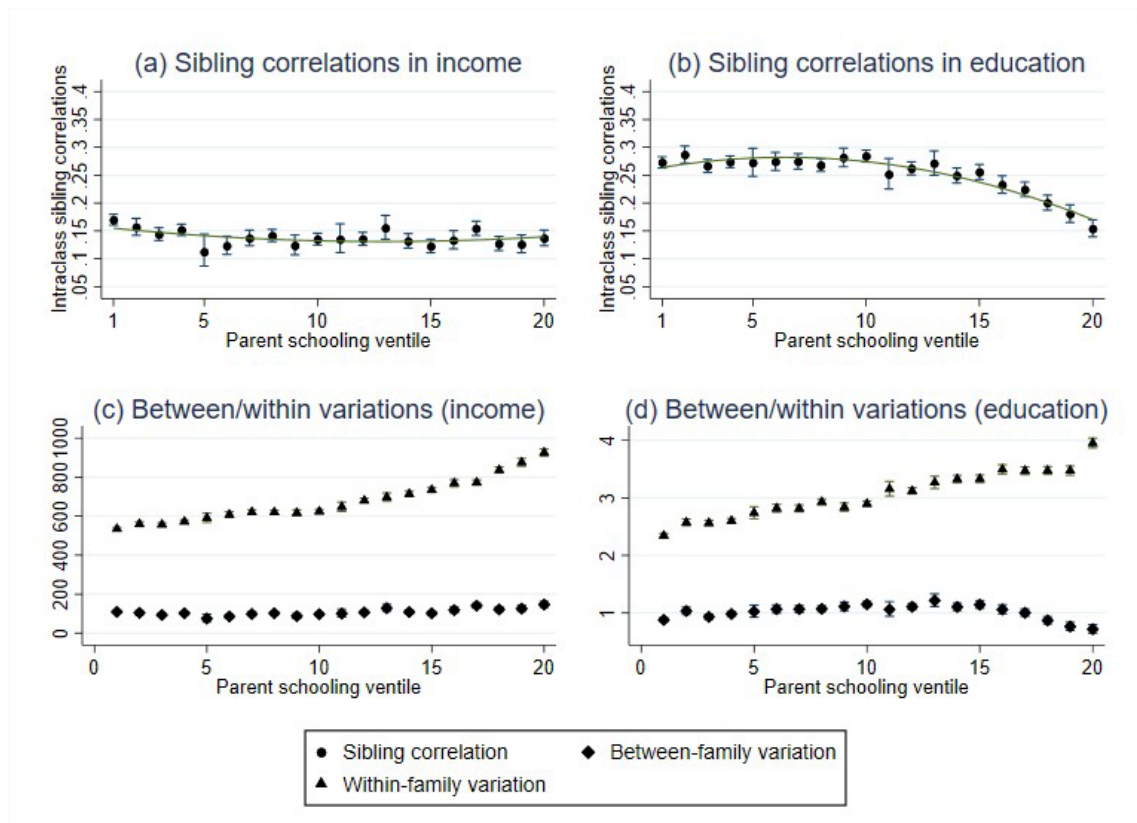
Appendix

Figure A1 Sibling correlations in earnings and education by parental income ventiles (men and women)



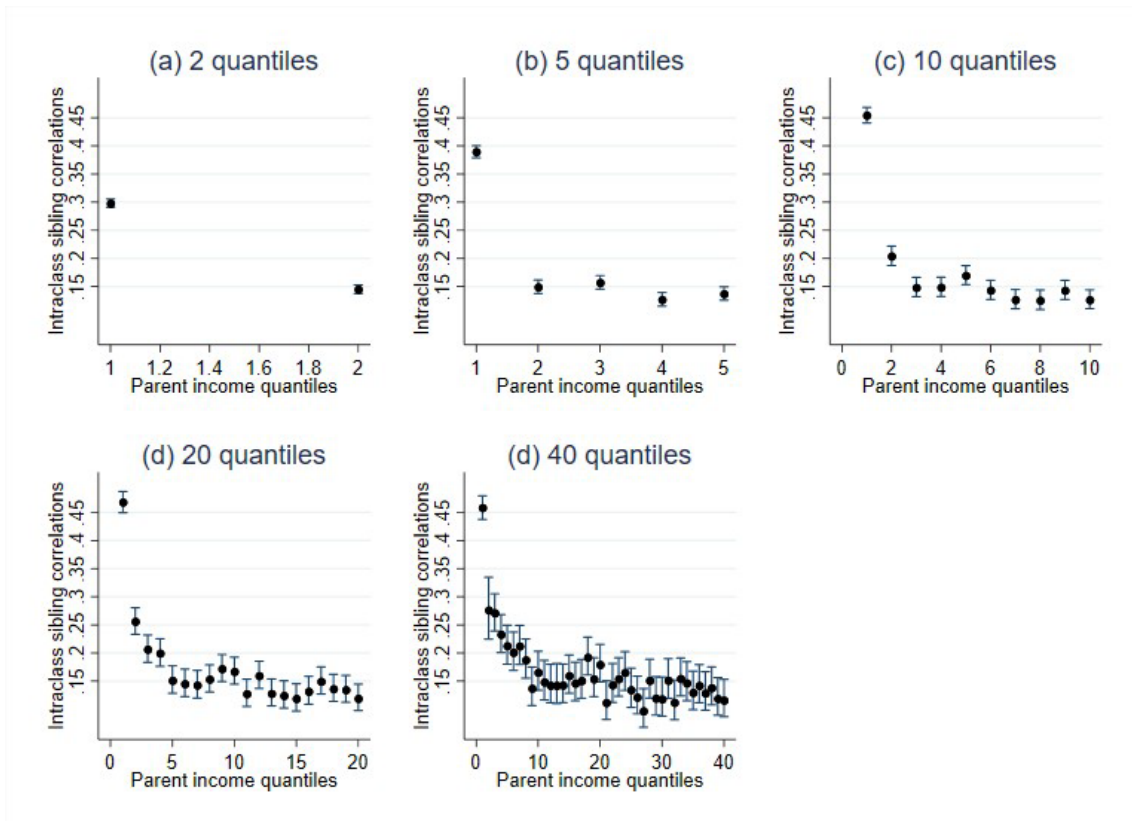
Note: The figure shows sibling correlations in income and years of schooling by parental income ventiles in a sample in which both men and women are included. The green line shows a second-order polynomial fitted line for the sibling correlations. The lower panels show the variance components that underlie the sibling correlation.

Figure A2 Sibling correlations in income and education by parental education ventiles (men and women)



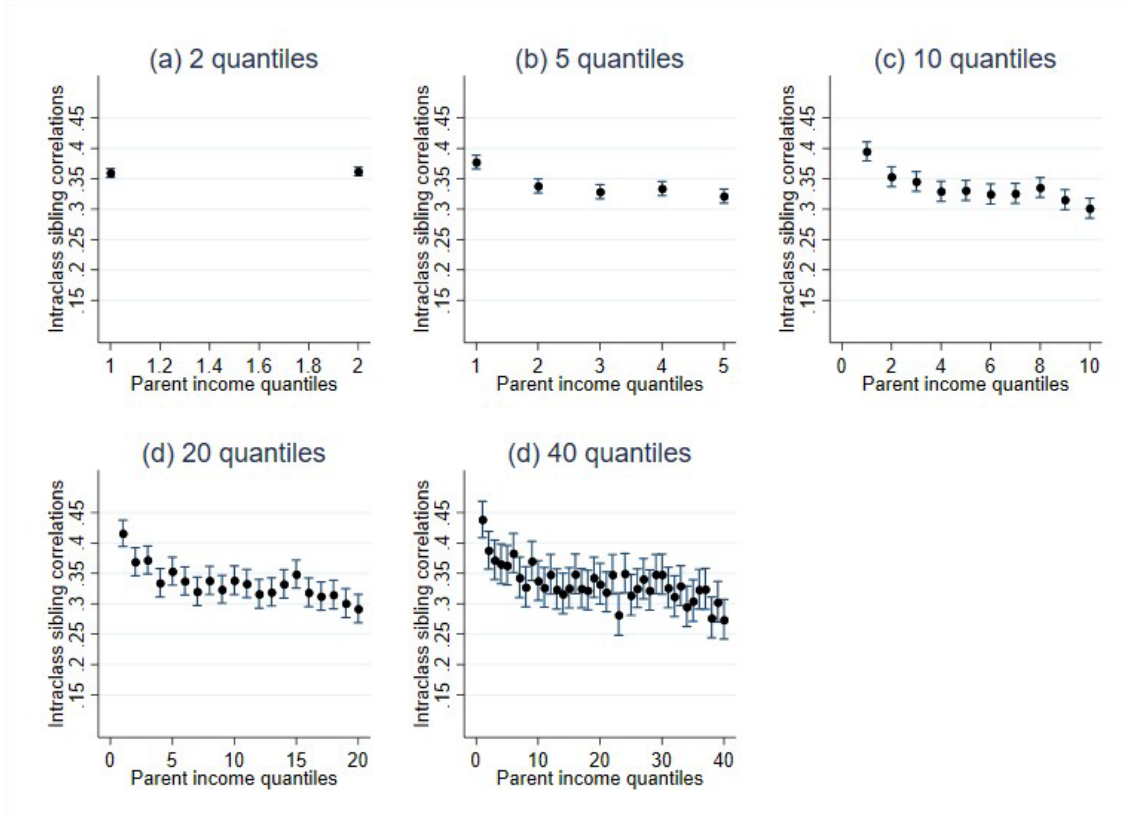
Note: The figure shows sibling correlations in income and years of schooling by parental education ventiles in a sample in which both men and women are included. The green line shows a second-order polynomial fitted line for the sibling correlations. The lower panels show the variance components that underlie the sibling correlation.

Figure A3 Sibling correlations in income by different quantiles of parents' income



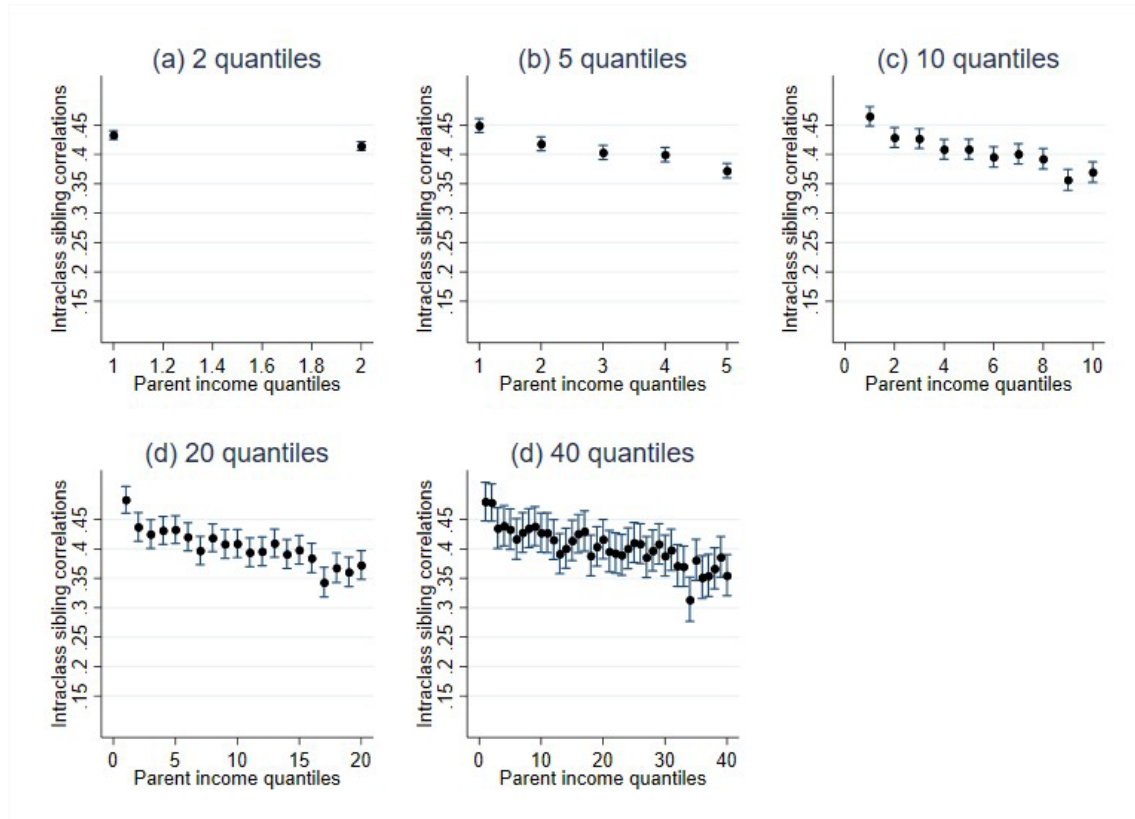
Note: The figure shows sibling correlations in income for men by different divisions of parental income quantiles, where parents' income has been divided into 2, 5, 10, 20 or 40 quantiles.

Figure A4 Sibling correlations in education by different quantiles of parents' income



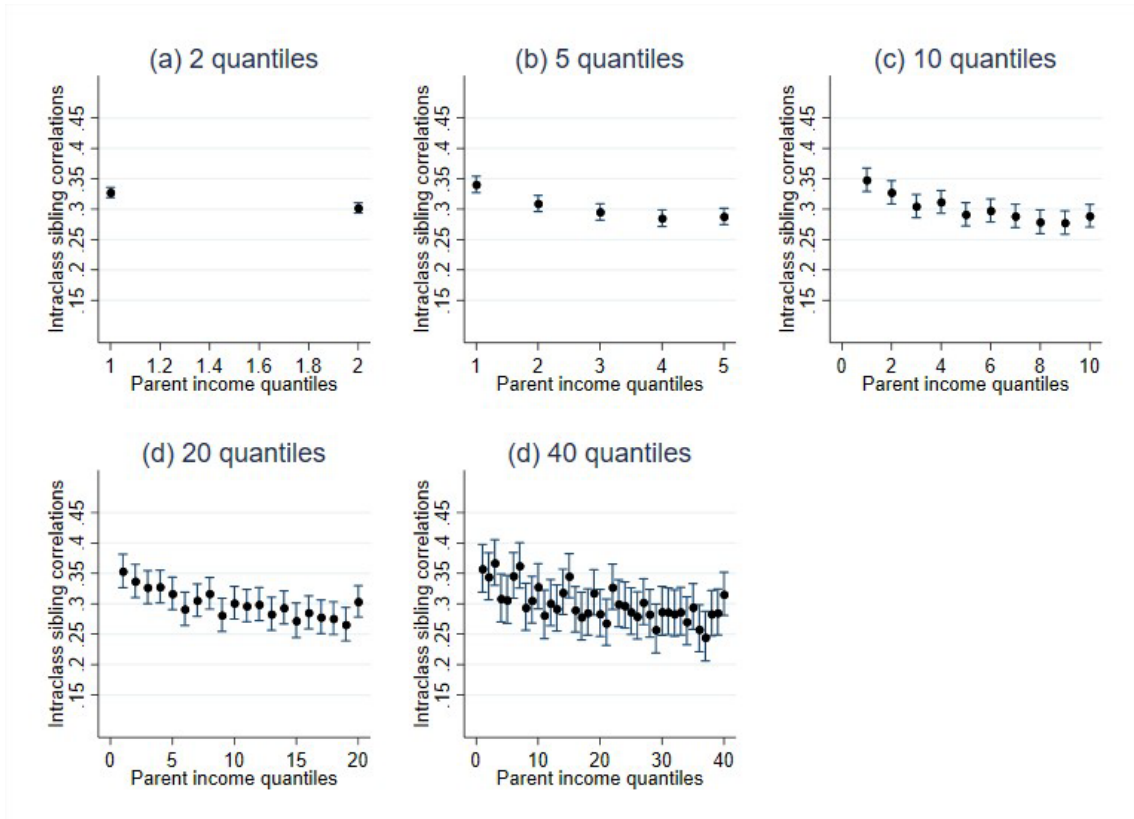
Note: The figure shows sibling correlations in education for men by different divisions of parental income quantiles, where parents' income has been divided into 2, 5, 10, 20 or 40 quantiles.

Figure A5 Sibling correlations in cognitive skills by different quantiles of parents' income



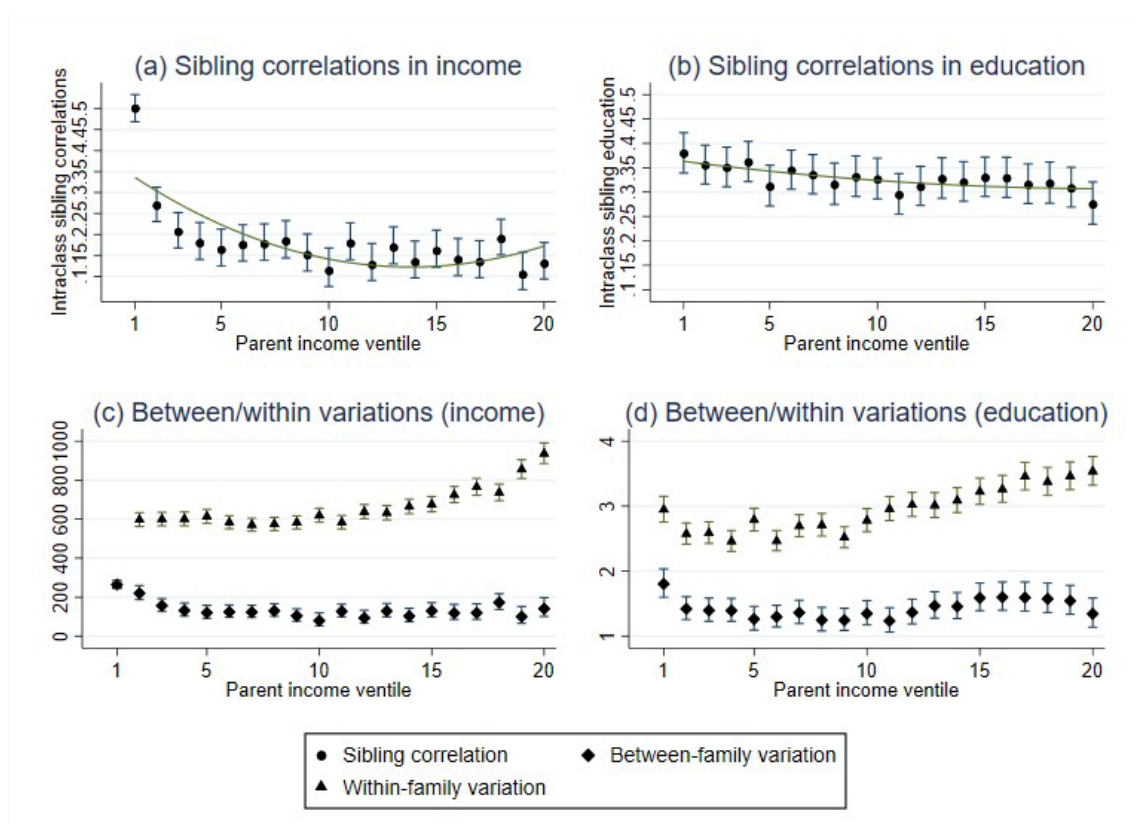
Note: The figure shows sibling correlations in cognitive ability for men by different divisions of parental income quantiles, where parents' income has been divided into 2, 5, 10, 20 or 40 quantiles.

Figure A6 Sibling correlations in non-cognitive skills by different quantiles of parents' income



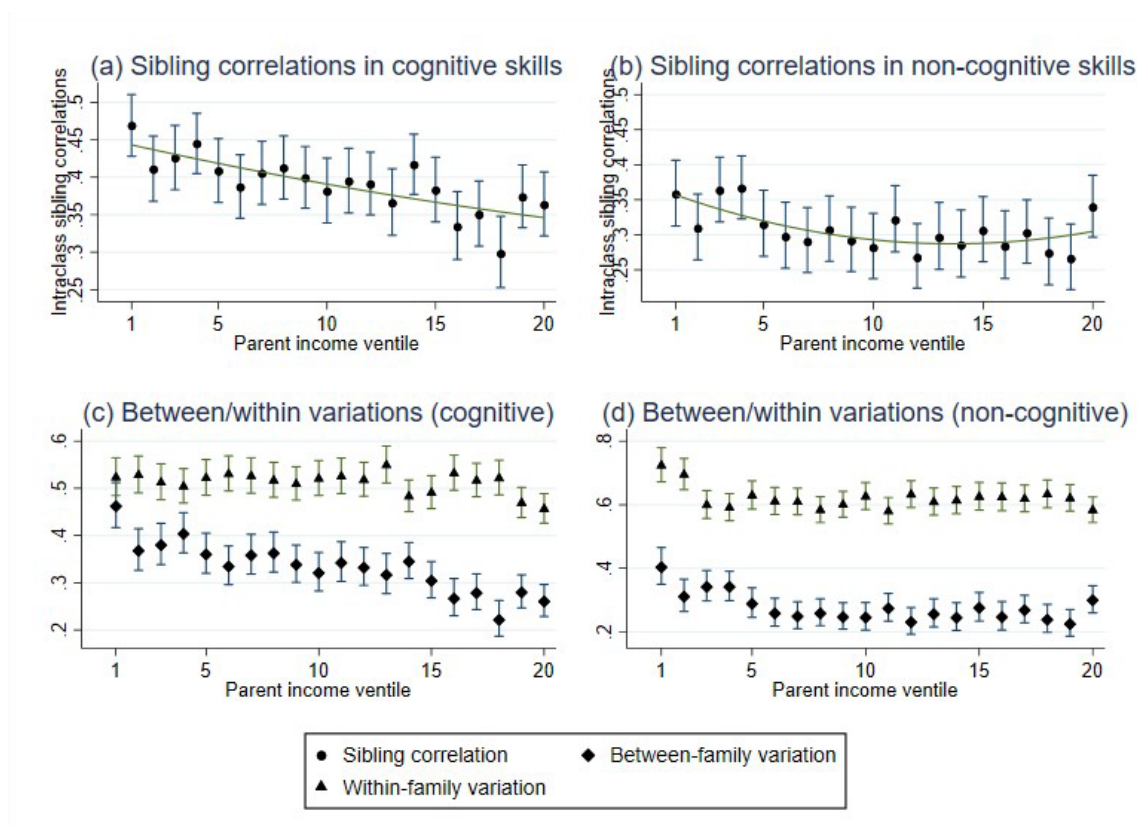
Note: The figure shows sibling correlations in non-cognitive ability for men by different divisions of parental income quantiles, where parents' income has been divided into 2, 5, 10, 20 or 40 quantiles.

Figure A7 Sibling correlations in earnings and education by parental income ventiles (family structure held constant across parental income ventiles)



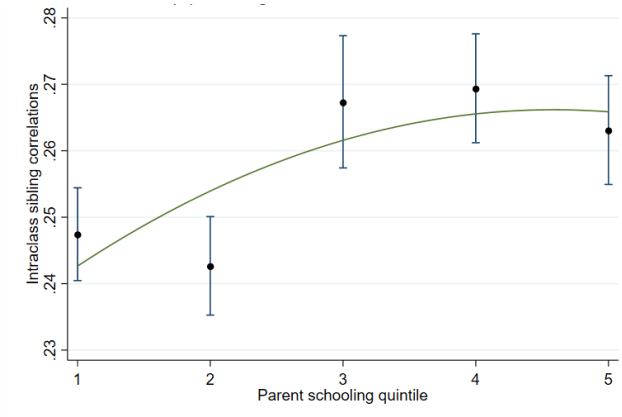
Note: The figure shows sibling correlations in earnings and years of schooling for male siblings by parental income ventiles. The green line shows a second-order polynomial fitted line for the sibling correlations. The sample is limited to families with two children with an age gap of four years or less. The lower panels show the variance components that underlie the sibling correlation.

Figure A8 Sibling correlations in cognitive and non-cognitive skills by parental income ventiles (family structure held constant across parent income ventiles)



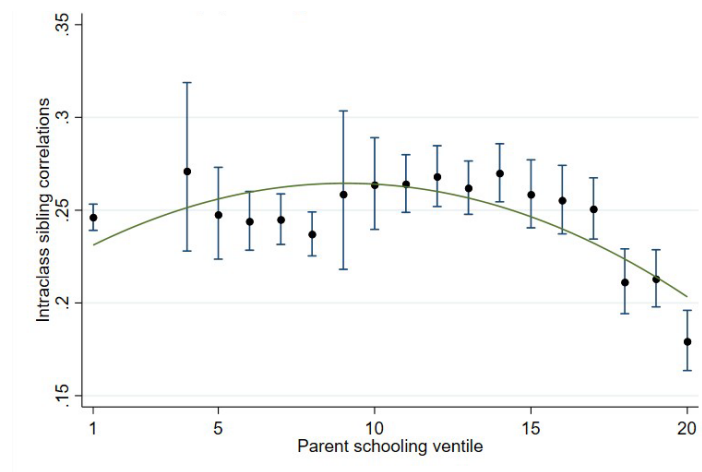
Note: The figure shows sibling correlations in cognitive and non-cognitive ability for male siblings by parental income ventiles. The green line shows a second-order polynomial fitted line for the sibling correlations. The sample is limited to families with two children with an age gap of four years or less. The lower panels show the variance components that underlie the sibling correlation.

Figure A9 Sibling correlations in education by parental education quintiles



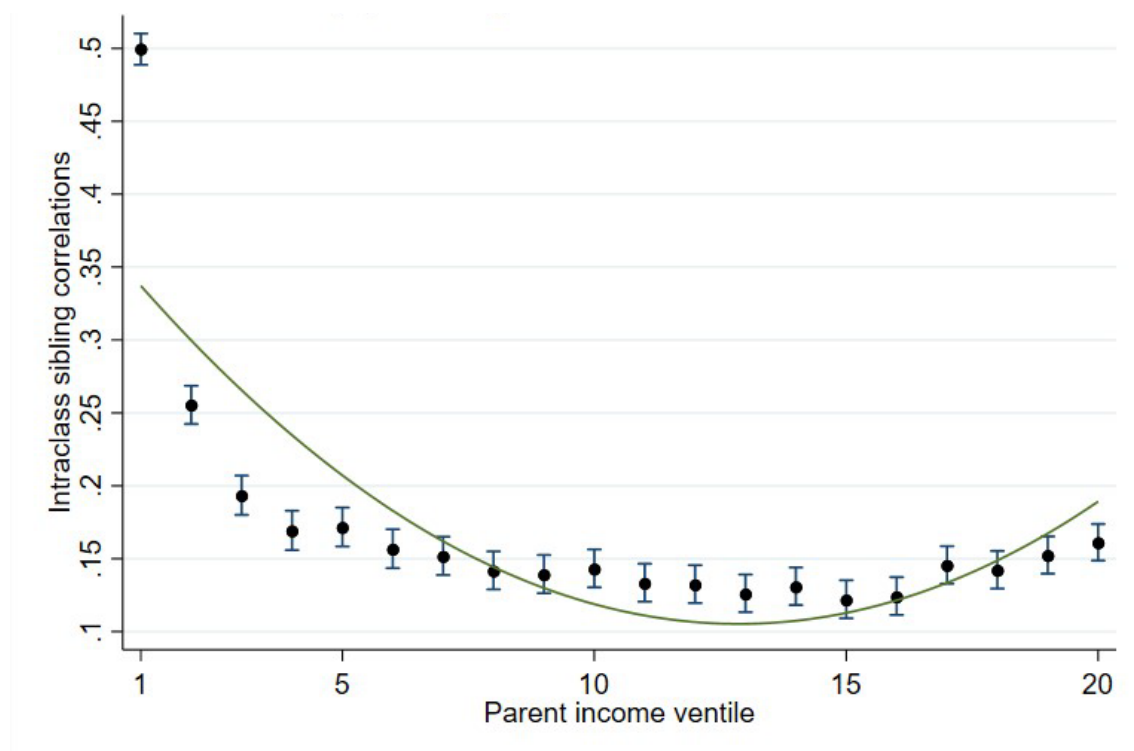
Note: The figure shows sibling correlations in schooling measured in ranks by parental education, where education is divided into 5 quintiles. The green line shows a second-order polynomial fitted line for the sibling correlations. The sample is limited to children born between the years 1945–1976 and parents born between 1930–1939.

Figure A10 Sibling correlations in education by parental education ventiles



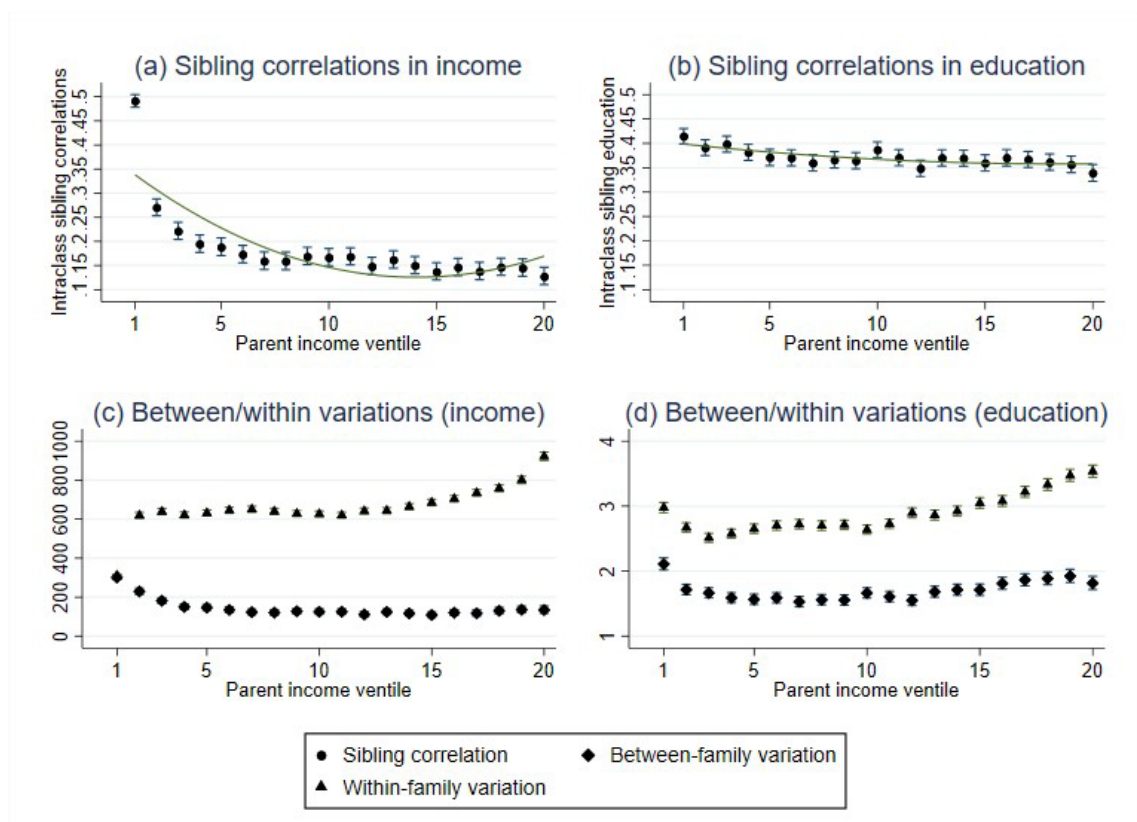
Note: The figure shows sibling correlations in schooling measured in ranks by parental education quartile, where education is divided into 20 ventiles. The green line shows a second-order polynomial fitted line for the sibling correlations. The sample is limited to children born between the years 1945–1976, and parents born between 1930–1939.

Figure A11 Sibling correlations in income by ventiles of parents' income (income measured at ages 25–30)



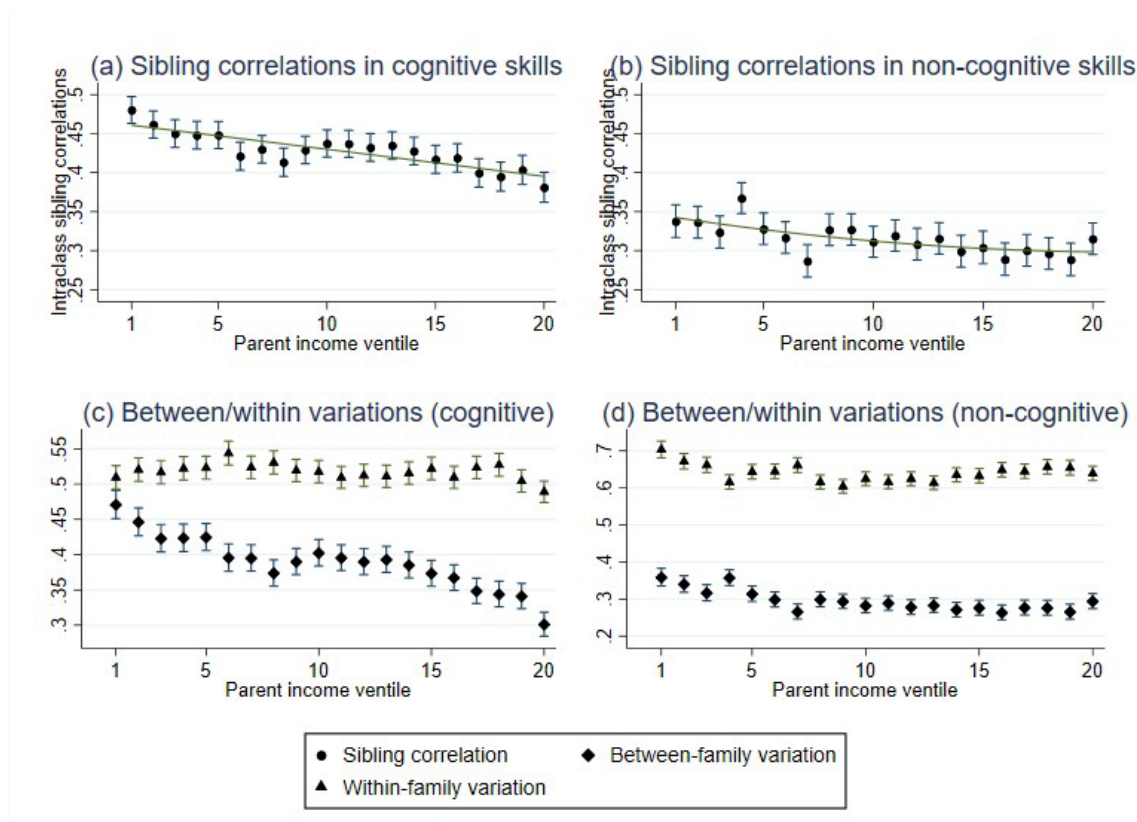
Note: The figure shows sibling correlations in income ranks for men by parental income ventiles. The green line shows a second-order polynomial fitted line for the sibling correlations. Income is measured as an average for the ages 25–30.

Figure A12 Sibling correlations in income and education by ventiles of parents' income (Extended parent sample)



Note: The figure shows sibling correlations in income and years of schooling by parental income ventiles. The green line shows a second-order polynomial fitted line for the sibling correlations. The sample consist of males born between 1965 and 1982 and their parents, using income data 1968–2019. The lower panels show the variance components that underlie the sibling correlation.

Figure A13 Sibling correlations in skills by ventiles of parents' income (extended parent sample)



Note: The figure shows sibling correlations in cognitive and non-cognitive skills by parental income ventiles. The green line shows a second-order polynomial fitted line for the sibling correlations. The sample consist of males born between 1965 and 1982 and their parents, using income data 1968–2019. The lower panels show the variance components that underlie the sibling correlation.