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Sibling Similarity in Education Across and Within Societies

Michael Grätz, Kieron J. Barclay, Øyvind N. Wiborg, Torkild H. Lyngstad, Aleksi Karhula, Jani Erola, Patrick Präg, Thomas Laidley, and Dalton Conley

ABSTRACT The extent to which siblings resemble each other measures the omnibus impact of family background on life chances. We study sibling similarity in cognitive skills, school grades, and educational attainment in Finland, Germany, Norway, Sweden, the United Kingdom, and the United States. We also compare sibling similarity by parental education and occupation within these societies. The comparison of sibling correlations across and within societies allows us to characterize the omnibus impact of family background on education across social landscapes. Across countries, we find larger population-level differences in sibling similarity in educational attainment than in cognitive skills and school grades. In general, sibling similarity in education varies less across countries than sibling similarity in earnings. Compared with Scandinavian countries, the United States shows more sibling similarity in cognitive skills and educational attainment but less sibling similarity in school grades. We find that socioeconomic differences in sibling similarity vary across parental resources, countries, and measures of educational success. Sweden and the United States show greater sibling similarity in educational attainment in families with a highly educated father, and Finland and Norway show greater sibling similarity in educational attainment in families with a low-educated father. We discuss the implications of our results for theories about the impact of institutions and income inequality on educational inequality and the mechanisms that underlie such inequality.

KEYWORDS Cross-national comparison • Educational inequality • Family background • Siblings

Introduction

Equality of opportunity is a widely shared ideal in advanced industrialized societies (Roemer 1998). Nevertheless, even in contemporary societies, family background affects educational and socioeconomic outcomes (Björklund and Jäntti 2012). In this study, we focus on inequality of educational opportunity. Education is an important predictor of life chances and a mechanism underlying the intergenerational transmission of economic status (Jerrim and Macmillan 2015). We measure educational inequality using sibling similarity in education to assess the omnibus impact of family

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background, understood in a broad sense to include the community environment, on education. We compare sibling similarity in cognition, educational performance, and educational attainment in adulthood across six countries—Finland, Germany, Norway, Sweden, the United Kingdom, and the United States—and between social groups within these countries, by parental educational attainment and occupational status.

A long-standing debate in stratification research concerns whether the effect of family background on life chances varies across advanced industrialized societies. In a classical study, Lipset and Zetterberg (1959:13) claimed that "the overall pattern of social mobility appears to be much the same in the industrial societies of various Western countries." Featherman et al. (1975) updated this prediction and argued that the Lipset-Zetterberg hypothesis holds only when the distributions of occupation and education are held constant. They predicted that "the genotypical pattern of mobility (circulation mobility) in industrial societies with a market economy and a nuclear family system is basically the same" (Featherman et al. 1975:340). Much research has tested these hypotheses, mainly by estimating the association between father's and son's education, income, and occupation (e.g., Andrews and Leigh 2009; Björklund and Jäntti 2009; Bukodi et al. 2020; Corak 2013; Erikson and Goldthorpe 1992; Grusky and Hauser 1984; Ishida et al. 1995). Some of these authors have argued that substantial differences remain between contemporary societies in educational and socioeconomic inequalities. They have hypothesized that countries with greater income inequality have a more persistent educational and socioeconomic inequality across generations, a relationship often referred to as the "Great Gatsby Curve" (Andrews and Leigh 2009; Björklund and Jäntti 2009; Corak 2013; DiPrete 2020; Durlauf and Seshadri 2019; Jerrim and Macmillan 2015). In addition, sociologists have often claimed that educational institutions strongly affect educational inequality (Breen et al. 2009; Pfeffer 2008; van de Werfhorst 2015). Clark (2014), however, used a method relying on the similarity of surnames of people in elite positions and found that social mobility does not meaningfully vary across time and countries.

Our comparative study sheds new light on the variation of inequality of educational opportunity across advanced industrialized Western societies, providing the first cross-national comparison of sibling similarity in cognitive skills and education using harmonized national data sources from six countries that vary in terms of income inequality, welfare regimes, and educational institutions. The sibling similarity approach has important advantages over other approaches used in the literature. In particular, this method allows us to take into account both observed and unobserved aspects of family background (Björklund and Jäntti 2012). At the same time, using sibling similarity avoids confounding group-based with individual-based mobility—a problem from which Clark's (2014) surname approach suffers (Torche and Corvalan 2018). Previous research has compared estimates of sibling similarity in education obtained from different studies (Björklund and Salvanes 2011). However, without harmonizing the measures and sample selection criteria across studies, it is impossible to say whether differences across studies are due to actual cross-country variation or are instead the result of idiosyncrasies of specific data sets (Firebaugh 2008).

In addition, many scholars assert that inequality of educational opportunity varies between social groups within societies. One long-held theory is that because of credit constraints, socioeconomically disadvantaged families experience less inequality of educational opportunity than socioeconomically advantaged families (Becker and

Tomes 1976; Blau and Duncan 1967; Erikson and Goldthorpe 1992; Mazumder 2005). An opposing point of view argues that compensatory parental investment strategies lead to less inequality of educational opportunity among socioeconomically advantaged families than among socioeconomically disadvantaged families (Conley 2004, 2008; Griliches 1979; Hsin 2012). Our study's second contribution to the literature is to test these claims by stratifying our results by harmonized measures of parental occupation and education within societies.

Finally, our study's third contribution is testing whether cross-country variation in inequality of educational opportunity varies across different measures of cognition and educational success. We examine sibling correlations in educational attainment, a cornerstone measure of socioeconomic status. Furthermore, we examine sibling similarity in cognitive skills and school grades. These educational outcomes provide a window into how sibling resemblance develops through early- and middle-childhood investments (cognitive skills), through the combined role of cognitive and noncognitive skills as well as through influences of teachers in adolescence (school grades), and through educational aspirations and decision making, expectations, and financing (final educational attainment). These comparisons shed light on the underlying mechanisms of educational inequality and provide suggestive clues for assessing the contours of parental investment strategies.

Our approach allows us to give a broad overview of the variation in inequality of educational opportunity as measured by sibling similarity in education both within and across advanced industrialized societies. Although our analysis is ostensibly descriptive, it provides important insights into the variation in educational inequality across societies and the mechanisms underlying this cross-national variation by examining variation between social groups within societies. Our analysis provides the basis for future research to extend our work in exploring more specific questions of which institutional or political features lead to these outcomes. Providing this cross-national foundation sets the stage for future research, which may unpack the more granular mechanics of the general trends we document here.[1] The variation we identify is likely to be an upper-bound estimate of the impact of educational policies and institutional factors as well as the level of income inequality on educational inequality in these societies. We conclude with a discussion of the implications of our results for policy and future research on educational inequality with an international perspective.

Background and Theoretical Considerations

Using Sibling Similarity to Measure the Omnibus Impact of Family Background

Most analyses of inequality of educational opportunity estimate the resemblance in education between parents and their offspring (e.g., Bradbury et al. 2015; Breen et al.

[1] As Firebaugh (2008:120) noted, "The objective of social research may be descriptive—to get the facts right. Even if our ultimate objective is to estimate causal effects, accurate description is vital, since questions of *what* come before questions of *why* and *how*. Often half the battle involves determining precisely what it is to be explained." Billari (2015:S11) referred to this part of the process of scientific investigations as the discovery phase, which "focuses on the production of novel evidence at the population level."

2009; Ermisch et al. 2012; Pfeffer 2008; Shavit and Blossfeld 1993). An alternative way to measure educational inequality in a society is to estimate sibling similarity in education. Because siblings share the same family and immediate environment, including the neighborhood, the similarity of siblings captures the omnibus impact of family background on children's educational outcomes.

Several studies have estimated educational inequality using sibling correlations in education in Australia, several European countries, and the United States, among others (e.g., Anger and Schnitzlein 2017; Benin and Johnson 1984; Björklund and Jäntti 2012; Björklund et al. 2009; Björklund and Salvanes 2011; Conley 2008; Conley and Glauber 2008; Conley et al. 2007; de Graaf and Huinink 1992; Duncan et al. 2001; Grätz 2018; Hällsten and Thaning 2018; Hauser and Mossel 1985; Hauser and Wong 1989; Jencks et al. 1972; Jencks et al. 1979; Kuo and Hauser 1995; Marks and Mooi-Reci 2016; Mazumder 2008; Nicoletti and Rabe 2013; Olneck 1977; Raaum et al. 2006; Schnitzlein 2014; Sieben and de Graaf 2001, 2003; Sieben et al. 2001; Teachman 1995; Toka and Dronkers 1996). We provide a comprehensive overview of prior findings on sibling similarity in education in upcoming Table 2.

Using sibling similarity in education to measure educational inequality offers four advantages. First, when using sibling similarity, we do not have to rely on a single characteristic of family background and estimate its association with child education, as done in research on intergenerational mobility (Björklund and Jäntti 2012). Rather, sibling correlations are influenced by all characteristics that are transmitted across generations and provide a composite measure of the impact of all these characteristics. Second, most studies on intergenerational mobility still rely on information about the father. Sibling correlations take into account the characteristics of both parents. Third, the use of sibling correlations allows us to take into account unobserved characteristics that are shared by siblings. For instance, the parental motivation to foster their children's development is part of the effect of family background on life chances, but it is difficult to measure in surveys or administrative data. Fourth, sibling correlations consider both the family and the immediate environment outside the family, including the neighborhood. For these reasons, sibling correlations provide the most comprehensive measure of the impact of family background on life chances currently available. This omnibus measure of family background also captures the combined effects of shared genetics, common environment, and sibling-reciprocal socialization.

However, several potential disadvantages are associated with the use of sibling correlations to signify educational inequality. First, because of their summative nature, sibling correlations cannot be decomposed into the constituent elements of genetic influence, family and neighborhood effects, and intersibling influences. This sort of decomposition, however, is not the aim of our analysis. Instead, we aim to obtain an overall measure of educational inequality within a society (or within a social group).

Another concern is that siblings may have different experiences within the same family. For instance, evidence from family fixed-effects models suggests that birth order differences lead to inequality in educational outcomes between siblings (Black et al. 2005; Conley et al. 2007; Grätz 2018; Härkönen 2014). Other examples include the impact of genetic differences between siblings (Björklund and Jäntti 2012), gender and age differences, and unobserved factors that produce inequalities between siblings. Because sibling correlations do not capture such differences, sibling correlations can be best understood as providing lower-bound estimates of the omnibus effect of family background on education (Björklund and Jäntti 2012).

Finally, the identification of educational inequality through sibling correlations necessarily relies on information among families with more than one child, which could introduce bias if inequality of educational opportunity is qualitatively different among singletons (Breen and Jonsson 2005). We maintain that most children grow up with siblings: only a minority of children are excluded from the estimation of educational inequality using sibling correlations. In addition, there is no empirical evidence that educational inequality does indeed differ between singletons and siblings. In addition, we are unaware of any cross-country differences in the variation of educational inequalities between siblings and singletons. If such variation does exist across countries, our estimates could be biased. Any such bias, however, is too small to systematically undermine our findings for two reasons. First, Präg et al. (2020) found that the share of singletons among all children varies little across countries for cohorts born after 1950—the cohorts included in our analysis. Second, Choi and Monden (2017) analyzed Programme for International Student Assessment (PISA) data from 31 countries and found that test scores in reading and math did not differ between singletons and children with one sibling in the countries we analyze.

Variation of Sibling Similarity in Education Across Social Groups

Estimates of educational inequality that focus on the similarity of parents and children or the population-level similarity of siblings do not consider that educational inequality may vary across social groups within societies. There are, however, strong theoretical reasons to expect such variation. In particular, socioeconomic differences in parental investment strategies may lead to variation in sibling similarity—that is, inequality of educational opportunity—by family socioeconomic background.

Two main theories concerning parents' allocation of resources among siblings can be distinguished. Theories of parental reinforcement argue that well-resourced parents invest more in the human capital of better-endowed children, thereby increasing within-family inequality compared with socioeconomically disadvantaged parents who face budget constraints in optimally investing in their children (Becker 1991; Becker and Tomes 1976). Therefore, this theoretical perspective predicts a higher similarity between siblings—that is, less inequality of educational opportunity—in socioeconomically disadvantaged than in socioeconomically advantaged families.

An alternative model of resource allocation within families argues that parents use resources to compensate for ability differences between siblings (Behrman et al. 1982). Because parents' ability to implement compensatory strategies is likely to depend on the resources available to them, it may be mainly socioeconomically advantaged families who employ these strategies to attenuate within-family differences (Conley 2004, 2008; Griliches 1979). In this latter paradigm, with limited resources, socioeconomically disadvantaged families may invest less equitably but more efficiently given budget constraints, thereby exacerbating sibling disparities in abilities by providing more resources to better-endowed offspring. This model leads to a prediction opposite that of the model assuming reinforcing parental investment strategies. Under compensatory parental investment behavior, we expect a higher similarity between siblings—that is, less inequality of educational opportunity—in socioeconomically advantaged than in socioeconomically disadvantaged families.

Evidence on the variation of sibling similarity by family socioeconomic background

is mixed, and results are limited to a small number of countries, including the United States (Conley 2008; Conley and Glauber 2008; Conley et al. 2007), Germany (Baier 2019; Grätz 2018), and Sweden (Hällsten and Thaning 2018). These studies largely found no robust evidence of substantial variation in sibling similarity by family socioeconomic background with respect to cognitive skills and educational attainment. However, Conley and Glauber (2008) found greater sibling resemblance in earnings and household income in the United States for siblings from socioeconomically advantaged families than for their disadvantaged counterparts. Similarly, Conley et al. (2007) and Anger and Schnitzlein (2017) found a higher sibling similarity in noncognitive skills in socioeconomically advantaged families in the United States and Germany, respectively.

To our knowledge, the variation of sibling similarity by family socioeconomic background has never been investigated across countries. We aim to fill this gap by examining sibling similarity in education with a comparative perspective. Such a study is important, given the many theoretical reasons to expect cross-national variation in sibling similarity by family background, as we detail in the next section. The analysis of the variation of sibling similarity by family socioeconomic background allows us to identify candidate mechanisms underlying cross-country differences in educational inequality.

In addition to studies analyzing socioeconomic differences in sibling similarity, some studies have analyzed the underlying parental behaviors, which are theorized to bring about differences in sibling similarity directly. A small number of studies in the United States have tested whether parents' reinforcing or compensatory responses to ability differences varied by family socioeconomic background, with equivocal results. Hsin (2012) and Restrepo (2016) found compensatory parental responses to birth weight differences between siblings in socioeconomically advantaged families and reinforcing parental responses in socioeconomically disadvantaged families. Grätz and Torche (2016), however, found neither reinforcing nor compensatory parental responses to birth weight differences between twins, and they found reinforcing parental responses to twin differences in early ability driven by socioeconomically advantaged families. Because of these contradictory results and the U.S.-centric nature of the current research, empirical questions remain as to whether and under which circumstances sibling similarity in education varies by family socioeconomic background. Although the parental behaviors that undergird social and economic outcomes among children are worthy of study, our study indirectly estimates the importance of these parental responses by investigating whether sibling similarity in education does indeed vary across social groups.

Variation of Sibling Similarity in Education Across Societies

A central question in stratification research is whether educational inequality varies across countries (Breen and Jonsson 2005). Institutionalist theories argue that differences in educational institutions lead to variation in the degree of educational inequality across countries (Pfeffer 2008; van de Werfhorst 2015). Robust conclusions about the causal influences of educational institutions on educational inequality are, however, difficult to achieve. Descriptive comparisons of educational inequality across countries cannot identify the factors bringing about cross-country variation in educational inequality because countries differ from each other in more ways than

any analysis could control for (Torche 2015a). The analysis presented here falls into this category. Our goal is to provide descriptive evidence on the variation of educational inequality across countries that can eventually form the basis for more specific interrogations about the causal pathways involved. We report descriptive results demonstrating the variation of educational inequality across the three main types of welfare regimes—liberal (the United Kingdom and the United States), conservative (Germany), and social democratic (Finland, Norway, and Sweden)—that can be found in advanced industrialized countries (Esping-Andersen 1990).[2]

A number of previous studies analyzed cross-country variation in inequality of educational opportunity. Table 1 gives an overview of studies that estimated cross-country differences in educational inequality. The table reports how these studies ranked different countries in terms of inequality of educational opportunity and summarizes the country-specific estimates of educational inequality these studies reported.

The comparison of the different studies shows that there is no unambiguous ranking of countries according to their level of inequality of educational opportunity. This conclusion is consistent with Breen and Jonsson's (2005) review of studies on educational inequality. We contribute to research on the cross-country variation in educational inequality by providing estimates of differences in sibling similarity for three educational outcomes (cognitive skills, school grades, and final educational attainment) based on harmonized high-quality data from administrative registers and nationally representative surveys. We collect estimates of sibling similarity in education for our three outcomes from previous research listed in Table 2.

Even though previous research provided estimates of sibling similarity in education across different outcomes and studies, without the harmonized approach that we follow in our study, it is impossible to determine whether differences in estimates of sibling similarity in education across countries are due to methodological differences across studies or whether they point to genuine cross-country variation in sibling similarity in education. By harmonizing measures across countries and including multiple indicators of cognition and education, our study lays a foundation for further investigations of the causal factors that underlie the patterns we document here. As Firebaugh (2008:106–107) noted:

> To gauge uncertainty, ideally we want to analyze different data sets in a single study because in a single study we can make every effort to run identical analyses across the data sets. Our goal then is identical analytic procedures, so that any differences in results can be attributed to differences in the data, not to differences in the way the data are analyzed.

In addition to analyzing cross-country differences in educational inequality, we test whether the variation in inequality of educational opportunity (i.e., sibling resemblance in education) varies across social groups within countries. Doing this allows us to explore how parents' behavior (i.e., their investments into children

[2] The vast majority of studies on educational inequality, including those referred to in Tables 1 and 2, are descriptive. Torche (2015a:359) wrote, "Description has a central place in the study of mobility, but given the challenges of establishing causal relationships from observational data when multiple variables are included and mediation is assumed, it is probably prudent to focus the descriptive effort on the bivariate intergenerational association." This is precisely what we do in this article looking at sibling correlations.

Table 1 Overview of previous studies analyzing cross-national variation in inequality of educational opportunity

Study	Data	Method	Ranking of Countries (from most to least mobile), With Estimates of Educational Inequality in Parentheses
Treiman and Yip (1989)[a]	Political Action, Scandinavian Welfare Study, Oxford National Occupational Mobility Inquiry, ZUMABUS, Determinants of Occupational Mobility, National Labor Force Survey, 1975 Social Stratification and Mobility Survey, Occupational Changes in a Generation II	Association between father's education and son's educational attainment, regression of respondent's years of schooling on father's years of schooling and father's occupational prestige	United States (0.33), Northern Ireland (0.39), Ireland (0.40), (West) Germany/Japan (0.41), Norway (0.44), Austria (0.48), Finland (0.51), England and Wales (0.53), Israel (0.57), Netherlands/Sweden (0.58), Italy (0.71), Denmark (0.94)
Treiman and Yip (1989)[a]	Political Action, Scandinavian Welfare Study, Oxford National Occupational Mobility Inquiry, ZUMABUS, Determinants of Occupational Mobility, National Labor Force Survey, 1975 Social Stratification and Mobility Survey, Occupational Changes in a Generation II	Association between father's occupation and son's educational attainment, regression of respondent's years of schooling on father's years of schooling and father's occupational prestige	Denmark (0.016), Ireland (0.018), Austria/Italy (0.019), Netherlands (0.025), Finland (0.026), Israel (0.027), (West) Germany (0.030), Northern Ireland (0.034), United States (0.040), Sweden (0.050), Japan (0.060), England and Wales (0.065), Norway (0.074)
Pfeffer (2008)	International Adult Literacy Survey (IALS)	Association between parental education and children's educational attainment in log-log models, ranking of countries based on the "unidiff" parameters for each country (average across countries set to 0) and multiplied by −1	Finland (0.24), Northern Ireland (0.22), New Zealand (0.19), Denmark (0.16), Great Britain/United States (0.14), Canada (0.13), Czech Republic (0.11), Sweden (0.10), Poland (0.08), Chile (−0.03), Ireland (−0.04), Italy (−0.14), Norway (−0.15), Hungary (−0.15), Switzerland (−0.17), Belgium (−0.20), Germany (−0.27), Slovenia (−0.34)
Hertz et al. (2008)[a]	International Adult Literacy Survey (IALS), International Social Survey Programme (ISSP)	Association between parental education and children's educational attainment, parent-child schooling association (both measured in years of education)	Denmark (0.30), Great Britain, (0.31), Northern Ireland (0.32), Finland (0.33), Norway (0.35), Netherlands (0.36), Slovakia/Czech Republic (0.37), Ukraine (0.39), Belgium (Flanders)/Sweden/Estonia (0.40), United States/Ireland/Switzerland (0.46), Slovenia (0.52), Italy (0.54)

Table 1 (continued)

Study	Data	Method	Ranking of Countries (from most to least mobile), With Estimates of Educational Inequality in Parentheses
Bol and van de Werfhorst (2013)	European Social Survey	Association between parental education and children's educational attainment, regression of social origin and years of education	United Kingdom (0.27), Greece (0.29), Sweden/Denmark (0.31), Finland (0.33), Ireland (0.35), Netherlands/Slovakia/Slovenia (0.36), Germany/Israel (0.37), Czech Republic (0.38), Belgium/Switzerland (0.39), Norway (0.40), Turkey (0.43), Poland (0.44), Spain (0.45), Hungary (0.46), Austria (0.47), Italy (0.51), France (0.52), Luxembourg (0.54)
Chmielewski and Reardon (2016)	Progress in International Reading Literacy Study (PIRLS), Early Childhood Longitudinal Study, Kindergarten Class (ECLS-K)	Association between parental income and children's reading test scores, 90/10 income achievement gap	Iceland (0.616), Sweden (0.695), Norway (0.698), Netherlands (0.779), Canada (Ontario) (0.881), England (0.947), Canada (Quebec) (0.948), New Zealand (0.958), Slovenia (1.025), Germany (1.098), Slovak Republic (1.104), Greece (1.112), United States (1.280)
Chmielewski and Reardon (2016)	Programme for International Student Assessment (PISA) 2006, ECLS-K	Association between parental income and children's reading test scores, 90/10 income achievement gap	Iceland (0.447), Denmark (0.650), Poland (0.655), Korea (0.795), New Zealand (0.924), Germany (1.011), United States (1.364), Portugal (1.383), Luxembourg (1.390)
Chmielewski and Reardon (2016)	Programme for International Student Assessment (PISA) 2006, ECLS-K	Association between parental income and children's mathematics test scores, 90/10 income achievement gap	Iceland (0.557), Denmark (0.749), Poland (0.758), New Zealand (0.924), Korea (1.042), Germany (1.148), United States (1.303), Luxembourg (1.362), Portugal (1.471)
Chmielewski and Reardon (2016)	Programme for International Student Assessment (PISA) 2006, ECLS-K	Association between parental income and children's science test scores, 90/10 income achievement gap	Iceland (0.539), Denmark (0.697), Poland (0.755), Korea (0.850), New Zealand (0.924), Germany (1.131), Luxembourg (1.391), Portugal (1.441)

[a] These studies also reported estimates for countries outside of Western Europe and North America, which we do not report here because these countries are not in our sample.

Table 2 Overview of estimates of sibling correlations at the population level from previous research

Study	Country	Data	Respondents' Gender	Estimate (SE in parentheses)
Outcome: Cognitive Skills				
Anger and Schnitzlein (2017)	Germany	SOEP	Mixed	.55 (.05) – .61 (.06)[a]
Björklund and Jäntti (2012)	Sweden	Registers	Male	.47 (.01)
Duncan et al. (2001)	United States	Add Health	Male	.46 (.07)
Duncan et al. (2001)	United States	Add Health	Female	.56 (.05)
Grätz (2018)	Germany	SOEP	Mixed	.42 (.03)
Outcome: School Grades				
Björklund and Jäntti (2012)	Sweden	Registers	Mixed	.51 (.01)
Nicoletti and Rabe (2013)	England	Registers (National Pupil Database)	Mixed	.54 (.00) – .61 (.00)[b]
Outcome: Final Educational Attainment (years of education)				
Björklund and Jäntti (2012)	Sweden	Registers	Mixed	.39 (.00)
Björklund and Salvanes (2011)	Norway	Registers	Mixed	.40 (.01) – .42 (0.1)[c]
Björklund et al. (2009)	Sweden	Registers	Male	.46 (.01) – .48 (.02)[c]
Conley and Glauber (2008)	United States	PSID	Mixed	.63 (.05)
Hällsten and Thaning (2018)	Sweden	Registers	Mixed	.38 (n/a)
Marks and Mooi-Reci (2016)	Australia	Data source not named in the paper	Mixed	.34 (n/a) – .58 (n/a)[c]
Mazumder (2008)	United States	PSID	Mixed	.60 (.01)
Raaum et al. (2006)	Norway	Registers	Male	.42 (.01)
Raaum et al. (2006)	Norway	Registers	Female	.46 (.01) – .47 (.01)[c]
Schnitzlein (2014)	Germany	SOEP	Male	.66 (.04)
Schnitzlein (2014)	Germany	SOEP	Female	.55 (.05)
Sieben et al. (2001)	West Germany	German Life History Study	Mixed	.38 (n/a) – .48 (n/a)[c,d]
Sieben et al. (2001)	East Germany	German Life History Study	Mixed	.24 (n/a) – .30 (n/a)[c,d]
Sieben et al. (2001)	Netherlands	Familie-enquete Nederlands Bevolking	Mixed	.41 (n/a) – .52 (n/a)[c,d]

[a] Several estimates because of different outcomes.

[b] Several estimates because of outcomes measured at different ages.

[c] Several estimates because of reporting estimates on different cohorts.

[d] These estimates are not intraclass correlation coefficients obtained using multilevel models but rather correlation coefficients based on two siblings for each family. Thus, these estimates are not strictly comparable to the others.

and the consequences of these investments) may contribute to the cross-country variation in educational inequality we find.

We expect that both population-level sibling similarity and differences in sibling similarity between social groups will vary across countries. Following the literature connecting income inequality and income mobility (Andrews and Leigh 2009; Björklund and Jäntti 2009; Corak 2013; DiPrete 2020; Durlauf and Seshadri 2019; Jerrim and Macmillan 2015), we expect greater sibling similarity in education in countries with more income inequality and less-developed welfare regimes. We expect this to be accompanied by greater sibling similarity in socioeconomically advantaged families in these countries (Conley 2004, 2008; Griliches 1979). The alternative expectation is no difference or only little variation in educational inequality across countries, which would indicate that sibling similarity in education is mainly due to family-level processes, which are similar across countries and are not strongly affected by policy variation (Clark 2014; Featherman et al. 1975; Lipset and Zetterberg 1959).

We estimate sibling similarity in education in six advanced industrialized societies that vary in their degree of income inequality, the extensiveness of their social safety net, and institutional arrangements of their education systems: Finland, Germany, Norway, Sweden, the United Kingdom, and the United States. In Esping-Andersen's (1990) influential terminology, these countries represent the *liberal* (the United Kingdom and the United States), *conservative* (Germany), and *social democratic* (Finland, Norway, and Sweden) welfare regimes. Differences in welfare regimes are accompanied by different education systems that can be found in these countries. The Nordic social democratic countries have inclusive education systems in which pupils learn together for a long time, extensive public childcare, and tuition-free universities. Germany's education system is characterized by early tracking between schools and by a lack of early childcare facilities. In contrast, the United States is characterized by comprehensive and inclusive primary and early secondary education. In the United Kingdom, pupils are tracked in the public school system at a comparatively late age (age 16), but there is a large private school sector to which upper-class families often send their children. The United States and the United Kingdom also stand out with their high tuition and fees at the university level (although in the United Kingdom, this primarily applies to more recent cohorts of postsecondary students); tuition and fees are especially high at the most prestigious universities.

Finally, the six countries differ in terms of income inequality. In 2015, the Gini coefficient, measuring income inequality, was 31.7 for Germany; in 2016, the Gini coefficient was 27.1 for Finland, 27.5 for Norway, 29.2 for Sweden, 33.2 for the United Kingdom, and 41.5 for the United States (World Bank 2018). Thus, the countries we analyze vary widely in their institutional structures, which may lead to cross-country differences in the level of sibling similarity in education and in the variation of sibling similarity between social groups within societies.

Variation of Sibling Similarity in Education Across Measures of Educational Success

Although most previous research focused on sibling similarity in educational attainment (see the overview in Table 2), inequality of educational opportunity can actually vary across different measures of educational success. We focus on three

important dimensions of educational success: (1) cognitive skills, (2) school grades, and (3) final educational attainment.

The three educational outcomes capture distinct underlying processes. First, cognitive skills are determined by birth endowments and parental investments in early and middle childhood. Second, because school grades capture cognitive skills and noncognitive skills and can be subject to teacher bias, school grades capture something different from cognition. Third, final educational attainment is influenced not only by cognitive skills, noncognitive skills, and teachers but also by educational aspirations, educational decision making, and families' financial means. Thus, some sociologists have distinguished between primary effects—that is, socioeconomic inequalities in educational achievement (cognitive skills and school grades)—and secondary effects—that is, socioeconomic differences in educational attainment, net of differences in educational achievement (Boudon 1973; Jackson 2013).

Differences in sibling similarity in education across countries can vary across these dimensions of education. Cognitive skills are largely determined by birth endowments and parental investment behavior, which are likely to vary little across countries. Therefore, we expect cross-country differences in sibling similarity in cognitive skills to be rather small. In addition, noncognitive skills and teacher bias in grading may also vary rather little across countries. We therefore also expect cross-country variation in school grades to be rather small. Because the financing of education varies strongly across countries, we expect cross-country differences to be the largest for sibling similarity in final educational attainment.

Methods

Data

We use survey data from Germany, the United Kingdom, and the United States. The German data come from the German Socio-Economic Panel Study (SOEP) (Goebel et al. 2019; SOEP 2016). For the United Kingdom, the United Kingdom Household Longitudinal Study (Understanding Society) is used (University of Essex et al. 2016). For the United States, we use the Panel Study of Income Dynamics (PSID) (PSID 2016) and the National Longitudinal Study of Adolescent to Adult Health (Add Health) (Harris 2009). Finland, Norway, and Sweden are analyzed using data from registers from the specific countries. We undertake extensive efforts to harmonize the data and variables as much as possible across countries. Although we limit the discussion of data sets and variable construction in the article to the most necessary elements, full details are provided in section A of the online appendix.

Measures

We measure three educational outcomes, harmonized across the different data sets: cognitive skills, school grades, and final educational attainment. Not all outcomes are available for all countries, but we have information available on each outcome for at least three countries. Table 3 gives an overview of the sample sizes used to obtain the estimates of sibling similarity for each outcome in each country.

Table 3 Sample sizes of the models estimating sibling correlations

Outcome	Finland	Germany	Norway	Sweden	United Kingdom	United States (PSID)	United States (Add Health)
A. Cognitive Skills							
N individuals		2,006	284,110	652,940		2,265	2,269
N families		1,441	230,896	536,224		1,567	1,072
B. School Grades							
N individuals			403,661	1,026,673			1,620
N families			271,162	683,546			1,040
C. Final Educational Attainment							
N individuals	79,467	1,034	643,701	2,302,256	5,017	5,578	
N families	60,766	815	412,328	1,371,369	4,131	2,866	

Sources: Finland: Registers. Germany: Socio-Economic Panel Study (SOEP). Norway: Registers. Sweden: Registers. United Kingdom: United Kingdom Household Longitudinal Study (Understanding Society). United States: Panel Study of Income Dynamics (PSID) and National Longitudinal Study of Adolescent to Adult Health (Add Health).

Cognitive skills are measured based on tests that aim to measure the intellectual development of respondents. These tests were conducted as part of the survey in the case of the PSID, Add Health, and the SOEP. Cognitive skills in the Norwegian and Swedish data refer to military conscription tests. Therefore, in Norway and Sweden, this information is available only for men.[3] All measures of cognitive skills are standardized within each country. The age at which these cognitive skills are measured varies; for example, age is measured at 16–17 for Germany, 17–20 for Norway and Sweden, and 3–18 in the United States.

We use *school grades* to construct in each country a measure of grade point sum or grade point average (GPA). We standardize these measures within each country. Children are between ages 14 and 18 in the United States and between ages 16 and 17 in the remaining countries when school grades are measured.

Finally, we study *final educational attainment*, a continuous variable based on years of education. Respondents are at least 25 years old when their final educational attainment is measured.

Table 4 presents the age and birth year for which these variables are measured in each country.[4]

To estimate the variation of sibling similarity by *family socioeconomic background*, we distinguish between a low and a high social origin based on father's education, mother's education, and parental occupation. Father's and mother's education measure the highest educational degree obtained. We identify in each country the major educational cutoff point, which defines a high and a low level of educa-

[3] Estimates for male siblings may be different than those for siblings with mixed gender. We cannot, however, take into account this possibility because small sample sizes do not allow us to estimate models restricted to male siblings in Germany and the United States.

[4] Even though we tried to standardize cohorts as much as possible, there are notable differences in the cohort coverage. Our coverage of cohorts differs across countries and across different outcomes within countries. This variation may bias our estimates even if we are not aware of any evidence that sibling correlations in education vary across the cohorts covered in our analysis in the countries we analyze.

Table 4 Overview of respondent's age and year of birth by outcome and country

Country	Age	Birth Year
A. Cognitive Skills		
Germany	16–17	1987–1997
Norway	17–20	1967–1976
Sweden	17–20	1965–1977
United States (PSID)	3–18	1985–1997
United States (Add Health)	11–18	1976–1984
B. School Grades		
Norway	16	1985–1992
Sweden	16	1982–1991
United States (Add Health)	14–18	1976–1980
C. Final Educational Attainment (years of education)		
Finland	30	1974–1980
Germany	25–38	1976–1989
Norway	30	1970–1980
Sweden	30	1960–1982
United Kingdom	25–43	1954–1989
United States (PSID)	25–56	1954–1986

Sources: Finland: Registers. Germany: Socio-Economic Panel Study (SOEP). Norway: Registers. Sweden: Registers. United Kingdom: United Kingdom Household Longitudinal Study (Understanding Society). United States: Panel Study of Income Dynamics (PSID) and National Longitudinal Study of Adolescent to Adult Health (Add Health).

tion for the father and the mother. For instance, in Germany, the main cutoff point is whether a parent has an *Abitur* degree—that is, has completed the highest level of secondary education in Germany. In the United States, where the secondary school system is less differentiated than in Germany, a high level of education is defined by having 16 or more years of education—that is, having at least a bachelor's degree. The country-specific cutoff points for the other countries are reported in section A of the online appendix. These country-specific cutoff points ensure that we pick up the most meaningful variation in parental education within each country. By adapting to meaningful cutoff points based on the specific circumstances of each country, we account for the variation in the distribution of education across countries. *Parental occupation* refers to whether the highest level of occupation of either parent is in a professional (high parental occupation) or in a nonprofessional (low parental occupation) position. In the online appendix, we also report separate results by maternal and paternal occupation.

Analytical Strategy

We measure sibling correlations using the intraclass correlation coefficients (ICC) of multilevel models in which respondents (i) are nested within families (j) (Conley and Glauber 2008; Conley et al. 2007; Mazumder 2008; Schnitzlein 2014). The estimated models with outcome y_{ij} can be written as follows:

$$y_{ij} = \beta \mathbf{X}_{ij} + \varepsilon_{ij}, \quad (1)$$

where $\mathbf{X}_{ij}$ is the vector of control variables. Because we are purely interested in the intraclass correlations, we estimate empty models without any control variables.[5]

The residual ε_{ij} can be decomposed into family-specific and individual-specific components under the assumption that the covariance between these two parts is 0:

$$\varepsilon_{ij} = a_j + b_{ij}. \tag{2}$$

The intraclass correlation coefficients (ICC), ρ, of these models are the sibling correlations. The ICC is given by the following relation of the variances:

$$\rho = \sigma_a^2 / (\sigma_a^2 + \sigma_b^2). \tag{3}$$

Consequently, the sibling correlation in education can be interpreted as the part of the total variation of education in a society that can be attributed to the family (Björklund and Jäntti 2012).

We estimate these models via restricted maximum likelihood estimation (Mazumder 2008; Schnitzlein 2014). The standard errors are estimated using the delta method. We report figures summarizing our main results. The full results, including the precise point estimates and the corresponding standard errors, are reported in Tables S1–S3 in the online appendix. We obtain the confidence intervals reported in the upcoming figures by transforming the normal-based confidence intervals using the logit function so that the lower and the upper bound are limited to vary between 0 and 1.[6] We conduct all analyses using the *xtmixed* or *mixed* commands in recent versions (12 to 16) of Stata.

We include only children without siblings (singletons) in the estimation of the main models. We test the robustness of our estimates to excluding singletons and obtain virtually identical results estimating models on samples including only respondents who have at least one sibling with valid information in the data. These results are reported in Tables S4–S6 of the online appendix.

We use two-tailed tests to determine whether the sibling correlations are statistically significantly different across countries as well as whether the sibling correlations are statistically significantly different across social groups within countries. Before conducting these tests, we apply Fisher's *z* transformation to the sibling correlations. We test differences across countries by comparing the *z*-transformed sibling correlation in a country to the sample size–weighted average of the *z*-transformed sibling correlations in all other countries. We refer to these significance tests in the main text and report all significance tests in Tables S1–S6 of the online appendix.

Results

We summarize our results in Figures 1–3. These figures report sibling correlations and their variation by family socioeconomic background and by country with respect

[5] Some of our outcomes are measured in some countries at different ages (as detailed in Table 3). Adding controls for age and age squared does not affect the sibling correlations, as demonstrated by a comparison of models that control for age and age squared and those that do not (see Table S16 of the online appendix).

[6] Normal-based confidence intervals are reported in Tables S7–S12 of the online appendix.

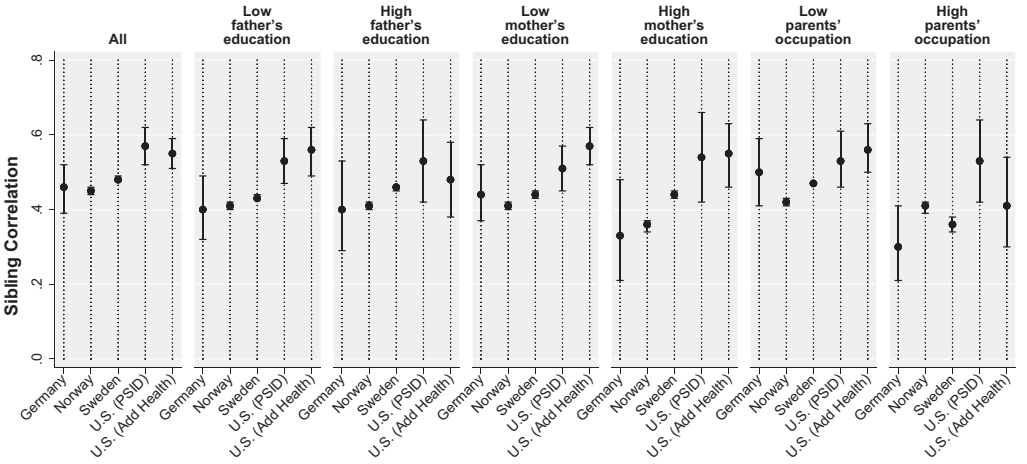

Fig. 1 Sibling correlations in cognitive skills. The 95% confidence intervals are bound to vary between 0 and 1. *Sources:* Germany: Socio-Economic Panel Study (SOEP). Norway: Registers. Sweden: Registers. United States: Panel Study of Income Dynamics (PSID) and National Longitudinal Study of Adolescent to Adult Health (Add Health).

to cognitive skills (Figure 1), school grades (Figure 2), and final educational attainment (years of schooling; Figure 3). The estimates on which these figures are based are fully reported in Tables S1–S3 of the online appendix.

The first panel in each figure reports the population-level estimates of sibling similarity in each country. In most cases, the sibling correlation for each country is statistically significantly different from the weighted average of the sibling correlations in the other countries (significance tests are reported in the online appendix, Tables S1–S3).

Differences in sibling similarity across countries are smaller for cognitive skills and for school grades than for final educational attainment (although we have information on fewer countries for the first two outcomes). The ranking of countries according to their level of educational inequality, measured by the sibling correlations, differs depending on whether we analyze cognitive skills or school grades. The results for cognitive skills (Figure 1) show greater sibling similarity, and therefore more educational inequality, in the United States than in Germany, Norway, and Sweden. The largest difference in sibling correlations is .12 (.45 in Norway and .57 in the United States [PSID]). Substantively, this means that 57% of the variation in cognitive skills in the United States is due to factors that do not vary across siblings (the estimate is somewhat smaller using Add Health data), compared with only 45% in Norway. This is a substantively meaningful difference. The substantive size of the difference between Germany and the United States is a bit more unclear because of the large confidence interval around the estimate for Germany.

Contrary to the results for cognitive skills, sibling similarity in school grades (Figure 2) is lower in the United States than in Norway and Sweden. The largest difference in sibling correlations in school grades is .10 (.42 in the United States and .52 in Sweden). Hence, these findings suggest that inequality of educational opportunity in school grades is meaningfully lower in the United States than in Sweden and in Norway.

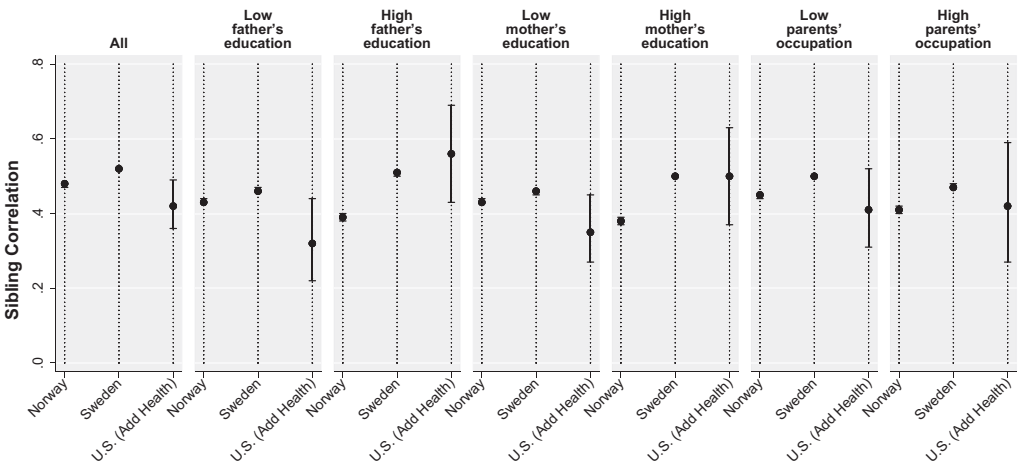

Fig. 2 Sibling correlations in school grades. The 95% confidence intervals are bound to vary between 0 and 1. *Sources:* Norway: Registers. Sweden: Registers. United States: National Longitudinal Study of Adolescent to Adult Health (Add Health).

The cross-country variation in sibling correlations is more pronounced for final educational attainment (Figure 3) than for cognitive skills and school grades. The correlation between siblings in educational attainment is comparatively higher in the United States (.51) and in Germany (.51) than in Finland (.36), Norway (.41), Sweden (.44), and the United Kingdom (.42). These differences are substantively meaningful but are smaller than the cross-country variation in sibling similarity in earnings found in previous research. Schnitzlein (2014) reported that sibling similarity in earnings similarity was .20 in Denmark, .43 in Germany, and .45 in the United States. The difference between Denmark and the United States in sibling similarity in earnings was .25–.09 larger than the difference between Finland and Germany/the United States in sibling similarity in educational attainment.

Another interesting finding is that the difference between Finland and Sweden is larger than the difference between Sweden and the two societies with the highest level of educational inequality in our sample (Germany and the United States). Further, even though Germany and the United States differ fundamentally in terms of income inequality, they show the same level of inequality in educational attainment. The estimate for Germany is, however, accompanied by more uncertainty, as indicated by its large confidence interval. This confidence interval overlaps with the Swedish one, although it does not overlap with the confidence intervals of Finland and of Norway. Surprisingly, and contrary to the Great Gatsby Curve hypothesis, the United Kingdom—a country with a rather high level of income inequality—has a relatively average level of sibling similarity in final educational attainment (.42). There is, however, also uncertainty in the estimate for the United Kingdom, with the confidence interval overlapping with the confidence intervals of Germany and of Finland.

Analyzing variation in sibling similarity between social groups allows us to explore the patterns underlying sibling similarity at the population level and to better understand cross-country differences. Our cross-country comparisons show that sibling similarity

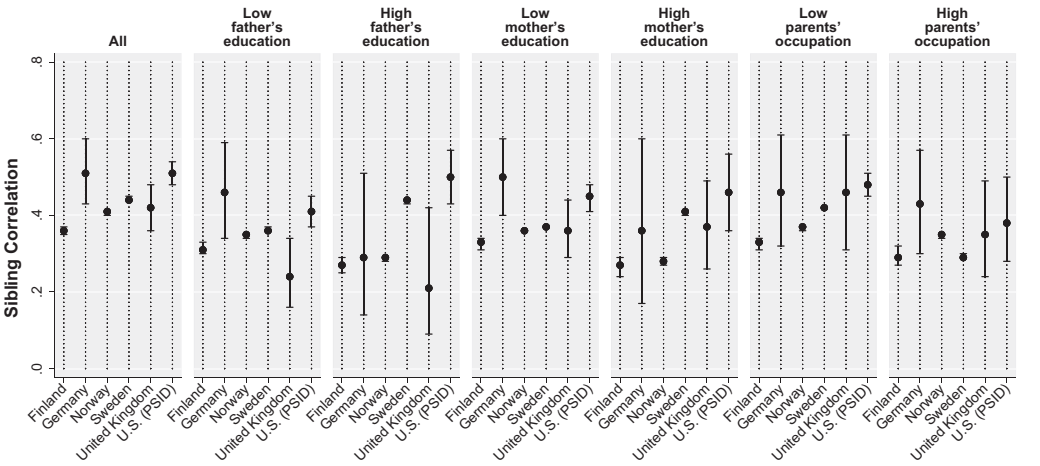

Fig. 3 Sibling correlations in final educational attainment. The 95% confidence intervals are bound to vary between 0 and 1. *Sources:* Finland: Registers. Germany: Socio-Economic Panel Study (SOEP). Norway: Registers. Sweden: Registers. United Kingdom: UK Household Longitudinal Study (Understanding Society). United States: Panel Study of Income Dynamics (PSID).

in final educational attainment at the population level was higher in the United States and (with more uncertainty) in Germany than in the Nordic countries and in the United Kingdom. The following analysis tests whether these country differences can be explained by differences in the variation of sibling similarity by family socioeconomic background.

In no country can systematic socioeconomic differences in sibling similarity be found with respect to cognitive skills (for significance tests, see Tables S1—S3 of the online appendix). In Germany, sibling similarity in cognitive skills is higher in families with a low versus high level of parental occupation (a difference of 20 percentage points). Sibling similarity in cognition is also higher in families with a low versus high level of maternal education (a difference of 11 percentage points). These socioeconomic differences vary in the direction expected by the theory of reinforcing parental investment strategies concentrated in socioeconomically advantaged families. However, no differences in sibling similarity are found with respect to the father's education. In addition, the socioeconomic differences are statistically significant in the estimation sample that includes singleton children (significance tests reported in Table S1, online appendix) but not in the sample that excludes them (significance tests reported in Table S4, online appendix).

Variation in sibling resemblance by family socioeconomic background in school grades is more pronounced than socioeconomic variation in cognitive skills. In Norway, siblings are consistently more similar in socioeconomically disadvantaged than in socioeconomically advantaged families, but these differences are small. The largest difference is found for maternal education, with sibling similarity being .06 higher for children of low-educated mothers than for children of highly educated mothers. In the United States, variation in sibling similarity in school grades by fathers' educational attainment goes in the opposite direction and is considerably larger (.24) than in Norway. The difference by maternal education is slightly smaller (.15) but goes in

the same direction and is statistically significant. The direction of this difference in the United States is in line with the theory of compensating parental investment strategies in socioeconomically advantaged families (Conley 2004, 2008; Griliches 1979; Hsin 2012). No differences in sibling similarity in school grades by parental occupation are found in the United States, but that could be due to parental occupation being a less-reliable measure of socioeconomic position (in the United States) than parental education (Torche 2015b). As in Sweden, the United States shows higher sibling similarity in families with a high level of parental education (but not with respect to parental occupation), but socioeconomic differences in sibling similarity are much smaller in Sweden than in the United States.

With respect to final educational attainment, differences between social groups are consistently higher in socioeconomically disadvantaged than in socioeconomically advantaged families for father's education, mother's education, and parental occupation in Finland and Norway only. These differences are rather small, with the largest difference being between high and low maternal education in Finland (.06) and Norway (.08). In addition, we find differences in sibling similarity in final educational attainment by parental education in Germany, the United Kingdom, Sweden, and the United States. In line with the school grade results in the United States and Sweden, we observe a .09 (United States) and .08 (Sweden) larger sibling similarity in educational attainment in families with a high level of father's education than in families with a low level of father's education. However, these differences do not materialize when we use measures of maternal education or parental occupation; again, this may be because these indicators are comparatively noisy proxies for socioeconomic status (Torche 2015b). In Finland, Germany, and Norway, socioeconomic differences in sibling similarity run in the opposite direction: when both father's and mother's education are used as measures of social origin, sibling similarity in final educational attainment is higher in families with low versus high parental education. In Germany, these differences by parental education are statistically significant only in the sample that includes singleton children (significance tests reported in Table S3, online appendix). In the sample that excludes singleton children, differences by father's and mother's education in sibling similarity in final educational attainment are not statistically significant in Germany (significance tests reported in Table S6, online appendix).[7]

In summary, our findings are not fully in line with our theoretical expectations. We hypothesized that the higher sibling similarity in educational attainment in the United States and Germany may be explained by higher sibling similarity in socioeconomically advantaged families. Our results are, however, in line with this expectation only when we use father's education as a measure of social origin and only in the United States. In Germany, we find the opposite pattern: higher sibling similarity in socio-

[7] A limitation of our analysis is that we employ survey data with rather small sample sizes for Germany, the United Kingdom, and the United States. Our ability to discover statistically significant differences between social groups is restricted by these small sample sizes. We test whether the differences in countries with register data would be significant if we had obtained the same point estimates using samples of the size of the smallest sample to study each outcome in the countries with survey data. These additional significance tests are reported in Tables S13–S15 of the online appendix. They show that hardly any differences between social groups are statistically significant in Finland, Norway, and Sweden had we relied on data of the size of the survey data in the other countries.

economically advantaged families. This finding, however, is not statistically significant in all model specifications. In addition, the other countries in our sample also follow distinct patterns, with higher sibling similarity in families with low parental education in Finland and Norway and higher sibling similarity in families with high parental education in Sweden. The differences in sibling similarity by parental education are, however, often smaller in the Nordic countries than in Germany and the United States. With respect to parental occupation, we find either no socioeconomic differences in sibling similarity or greater sibling educational similarity in socioeconomically disadvantaged families.

In additional analyses, we find no systematic variation in sibling similarity by migration background, family size, or maternal age at birth. We report these results in Tables S1–S3 in the online appendix.

Discussion and Conclusion

In this study, we analyze the similarity of siblings in cognitive skills, school grades, and final educational attainment across different societies and between social groups within societies. Our findings show that inequality of educational opportunity varies across countries. Differences between countries are larger for final educational attainment than for cognitive skills and school grades, demonstrating that educational attainment is influenced more by factors that vary between countries than by cognitive skills and school grades. Even for educational attainment, however, variation in sibling similarity across countries is smaller than for earnings (Schnitzlein 2014).

For final educational attainment, sibling correlations in Germany and the United States (both .51) are .15 higher than in Finland (.36). This variation shows the largest impact income inequality, welfare regimes, and educational institutions—such as the degree of tracking or education costs—can possibly have on the inequality of educational opportunity. However, there are also other possible explanations for differences across countries. For instance, demographic differences could account for the observed variation in educational inequality across countries (Maralani 2013; Mare 2011; Mare and Maralani 2006).

With respect to the hypotheses posed by Lipset and Zetterberg (1959) and Featherman et al. (1975), our study reveals variation in the level of sibling resemblance across countries.[8] The largest differences across countries are found for sibling correlations in educational attainment. Population-level sibling similarity in educational attainment varies between .36 and .51 in the countries we study, which is lower than the variation across countries indicated by the comparison of estimates from previous research collected in Table 2. Lipset and Zetterberg (1959) also found variation in occupational mobility in the countries they analyzed. They found total vertical mobility to be lowest in Switzerland (23%) and highest in Germany (31%). Featherman et al. (1975) reported estimates for only two countries, Australia and the United States.

[8] Because our data are suitable only for examining national-level estimates of educational inequality, we cannot speak to the geographic variation within countries. There may be geographic variation that we cannot account for. For instance, Chetty et al. (2014) and Connolly et al. (2019) found considerable regional variation in income mobility in the United States and Canada.

They found that net (i.e., absolute) mobility was higher in the United States (21.8) than in Australia (14.9), but circulation (i.e., relative) mobility was similar across the two countries (83.5 in the United States and 78.2 in Australia). Even though we found some variation in educational inequality across countries, our findings show that the largest part of sibling resemblance in education does not vary across countries. In our view, this result implies that if we are interested in explaining why there is such a high level of inequality of educational opportunity in advanced industrialized societies, we have to note that considerable educational inequality exists in all countries.

An additional finding of our study is that the United States ranks differently compared with other countries depending on whether sibling similarity in cognitive skills, school grades, or educational attainment is used to measure educational inequality. This finding further complicates the explanation of how income inequality, welfare regimes, and educational institutions affect educational inequality. Note that we find the highest level of inequality of opportunity in educational attainment in Germany and the United States. The level of income inequality, indicated by the Gini coefficient, is highest in the United States but considerably lower in Germany. The United Kingdom, which also has a high level of income inequality, has a rather average level of inequality in educational attainment. At the same time, given the uncertainty in the estimates, we cannot exclude the possibility that sibling similarity in educational attainment in the United Kingdom is at the same level as in Germany. In addition, even within the group of Nordic countries, which do not differ in their welfare and education regimes and which show very similar levels of income inequality, there is variation in terms of sibling similarity in education. The difference between sibling similarity in education in the most (Finland) and in the least mobile Nordic society (Sweden) is bigger than the difference between Sweden and either Germany or the United States. All these findings complicate theories claiming that income inequality, welfare regimes, and educational institutions are the main determinants of inequality of educational opportunity.

Not only do our rankings of countries differ across different measures of education (at least with respect to the placement of the United States), but they also differ from rankings in studies that used other approaches to measure inequality of educational opportunity (Bol and van de Werfhorst 2013; Chmielewski and Reardon 2016; Hertz et al. 2008; Pfeffer 2008; Treiman and Yip 1989). Of course, differences in rankings of countries in terms of educational opportunity are likely to be due to methodological differences between studies. However, given that each methodological approach has its own advantages and disadvantages, a conservative interpretation of the finding of diverging rankings of countries in terms of inequality of educational opportunity is that there is no unambiguous ranking of countries according to their level of educational inequality (Breen and Jonsson 2005).

In interpreting our results, a central limitation of our study must be kept in mind. Even though we harmonize indicators across countries as much as possible, these measures are not, strictly speaking, wholly identical. Cognitive skills are measured in the different data sets in slightly different ways, as described in detail in the online appendix. Such differences necessarily result from using country-specific data sources, which were required for our study. We also employ two data sets to determine sibling similarity in cognitive skills in the United States to test the robustness of results across data sets. School grades may also differ across countries because of different grading

systems. We address this issue by standardizing the grades within each country before estimating the sibling correlations. Finally, we employ a continuous measure of education to be able to compute sibling correlations. Despite various ways to estimate sibling correlations for categorical variables, these are not standardized, and the resulting estimates are not comparable with sibling correlations based on continuous variables. In reality, though, thresholds (i.e., those signaling credential attainment) are doubtlessly important in assessing life chances and educational achievement.

With respect to the variation in educational inequality across social groups, we find variation across countries as well as across measures of parental resources and of educational success. Our findings therefore show a complex pattern of variation in sibling similarity, shedding light on previous research, which found little systematic variation in sibling correlations in education by family socioeconomic background in Germany (Baier 2019; Grätz 2018), the United States (Conley 2008; Conley and Glauber 2008; Conley et al. 2007), and Sweden (Hällsten and Thaning 2018). Our finding suggests more socioeconomic variation in sibling similarity in school grades and educational attainment than in cognitive skills. In the United States, siblings from highly educated fathers are more similar in their school grades and educational attainment than siblings with low-educated fathers. Findings in Sweden go in the same direction, but the variation of sibling similarity in school grades by father's education is smaller in Sweden than in the United States. By contrast, in Finland, Germany, and Norway, we find a higher sibling similarity in families with a low versus high level of parental education. With respect to parental occupation, we find either no socioeconomic differences or greater sibling similarity in low- than in high-occupational status families in all countries. These findings suggest that parental investment strategies depend on the nature of the parental resource and vary across countries. More targeted future research may test why this is the case. ■

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Michael Grätz (corresponding author)
michael.gratz@unil.ch

Dalton Conley (corresponding author)
dconley@princeton.edu

Grätz • Institut des sciences sociales, University of Lausanne, Lausanne, Switzerland; Swedish Institute for Social Research (SOFI), Stockholm University, Stockholm, Sweden

Barclay • Max Planck Institute for Demographic Research, Rostock, Germany; Department of Sociology, Stockholm University, Stockholm, Sweden; Swedish Collegium for Advanced Study, Uppsala, Sweden

Wiborg • Department of Sociology and Human Geography, University of Oslo, Oslo, Norway; Centre for the Study of Professions (SPS), Oslo Metropolitan University (OsloMet), Oslo, Norway

Lyngstad • Department of Sociology and Human Geography, University of Oslo, Oslo, Norway

Karhula • Faculty of Biological and Environmental Sciences and HELSUS, University of Helsinki, Helsinki, Finland; Invest Research Flagship Center, University of Turku, Turku, Finland

Erola • Invest Research Flagship Center, University of Turku, Turku, Finland

Präg • Center for Research in Economics and Statistics (CREST), ENSAE, IP Paris, Paris, France

Laidley • Institute of Behavioral Science and Institute for Behavioral Genetics, University of Colorado, Boulder, CO, USA

Conley • Department of Sociology, Princeton University, Princeton, NJ, USA