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THE INFLUENCE OF COUSIN ORDER AND COUSIN GROUP SIZE ON EDUCATIONAL OUTCOMES

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A data appendix is available at http://www.nber.org/data-appendix/w29844

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ABSTRACT

Despite growing interest in the potential influence of grandparents on grandchild status attainment, research has not addressed whether the ordinal position or number of grandchildren affects outcomes. We apply sibling- and cousin-fixed effects analyses to Swedish population data to examine how cousin order and cousin group size influence grade point average (GPA) percentile rank at the end of compulsory school. We study cohorts born 1972-2003 (N=1,591,979). In cousin fixed effects analyses, second-born, fifth-born, and tenth or later born maternal cousins achieve GPA ranked scores 1.04, 2.17, and 4.97 percentile points lower than first-born cousins, respectively. Amongst paternal cousins the differences relative to the first-born cousin are 0.02, 0.46, and 1.86 percentile points lower, respectively—suggesting the greater influence of the mother's extended family. In further analyses we examine whether an arguably exogenous shock to cousin group size, a twin birth to an aunt or uncle, has any impact on GPA percentile rank. Instrumental variable analyses indicate that an increase in maternal cousin group size has a statistically significant negative effect on GPA rank, lowering GPA rank in percentile points by 0.27, but an increase in paternal cousin group size does not negatively affect GPA rank.

INTRODUCTION

The role that kin play in shaping outcomes over the life course has been the subject of research by social scientists for over a century. Many sociologists and economists have devoted their careers to studying how the family influences socioeconomic outcomes and health, and there is a strong consensus around the importance of the family, and particularly the parents, for shaping socioeconomic attainment (Blau and Duncan, 1967; Becker and Tomes, 1986; Erikson and Goldthorpe, 1992; Jonsson et al., 2009; Adermon et al., 2021). While the importance of the immediate family for shaping life outcomes is undisputed, the relative importance of extended kin, such as grandparents, aunts, and uncles, for influencing educational and socioeconomic success is more contentious (e.g., see Ander-

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son et al., 2018), and many have argued that intergenerational transmission of status follows a Markovian process. Most studies evaluating the importance of the extended family have sought to examine the influence of grandparents on grandchild outcomes by measuring the vertical transmission of status (e.g. see Song et al. 2016), or by using horizontal measures such as cousin correlations to infer the latent effect of grandparents (e.g. see Lundberg 2020). In this study, however, we use a new, alternative, approach for estimating the influence of extended kin: we examine whether the size of the cousin group, and an individual's ordinal rank within the cousin group, has any influence on high school GPA, which is itself an important predictor of later educational and socioeconomic attainment (Erikson and Jonsson 1998; Hällsten 2010; French et al., 2015). As we will argue, cousin group characteristics should only matter for educational outcomes if the extended family influences educational and status attainment.

The influence of the parallel measures for cousin order and cousin group size in the sibling group – birth order and sibling group size – on long-term educational and socioeconomic attainment have long been examined by psychologists, biologists, sociologists, economists, and demographers (e.g. Galton, 1874; Apperly, 1939; Becker and Lewis, 1973; Belmont and Marolla, 1973; Blake, 1989; Steelman et al., 2002; Black et al., 2005; Powell and Steelman, 1990). Studies in North America and Europe have consistently found that, relative to first-born siblings, later-born siblings have lower educational achievement in high school, a lower probability of entering tertiary education, and lower completed educational attainment (Black et al., 2005; Kalmijn and Kraaykamp, 2005; Härkönen, 2014; Barclay, 2015). Research on sibship size long supported the conclusion that growing up in a large family has a negative effect on educational attainment (Blake, 1989; Powell and Steelman, 1990); however, more recent research has suggested that sibship size effects vary by context (Park 2008; Gibbs et al. 2016) and may be overstated due to unobserved differences between large and small families that, in turn, also affect educational outcomes (Guo and VanWey, 1999; but also see Conley and Glauber 2006; Cáceres-Delpiano 2006). However, despite this long history of birth order and sibship size research, few if any scholars have considered how the parallels of birth order and sibship size in the extended family— cousin order and cousin group size—are related to educational outcomes.

Although birth order and sibship size in the household of origin are likely to be more important than cousin order and cousin group size for educational outcomes, cousin order and cousin group size are likely to moderate the degree of attention that grandparents, aunts, and uncles bestow upon any given grandchild, as well as the number of grandchildren by which any potential inheritance may be divided. For example, the first-born of a cousin group, i.e. the first grandchild/nephew/niece in an extended family, may not only elicit special attention from the parents, but likely also special attention from the grandparents, aunts, and uncles in a way that, say, a fifth-born cousin might not. Although there is a large body of literature examining the main effects of grandparents on the educational and socioeconomic attainment of grandchildren (e.g., see Anderson et al., 2018; Song, 2016; Lundberg, 2020), this research has not differentiated by the ordinal position of grandchildren or the number of grandchildren. In this study we apply sibling and cousin fixed effects, and instrumental variable analyses that exploit twin births to an aunt or uncle as an exogenous shock to cousin group size, to Swedish population register data in order to examine whether cousin order and cousin group size are related to high school GPA percentile rank in the index person's school cohort.

Influence of Extended Kin on Educational and Socioeconomic Attainment of Grandchildren.

An examination of how cousin order and cousin group size may affect educational achievement and attainment inherently suggests that an individual's educational outcomes are partly influenced by factors outside the nuclear family. The relative importance of grandparents for socioeconomic attainment is the subject of much debate in the literature on stratification and status attainment. Theoretically, the debate centers around whether status transmission follows a Markovian process, where the attainment of any generation is influenced only by the attainment of the directly preceding generation (Becker and Tomes, 1986), or whether there is a residual effect of grandparental, and even great-grandparental, status and resources net of the socioeconomic status of the parents — or non-dynastic effects from uncles and aunts (Hällsten and Kolk 2020; Adermon et al., 2021). From a demographic perspective, we are currently living through a zenith in terms of lifespan overlap between grandparents and grandchildren in high-income countries, influenced by steady gains to longevity, and historically low mean parental ages at birth in the second half of the 20th century (Murphy and Grundy, 2003; Leopold and Skopek, 2015). Furthermore, current fertility rates in rich countries, probably the lowest in human history (Kohler et al., 2002), mean that there is more focus on the children that are born — including perhaps by family members beyond the nuclear household. In theory, grandparents have more opportunities to influence grandchild development and attainment now than ever before, especially given how few grandchildren they typically have now in comparison to earlier periods. On the other hand, in the West, grandparental (and other extended family) co-residence has steadily declined in tandem with the demographic changes mentioned above, so the influence of non-parental kin could also have waned in more recent cohorts (Glaser et al. 2018).

Many studies have indicated that grandparental socioeconomic status and wealth do influence the socioeconomic attainment of grandchildren, even net of parental characteristics (Chan and Boliver, 2013; Hällsten and Pfeffer, 2017; Pfeffer and Killewald, 2018; Anderson et al., 2018; Adermon et al., 2021). Typically, these studies have pursued one of two empirical strategies. First, some research has regressed individuals' social statuses (education, occupation, income, or wealth) on their grandparent(s)' SES, holding their parents' values on these measures constant. A residual effect of grandparental characteristics on grand-offspring after holding values for the intervening generation constant is seen as evidence of a non-Markovian process of status transmission (e.g. see Warren and Hauser, 1997; Zeng and Xie, 2014; Hällsten and Pfeffer, 2017). A second empirical approach decomposes variance in SES measures into a nuclear family component (i.e. the sibling correlation) and an extended family component (i.e. the cousin correlation). In this design, grandparents' characteristics need not be measured, and the interpretation of the cousin correlation is that it captures the omnibus effect of the extended family, net of unmeasured, immediate family effects. Although several studies have estimated a non-trivial cousin correlation, thereby suggesting that grandparents and the rest of the extended family may indeed influence grandchild outcomes (Jæger, 2012; Hällsten, 2014; Knigge, 2016; Hällsten and Kolk 2020), others have cogently argued that these cousin correlations are entirely consistent with several alternative theoretical explanations, including, but not limited to, a Markovian transmission process (Lundberg, 2020).

Although most of the research on how the extended family may influence grandchild socioeconomic attainment has ostensibly focused upon grandparents, some studies have also considered the potential influence of aunts and uncles (Jæger, 2012; Prix and Pfeffer, 2017; Barclay and Hällsten 2021; Querin, 2022). Aunts and uncles could serve as role models for their nieces and nephews, expose them to different ideas or behaviors, and contribute towards the general supervisory environment surrounding their niblings (Loury 2006). Relationships with aunts and uncles can span the full spectrum from a minimal degree of contact to a supplementary parent role (Milardo, 2010). Individuals with few or no cousins may receive more attention from their aunts and uncles. Research on the influence of aunts and uncles on the attainment of their nieces and nephews net of parental and grandparental influences is mixed, with some studies suggesting that, on average, they play little direct role (Warren and Hauser, 1997; Jæger, 2012), while others suggest that they play a more important role than grandparents (e.g. see Erola et al., 2018). Aunts and uncles may play a more significant role in compensating for socioeconomic disadvantage in the nuclear family (Jæger, 2012; Prix and Pfeffer 2017; Erola et al., 2018), though the compensatory role that aunts and uncles play for their nieces and nephews after more extreme events, such as parental death, does not seem to be very important (Barclay and Hällsten, 2021).

Cousin Order, Cousin Group Size and Educational Attainment: Theoretical Expectations.

Potential mechanisms underlying a direct effect of grandparents on grandchild outcomes include both contact-based and non-contact-based influences (Anderson et al., 2018). Contact-based mechanisms refer to face-to-face contact with grandchildren, such as reading, speaking, and playing with them. Non-contact-based mechanisms include direct financial transfers, generalized as a purchasing mechanism (Hällsten and Pfeffer, 2017). However, non-contact-based influences may also be more subtle. For example, the insurance function of wealth may enable grandchildren to pursue riskier educational and labor market strategies (Spilerman, 2000; Pfeffer and Hällsten, 2012), and wealth is also likely to promote high expectations about educational achievement (Hällsten and Pfeffer, 2017). More generally, grandparents may influence grandchildren by serving as enduring role models, even after death.

These potential mechanisms for grandparental influence likely interact with traditional, nuclear-family-focused theories that attempt to account for why birth order and sibling group size should influence educational outcomes, such as the resource dilution model (Blake, 1989) and the confluence model (Zajonc and Markus, 1975; Zajonc, 1976). The *resource dilution model* makes the straightforward prediction that, as sibling group size grows, finite parental resources are shared amongst more children, and this should lead to lower average attainment amongst those children (Blake, 1989). Sibling group size might also interact with cousin group size, with the overall degree of competition from siblings and cousins for resources from parents, aunts, uncles, and grandparents influencing educational and socioeconomic attainment. Under the assumption that children go through critical development periods, and that the first few years of life constitute one of these critical periods (Heckman, 2006; Knudsen et al., 2006), the resource dilution hypothesis is also clearly relevant for understanding birth order, and potentially cousin order, effects: first- and earlier-born children have greater access to the resources of parents and other kin during the first few years of life than later-born siblings and cousins. The resource dilution hypothesis has, in recent years, come under increased scrutiny given that estimates for the effects of sibship size on educational attainment vary widely across countries and even amongst different groups within the same country. However, this variation seems to be explained by state and community level support (Gibbs et al., 2016); stronger public support for childcare, universal child benefits, and larger public expenditures on education and the family, all of which reduce the relative importance of household-level resources, seem to lead to weaker family size effects (Park, 2008). Meanwhile, the *confluence model* suggests that it is the general intellectual climate of the household or family environment that explains both sibship size and birth order effects, where the average age of household members serves as a proxy for the intellectual climate. Each additional birth lowers the average age within the household, and later-born children spend more of their childhood in an environment with a lower average age, which is purported to provide relatively less intellectual stimulation (Downey, 1995).

The influence of cousin group size on educational outcomes could clearly be related to dilution of resources, such as wealth, but also time and attention, of grandparents, aunts, and uncles over a larger kin network. Cousin *order* effects could also emerge through contact-based mechanisms – i.e., either the confluence model within the extended family framework, the increased salience of non-pecuniary resources during early-life development, or even through competition between cousins for family resources. Grandparents, aunts, and uncles often involve themselves in raising the next generation. In Sweden, people who are still working are more likely to retire after they become a grandparent (Kridahl, 2017), and grandparents tend to live close to their grandchildren (Kolk, 2017). The transition to grandparenthood is a significant step in life, and there is some evidence that becoming a first-time grandparent increases life satisfaction and decreases depression amongst grandmothers – though perhaps not amongst grandfathers (Sheppard and Monden 2019; Di Gessa, Bordone and Arpino, 2020). Grandparents not only help to care for grandchildren, but by reducing the burden of care, they may also make it possible for parents to spend more quality time with children, which may be particularly stimulating. However, grandparental care is simply not likely to be available to the same extent for later-born cousins as for first- and earlier-born cousins, because the extent to which grandparents can directly help in raising grandchildren via contact-based mechanisms is increasingly limited as the number of grandchildren increases, and particularly as the number of grandchildren increases across multiple different households. Moreover, the arrival of later born grandchildren may coincide with functional decline in the grandparents' health, leading to less valuable interaction with later-born grand offspring relative to those born earlier. Similarly, aunts and uncles without any children of their own may be more likely to direct attention and resources towards nieces and nephews, at least until they have their own children, and this may advantage the first-born in any given cousin group.

In addition to these interactional dynamics that may produce cousinship size and cousin order effects, there may be non-contact-based causal mechanisms at play such as *inter vivos* transfers of wealth, bequeathment of assets at death and serving as role models. Along these lines, grandparent–grandchild rank correlations in wealth are approximately 0.1–0.2 in Sweden, while parent–child rank correlations in wealth are approximately 0.3–0.4, and most of the grandparent-grandchild association is mediated by parental wealth (Adermon et al., 2018). Significant inheritances that skip the parental generation and go directly to grandchildren while the parents are still alive are relatively uncommon, and Swedish inheritance law also limits these options (see Swedish Ministry of Justice, 2013).

There are also plausible reasons for supposing that educational achievement might *not* vary by cousin order or cousin group size in Sweden. For one, high levels of institutional support for parents in Sweden, for example in the form of long periods of parental leave and highly subsidized childcare, mean that the relative importance of grandparents, aunts, and uncles, at least via contact-based mechanisms, for offspring outcomes should be relatively less important than in other contexts (Park, 2008; Gibbs et al., 2016). Likewise, the Swedish education system is completely tuition free, including for tertiary education, and is highly standardized. As such, family resources should, in principle, matter less for educational achievement in Sweden than in countries such as the United States or the United Kingdom. Furthermore, multigenerational households are rare in Sweden. Although Swedish grandparents are amongst the most likely in Europe to provide any childcare for their grandchildren, they are among the least likely to provide childcare 'almost weekly or more often' (Hank and Buber, 2009). For all these reasons, if we detect variation in educational attainment by cousin order and cousin group size in Sweden, we might expect any such relationship to be stronger in countries where institutional support for parents is weaker, and multigenerational contact patterns are more pronounced.

Heterogeneity by Lineage and Parental Resources.

The existing literature has identified several potential sources of heterogeneity in multigenerational associations, including variation by grandparental lineage. Differentiating the potential influence of matrilineal and patrilineal grandparents is important due to differential contact patterns. The parental generation is critical for facilitating grandparent-grandchild interactions, and parents are gatekeepers in terms of grandparental access to grandchildren (Chan and Elder, 2000). Maternal grandparental ties are typically stronger because of the closer relationship between the mother and her parents, reflecting the fact that women act as a kin-keepers to a much greater extent than men (Eisenberg, 1988; Rossi and Rossi, 1990; Kalmijn et al., 2019). These strong inbuilt maternal biases are even clearer after divorce or separation (Chan and Elder, 2000). Although the extant literature on multigenerational socioeconomic associations does not provide much support for variation by grandparental lineage differences (Anderson et al., 2018), there is evidence that support from maternal grandparents is greater during times of need (Coall and Hertwig, 2010). Furthermore, grandchildren report closer relationships to maternal grandmothers than any other grandparent (Eisenberg 1988). Consequently, we investigate whether any effects of cousin order and cousin group size vary between maternal cousins and paternal cousins.

Another potentially important source of heterogeneity in grandparental influence is parental socioeconomic resources. Some research suggests that patterns and degrees of interaction in the extended family, e.g. between cousins, varies by family socioeconomic status (e.g. see Lareau, 2011). Most studies find that grandparents are particularly important for grandchildren when parental resources are limited, and/or during times of difficulty or crisis; for example, teenage parenthood and divorce have received particular empirical attention (Coall and Hertwig, 2010; Anderson et al., 2018). Other research has shown that grandchildren benefit from grandparental socioeconomic resources to a greater extent when the parents have lower household income (Jæger, 2012). Therefore, most research suggests that grandparental socioeconomic resources can play a particularly important role in compensating for disadvantage (Coall and Hertwig, 2010; Anderson et al., 2018). A notable exception in this literature is that Song (2016) found that direct effects of grandparental education on grandchild educational attainment in the United States were strongest for grandchildren who grew up in two-parent families, and weaker for grandchildren growing up in less advantaged family structures.

A related debate in the literature concerns the degree to which parents either compensate for differences between siblings to equalize outcomes (Behrman et al., 1982), or whether they exaggerate them by investing more in children that demonstrate greater ability (Becker and Tomes, 1976); and, moreover, whether this behavior might vary by socioeconomic status (Grätz and Torche, 2016). Most of this research has focused on the nuclear family, but any such patterns are even less well understood at the level of the extended family. Given that research has also shown that birth order effects on educational outcomes vary by parental socioeconomic status in Sweden (Barclay et al, 2017), we examine whether the effects of cousin order and cousin group size vary according to parental and grandparental socioeconomic resources, indexed by educational attainment.

DATA AND METHODS

Data

We use Swedish administrative register data to study whether and how cousin order and cousin set size are associated with grade point average (GPA) amongst men and women born 1972-2003. Swedish administrative data covers the entire population resident in Sweden, and through a unique personal identification number it is possible to link records from different administrative sources. A key data source for our study is the Swedish multigenerational register. Each individual can be linked to his or her mother and father, and this allows full biological kinship networks to be constructed, including links to aunts and uncles, grandparents, and cousins.

Outcome Variables

Grade Point Average (GPA)

Education in Sweden is state funded at all levels, and tertiary education is free for Swedish citizens (Halldén, 2008; Högskoleverket, 2012). The Swedish education system is divided into three sections: (i) 9 years of compulsory schooling (*grundskolan*); (ii) three additional years of secondary school (*gymnasium*); and (iii) the tertiary section (Halldén, 2008). The data on GPA is based upon grades from the ninth and final year of compulsory schooling in Sweden. Students are typically aged 15 or 16 at the end of the ninth grade. We study GPA amongst men and women born 1972-2003, who would therefore have been aged 15 or 16 between 1988-2019. The Swedish educational system went through a series of different reforms over these three decades, including some changes to the grading systems (Björklund et al. 2004). Between 1988 and 1997 students were graded on a scale from 1-5, with the GPA based on the mean grades across subjects (Öster, 2006). Between 1998 and 2011, students could receive one of four grades for each subject: pass with special distinction, pass with distinction, pass, or fail. During this period, each grade was assigned a numerical score: pass with special distinction = 20, pass with distinction = 15, pass = 10, and fail = 0 (Skolverket 2010). The overall GPA for each student was calculated by summing the values for the 16 best grades achieved, with an overall range of 0 to 320 (Skolverket 2010; Turunen 2014). In July 2011 a grading scheme with grades A to F was introduced, but with the same underlying scoring logic, i.e. A=20 points; B=17.5; C=15; D=12.5; E=10; F=0 (Skolverket 2017). To facilitate interpretation of the results, and to allow us to compare grades across cohorts, we transform GPA into percentile rank within each graduating class using the cumulative distribution function, where scores of 100 are highest and 0 are lowest. We have conducted analyses to check whether our results vary between different testing and grading regimes over the cohorts that we study; however, as the results in the Supplementary Materials show, the patterns of results are very similar across cohorts. Thus, the results presented below are based on pooling all cohorts together.

Additional Variables

Sociodemographic Characteristics

In our analyses we control for a series of pre-treatment factors that may be related to both cousin order and cousin group size as well as GPA. Key among these is birth year, which is associated with both fertility as well as secular changes in GPA scores, though any influence of grade inflation is mitigated by examining GPA rank within each school cohort. However, birth year also effectively adjusts for differences in parental or grandparental age at the time of birth in the within-family comparison models that we use, detailed below, because any differences in, for example, maternal age at birth between siblings, or grandmaternal age at birth between cousins, is collinear with differences in birth year between siblings or cousins in our family fixed effects analyses. In models that do not include any family fixed effects, we control explicitly for maternal age at birth. We also control for birth order and sibling group size in the nuclear family in order to estimate, as closely as possible, the association between cousin order and cousin group size net of similar factors in the sibling group. This is important because, for instance, only a first-born sibling can be a first-born cousin, though a first-born sibling can also be a later-born cousin. We also control for sex, as recorded in the administrative registers.

Parental and Grandparental Socioeconomic Status

Some statistical models that we employ in this study, namely the family fixed effects models, adjust for all shared family background factors that are shared by siblings, or cousins. However, we are also able to adjust explicitly for parental socioeconomic status in the cousin fixed effects models where the cousin group includes children nested within two or more discrete nuclear families. Furthermore, we adjust for the SES of paternal grandparents in models where we use maternal cousin fixed effects, and we adjust for the SES of maternal grandparents in models where we employ paternal cousin fixed effects.

We adjust for the socioeconomic status of parents and grandparents using measures of income and education. Our measure for income is the natural log of mean annual disposable income, adjusted for inflation. We use data on income over the period 1968—2018, and our measure of mean annual income considers all income recorded from age 18 until the latest point available in the data. Due to the period for which data is available, the mean value for parental income reflects the average from data representative of the whole parental life course, while for grandparents the measure cannot always reflect the contribution of earnings at younger ages to the mean. For example, if a grandparent was born in 1930, we would not have data on their earnings between ages 18—37 (1948-1967). The median number of years for which we observe income for maternal and paternal grandmothers is 50, and for maternal and paternal grandfathers it is 48 and 45, respectively.

We also adjust for a highly detailed measure of parental and grandparental education that considers both the level of education as well as the field of study. Taking every potential combination of level of education as well as field produces a large number of combinations; to adjust for this factor efficiently, we follow previous practice in the literature (e.g. see Hällsten and Pfeffer, 2017) and regress the outcome variable (i.e. GPA) on fixed effects for every unique combination of father's, and mother's, educational level and field, and then include the predicted values for GPA based on those analyses in our subsequent regression analyses. We perform the same routine to obtain control variables for the education of maternal and paternal grandparents.

Study Design and Statistical Analyses

Cousin Order Analyses

To estimate the association between cousin order and educational outcomes and test scores, we implement several different analyses. We first estimate the association between cousin order and GPA using a sibling fixed effects model, examining biological siblings who share both a mother and father:

$$(1)\ y = \alpha_j + \beta_1 CCO + \beta_2 BO + \beta_3 Sex + \beta_4 BirthYear + \varepsilon$$

where α_j refers to a sibling group fixed effect specific to sibling group j, and y refers to the outcome of interest, GPA percentile rank. *CCO* refers to cousin order across both the maternal and paternal cousin groups (1,2,…,10+), *BO* refers to birth order (1,2,…,10+), *Sex* indexes biological sex as registered at birth (Male, Female), and *BirthYear* indexes year of birth using individual year dummies (e.g. 1982,1983,…,2003). Cousin and sibling group size are constant within the sibling group, and we therefore cannot obtain estimates for those variables within this framework. Model 1 conditions on having at least one maternal cousin, and at least one paternal cousin, net of any siblings.

In Model 2 we again use a sibling fixed effects analysis, but instead use separate terms for maternal and paternal cousin order:

$$(2)\ y = \alpha_j + \beta_1 MCO + \beta_2 PCO + \beta_3 BO + \beta_4 Sex + \beta_5 BirthYear + \varepsilon$$

where *MCO* refers to maternal cousin order (1,2,…,10+), and *PCO* refers to paternal cousin order (1,2,…,10+).

We then estimate two models using a cousin fixed effects approach, first for the maternal cousin group:

$$(3)\ y = \delta_k + \beta_1 MCO + \beta_2 PCO + \beta_3 PCGS + \beta_4 BO + \beta_5 SGS + \beta_6 Sex + \beta_7 BirthYear + \beta_8 ParentSES + \beta_9 PaternalGPSES + \varepsilon$$

where δ_k indexes a maternal cousin group fixed effect k, *MCGS* refers to cousin group size (1,2,…,10+), *PCGS* refers to cousin group size (1,2,…,10+), and *SGS* refers to sibling group size (1,2,…,10+), *ParentSES* indexes control variables for income and education of parents, and *PaternalGPSES* indexes control variables for the income and education of the paternal grandparents. This model conditions on the index person having at least one maternal cousin, but does not condition on paternal cousin group size.

We then estimate similar models for the paternal cousin group:

$$(4)\ y = \xi_l + \beta_1 MCO + \beta_2 PCO + \beta_3 MCGS + \beta_4 BO + \beta_5 SGS + \beta_6 Sex + \beta_7 BirthYear + \beta_8 ParentSES + \beta_9 MaternalGPSES + \varepsilon$$

where ξ_l indexes a paternal cousin group fixed effect *l*, and *MaternalGPSES* indexes control variables for the income and education of the maternal grandparents. This model conditions on there being at least one paternal cousin, but does not condition on maternal cousin group size. Our estimates from models 3 and 4 hold all factors shared amongst cousins, in the maternal and paternal groups respectively, constant.

We then examine the association between cousin order and the outcomes that we study amongst only children – that is children without any biological siblings – who have cousins. In these models we examine cousin order free of any interference from sibling influence in the index person's own sibling group:

$$(5)\ y = \delta_k + \beta_1 MCO + \beta_2 PCO + \beta_3 PCGS + \beta_4 Sex + \beta_5 BirthYear + \beta_6 ParentSES + \varepsilon \Leftrightarrow SGS = 1$$

$$(6)\ y = \xi_l + \beta_1 MCO + \beta_2 PCO + \beta_3 MCGS + \beta_4 Sex + \beta_5 BirthYear + \beta_6 ParentSES + \varepsilon \Leftrightarrow SGS = 1$$

where $\Leftrightarrow SGS = 1$ indicates that the model is estimated only upon the subset of index persons from sibling groups with 1 child; β_1 from Model 5 and β_2 from Model 6 are estimates for, respectively, the maternal and paternal cousin order effects amongst only children. Model 5 conditions on the index person having at least one maternal cousin, and Model 6 conditions on the index person having at least one paternal cousin. In these models the variables for cousin order and cousin set size are capped at 5+, because having a cousin group with more than five only children is rare.

Within the cousin fixed effects framework, we also examine the interaction between cousin order and birth order:

$$(7)\ y = \delta_k + \beta_1 MCO \text{ x } BO + \beta_2 PCO + \beta_3 PCGS + \beta_4 SGS + \beta_5 Sex + \beta_6 BirthYear + \beta_7 ParentSES + \beta_8 PaternalGPSES + \varepsilon$$

$$(8)\ y = \xi_l + \beta_1 MCO + \beta_2 PCO \text{ x } BO + \beta_3 MCGS + \beta_4 SGS + \beta_5 Sex + \beta_6 BirthYear + \beta_7 ParentSES + \beta_8 MaternalGPSES + \varepsilon$$

where the interaction examines whether cousin order effects vary within different levels of birth order. Model 7 conditions on the index person having at least one maternal cousin, and Model 8 conditions on the index person having at least one paternal cousin. In these models the variables for birth order, cousin order, sibling group size, and cousin set size are capped at 5+ in order to maintain a manageable number of parameters in the interaction analysis (i.e. 5 x 5, rather than 10 x 10).

Cousin Group Size Analyses

We estimate several further models to examine how cousin group size is associated with the outcomes that we study. First, we estimate how cousin group size, combining both maternal and paternal cousins, is associated with GPA using a linear regression model without sibling or cousin fixed effects:

$$(9)\ y = \beta_1 MCO + \beta_2 PCO + \beta_3 CCGS + \beta_4 BO + \beta_5 SGS + \beta_6 Sex + \beta_7 BirthYear + \beta_8 MatAge + \beta_9 ParentSES + \beta_{10} MaternalGPSES + \beta_{11} PaternalGPSES + \varepsilon$$

where *CCGS* indexes combined cousin group size and *MatAge* indexes maternal age at birth (<20, 20-24, …, 35-39, 40+). Next, we use a cousin fixed effect approach similar to that seen in Models 3 and 4:

$$(10)\ y = \delta_k + \beta_1 MCO + \beta_2 PCO + \beta_3 PCGS + \beta_4 BO + \beta_5 SGS + \beta_6 Sex + \beta_7 BirthYear + \beta_8 ParentSES + \beta_9 PaternalGPSES + \varepsilon$$

$$(11)\ y = \xi_l + \beta_1 MCO + \beta_2 PCO + \beta_3 MCGS + \beta_4 BO + \beta_5 SGS + \beta_6 Sex + \beta_7 BirthYear + \beta_8 ParentSES + \beta_9 MaternalGPSES + \varepsilon$$

We call these Models 10 and 11. The difference between Models 3 and 4, and 10 and 11, are that in Models 10 and 11 we do not condition on the index person having any cousins. While cousin *order* only has salience in the presence of cousins, we are also interested in understanding how educational outcomes between those who have no cousins and those who have some, or many, cousins. The objective of Models 10 and 11 is to compare cousins who share, for example, a set of maternal grandparents, but who have different numbers of paternal cousins, and to try and estimate the net association between paternal cousin group size and GPA while holding unmeasured aspects of the maternal cousin group constant, and controlling explicitly for measurable dimensions of socioeconomic status of both parents and paternal grandparents.

In additional analyses that extend models 10 and 11, we examine the interaction between sibling group size and cousin group size:

$$(12)\ y = \delta_k + \beta_1 MCO + \beta_2 PCO + \beta_3 SGS \text{ x } PCGS + \beta_4 BO + \beta_5 Sex + \beta_6 BirthYear + \beta_7 ParentSES + \beta_8 PaternalGPSES + \varepsilon$$

$$(13)\ y = \xi_l + \beta_1 MCO + \beta_2 PCO + \beta_3 SGS \text{ x } MCGS + \beta_4 BO + \beta_5 Sex + \beta_6 BirthYear + \beta_7 ParentSES + \beta_8 MaternalGPSES + \varepsilon$$

where the interaction examines whether cousin group size effects vary within different levels of sibling group size.

In further analyses, we examine the interaction between the cousin group measures and measures of parental and grandparental education to evaluate whether family educational background moderates the strength of the association between cousin group characteristics and GPA.

Instrumental Variable Analyses

In a final step we try to identify the effect of cousin group size on GPA rank by using a twin birth to an aunt or uncle as an instrument for estimating the impact of cousin group size on GPA. There is an empirical tradition in the social sciences of using twin births as a way of estimating how sibling group size affects a variety of subsequent outcomes (e.g. Rosenzweig and Wolpin, 1980; Black et al., 2005). The logic underlying this study design is that a twin birth is an exogenous shock to family size, and this plausibly random event can be exploited to identify the causal effect of sibling group size on the outcome of interest. We extend this approach to the extended family, via a twin birth to an aunt or uncle, to attempt to estimate the causal effect of cousin group size.

The first birth resulting from in-vitro fertilization (IVF) in Sweden took place in 1982 (Swedish National Board of Health and Welfare, 2006). Given that IVF use is influenced by socioeconomic status (e.g. see Räisänen et al. 2013), which could bias our estimates, we restrict our sample for these analyses to those born before the introduction of IVF to Sweden, i.e. those born 1972-1981. As such, during this period, any twin births may be considered more or less random. Individuals who are themselves born of a multiple birth, such as twins or triplets, are not included in the analysis, and nor are individuals who experienced a multiple birth within their own sibling group, as this would violate the exclusion restriction. We focus upon cousin groups that experienced only one twin birth in order to create a uniform exposure, otherwise some individuals are exposed to multiple plural births.

Our approach is similar to that outlined by Black et al. (2005). We consider an individual to be exposed to an exogenous increase in cousin group size if the twin birth to an aunt or uncle occurred after the index person's birth, but before they reach age 16 – the age at which our outcome variable, GPA, is measured. In turn, this implies that they would be exposed to a larger cousin group size than would otherwise have been expected, as well as the potential consequences, such as further resource dilution amongst cousins. We estimate these models using a two-stage least squares (2SLS) approach (Angrist and Pischke, 2008, Chapter 4):

$$(14)\ COUSIN\_GROUP\_SIZE = \alpha_0 + \alpha_1 AU\_TWIN + \alpha_2 X + \vartheta$$

$$(15)\ GPA = \beta_0 + \beta_1 COUSIN\_GROUP\_SIZE + \beta_2 X + \varepsilon$$

where *COUSIN_GROUP_SIZE* is the final cousin group size of the index person, minus the size of their own sibling group, *AU_TWIN* is a binary indicator for a twin birth to an aunt or uncle occurring after the birth of the index person, *X* is a vector of control variables that includes birth year, sex, maternal age at birth, and sibling group size, and *GPA* is the percentile rank in grade point average of the index person in their school cohort. Equation 13 is the first-stage estimation, and equation 14 the second-stage. We estimate these 2SLS models separately for the maternal and paternal cousin groups.

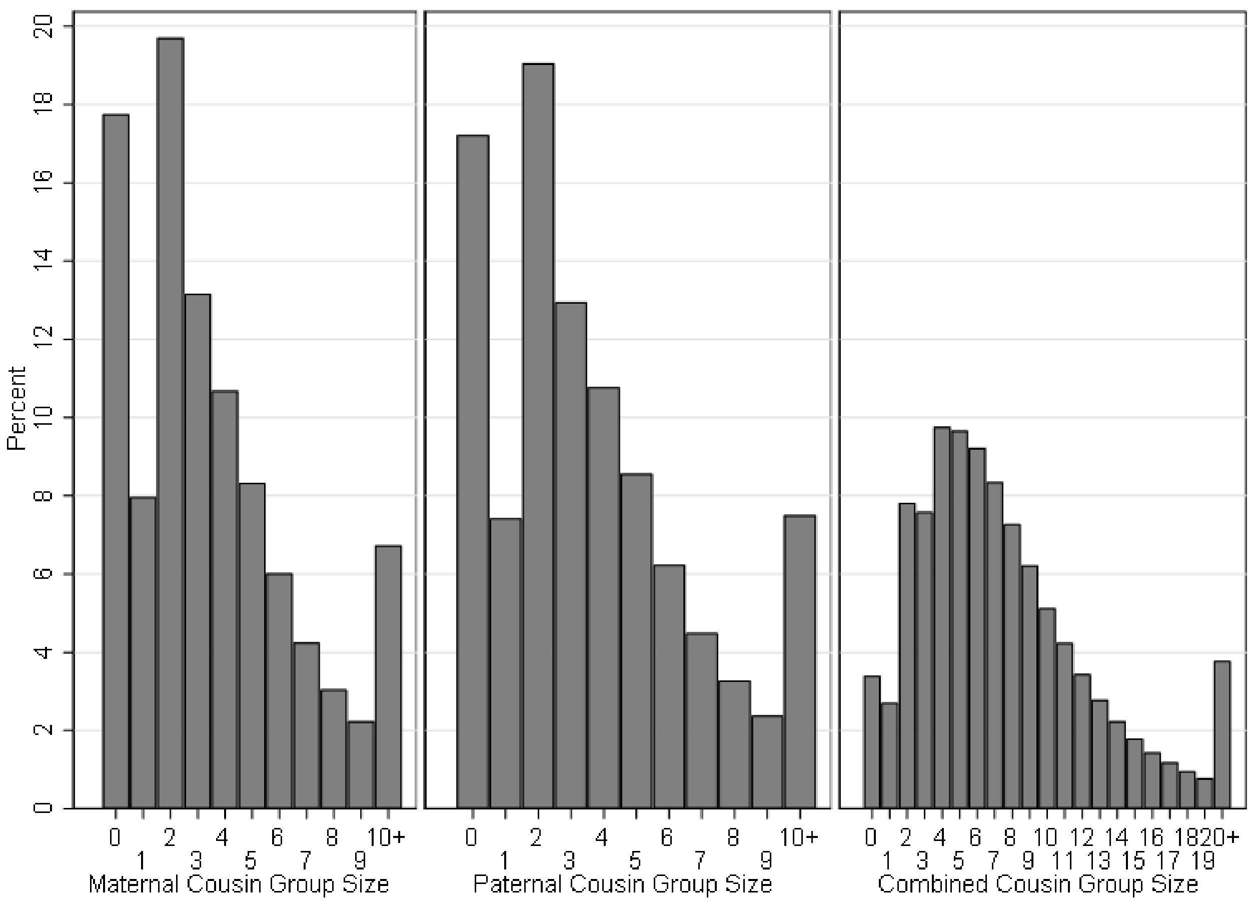

Figure 1. Maternal and paternal cousin group size, and combined cousin group size, after subtracting sibling group size, men and women born in Sweden 1972-2003.

RESULTS

Descriptives

Descriptive statistics for the sample by cousin order and cousin group size can be seen in Table 1. The mean GPA percentile rank is 52, reflecting that it was normed over the population, including some individuals that were eventually excluded from the analysis. Table 1 shows that there is an overall decrease in the unconditional mean GPA percentile rank by maternal and paternal cousin order, where first-born cousins have the best average performance and tenth- or later-born cousins have the worst average performance. First-born maternal cousins are, on average, ranked around the 55^{th} percentile in their graduating class, while third-born cousins, sixth-born cousins, and tenth- or later-born cousin are at positions 53.5, 52.4, and 48.3 in the distribution. The trend is rather similar for paternal cousins, with first-, third-, sixth, and tenth- or later-borns averaging positions 54.7, 54.2, 52.7, and 48.0 in the distribution. The patterns for cousin group size are a little different, but also show that individuals from larger cousin groups tend to place worse in the GPA rank distribution. However, for cousin group size there is a clear pattern where those with one cousin rank lower in the GPA distribution than those with either zero or two to six cousins. For example, those who have zero maternal cousins rank, on average, at the 56^{th} percentile in the GPA distribution, while those with one cousin are at percentile 51.5 in the distribution, and those with two cousins are at percentile 56.0. Given that these are unconditional means, these patterns also reflect selection processes, and are particularly likely to be influenced by the strong two-child norm that characterizes Swedish fertility. Figure 1 shows the distribution of maternal and paternal cousin group size after subtracting the size of the index person's sibling group. Further detailed descriptive statistics can be found in Supplementary Tables S1 and S2.

Table 1. Descriptive statistics by maternal and paternal cousin order and cousin group size, men and women born in Sweden 1972-2003.

		Cousin Group Size			Cousin Order		
Lineage	Size/ Order	N	%	Mean GPA Rank	N	%	Mean GPA Rank
Maternal	0	412,960	17.8	55.6			
	1	185,256	8.0	51.5	586,209	25.2	55.2
	2	459,773	19.8	56.0	531,769	22.9	53.3
	3	306,777	13.2	54.1	365,518	15.7	53.5
	4	249,071	10.7	53.3	267,908	11.5	53.5
	5	194,149	8.4	52.9	181,691	7.8	52.9
	6	140,172	6.0	52.1	121,823	5.2	52.4
	7	98,844	4.3	51.0	82,221	3.5	51.7
	8	71,130	3.1	49.9	55,424	2.4	51.0
	9	52,116	2.2	49.4	38,108	1.6	50.4
	10+	156,061	6.7	47.2	95,638	4.1	48.3
	All	2,326,309	100.0	53.4	2,326,309	100.0	53.4
Paternal	0	400,545	17.2	54.95			
	1	172,704	7.4	52.32	504,200	21.7	54.7
	2	444,731	19.1	55.87	463,822	19.9	53.7
	3	301,731	13.0	54.34	366,774	15.8	54.2
	4	251,202	10.8	53.53	291,232	12.5	54.0
	5	199,391	8.6	53.37	207,708	8.9	53.3
	6	145,322	6.3	52.44	144,631	6.2	52.7
	7	104,737	4.5	51.31	100,578	4.3	52.0
	8	76,551	3.3	50.55	70,276	3.0	51.1
	9	55,482	2.4	49.77	48,566	2.1	50.4
	10+	173,913	7.5	47.11	128,522	5.5	48.0
	All	2,326,309	100.0	53.39	2,326,309	100.0	53.4

Cousin Order

The results from Models 1 to 6 can be seen in Figure 2. Full tables of results can be found in Supplementary Tables S3 to S8. The results from Model 1, a sibling comparison model that examines cousin order regardless of whether the cousins are maternal or paternal, shows a negative relationship between cousin order and GPA. Relative to first-born cousins, second-born cousins have a GPA percentile rank that is 0.28 lower, while fifth-born cousins have a GPA rank 0.81 lower, and 10th or later-born cousins have a GPA rank 1.29 lower than first-born cousins. The results from Model 2, again a sibling comparison model, also show that cousin order is associated with GPA percentile rank amongst siblings' net of birth order and all factors shared by siblings. First-born cousins have a higher GPA rank than later-born cousins, net of birth order. The cousin order pattern in Model 2 is much clearer and stronger amongst maternal cousins than paternal cousins. Relative to first-born cousins, second-born maternal cousins are ranked 0.60 places lower, fifth-born cousins are ranked 1.09 places lower, and tenth or later born cousins are ranked on average 1.47 places lower.

The results from Models 3 and 4 are based upon cousin fixed effect models. The estimates for maternal cousin order from Model 3 are larger than those estimated in Model 2. In Model 3, relative to first-born cousins, second-born maternal cousins are ranked 1.04 places lower, fifth-born cousins are ranked 2.17 places lower, and tenth or later born cousins are ranked on average 4.97 places lower. The results from Model 4 show that, amongst paternal cousins, the differences for second-, fifth-, and tenth or later-born cousins relative to the first-born cousin are ranks 0.02, 0.46, and 1.86 lower, respectively. The results from Models 5 and 6 are based upon cousin fixed effect models estimated upon the population of children without siblings, i.e. only-children, but with cousins. The results from Model 5 show a clear relationship between maternal cousin order and GPA rank, similar to that seen in Model 3. By contrast, the patterns for paternal cousin order are less clear: in Model 6, the differences by paternal cousin order are not statistically significant, and do not evince any clear pattern. Overall, these results indicate that maternal cousin order may influence GPA rank to a greater extent that paternal cousin order does.

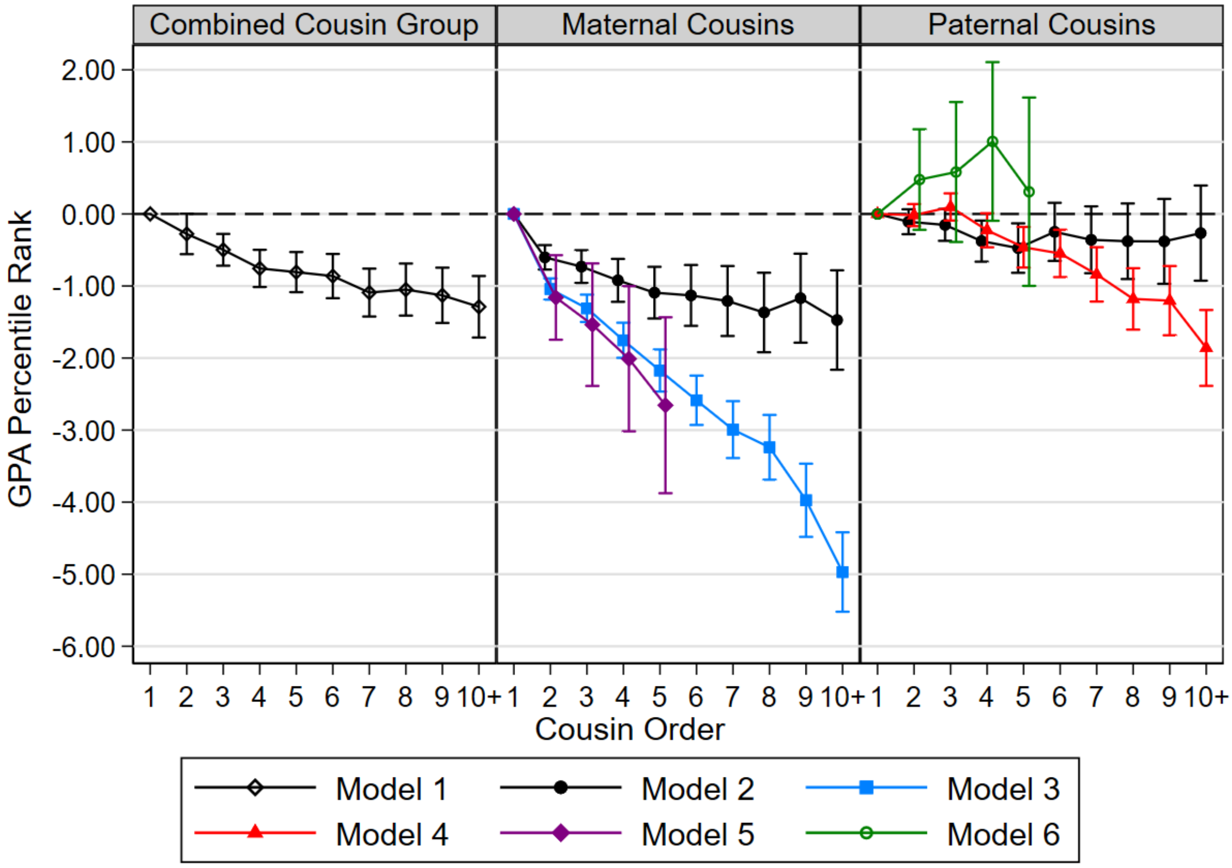

Figure 2. Estimates for the relationship between cousin order and grade point average (GPA) rank at age 16 amongst Swedish men and women, born 1972-2003. Based upon estimates from Models 1 to 6.

In further analyses we use cousin fixed effect models to examine the interaction between birth order in the sibling group of origin and cousin order in the wider cousin group. Figure 3 illustrates these interactions for both maternal and paternal cousins. Figure 3 clearly shows that the influence of sibling birth order for GPA percentile rank is far greater than the influence of cousin order. Nevertheless, cousin order seems to exert an influence on GPA beyond birth order, and particularly for those individuals who are first-born within their own sibling group. For example, first-borns who are not only the first in their sibling group but also in the larger maternal cousin group rank higher in the GPA distribution than later-born cousins who are first-born in their own sibling group, with first-borns who are the second amongst cousins ranked 0.49 places lower, and first-borns who are the fifth or later amongst cousins ranked 1.68 places lower. However, these patterns are more ambiguous amongst paternal cousins, and in fact second-, third-, and fourth-born cousins who are first-born siblings rank higher than the first-born cousin in the group. Full tables of results can be found in Supplementary Tables S9 and S10.

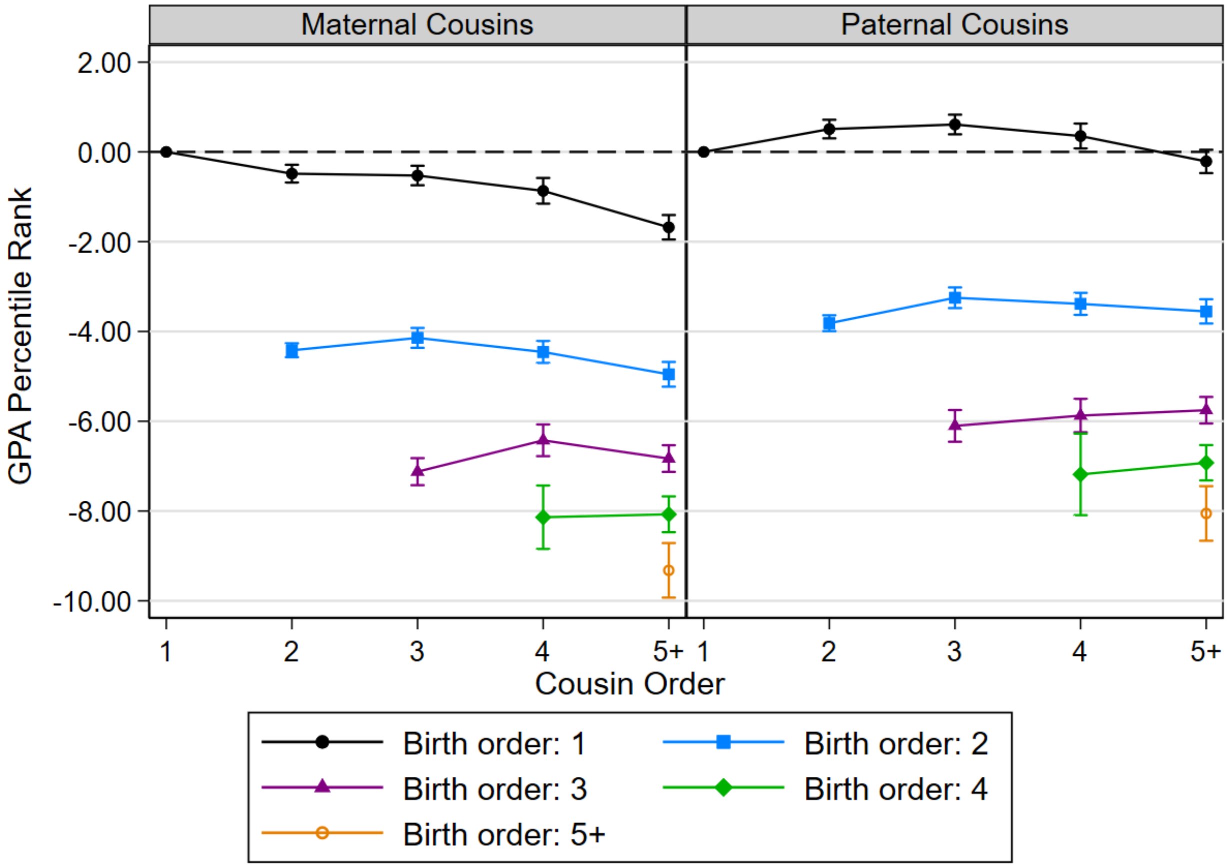

Figure 3. Estimates for the relationship between maternal and paternal cousin group size, birth order, and grade point average (GPA) rank at age 16 amongst Swedish men and women, born 1972-2003. Based upon estimates from Models 7 and 8.

Cousin Group Size

In further analyses we examine the relationship between cousin group size and GPA percentile rank. Figure 4 shows estimates from Models 9, 10, and 11, for maternal cousin group size, paternal cousin group size, and a combination of the two. Full tables of results can be found in Supplementary Tables S11 to S13. Consistent with the results from our analyses of cousin order, the results from our cousin fixed effects analyses shown in the left-panel suggest that the maternal cousin group has a greater impact than the paternal cousin group. The results for both maternal and paternal cousin group size indicate that those without any cousins, or with two cousins, seem to do best in terms of GPA. The results shown in the right-panel, which combine maternal and paternal cousin group size, also suggest that those without any cousins, and to a lesser extent also those with two cousins, have higher GPA scores, while those with many cousins seem to have particularly worse GPA scores.

Amongst those with any cousins, there is an indication that children with two maternal or paternal cousins rank better on GPA scores in their graduating class than those with either one cousin or more than two. One interpretation of these results is that there is some kind of ideal cousin group size, but an alternative explanation is that our cousin fixed effects models with detailed controls for parental and grandparental socioeconomic status fail to adequately control for the endogeneity of family size; those with two cousins may be most likely to be born to parents who come from a two-child sibling group. There is a very strong two-child norm in Sweden, and deviations from this norm can sometimes reflect different types of negative selection, for example socioeconomic or health related, into childlessness or relatively high fertility. To try and address this point further we will also estimate models that use twin birth to an aunt or uncle as an instrument for cousin group size. However, we first examine the interaction between sibling group size and cousin group size, with these results shown in Figure 5.

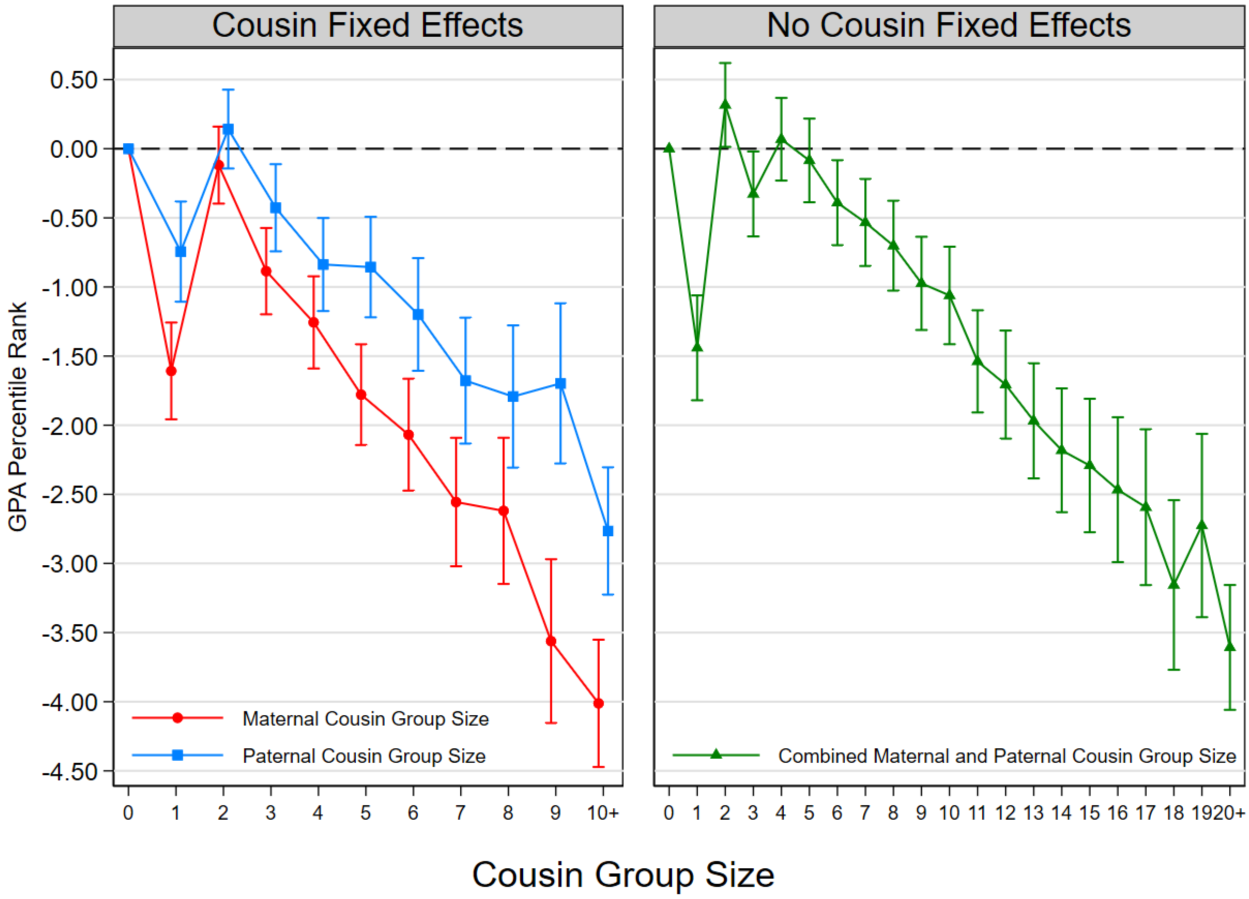

Figure 4. Estimates for the relationship between cousin group size and grade point average (GPA) rank at age 16 amongst Swedish men and women, born 1972-2003. Based upon estimates from Models 9-11.

The results in Figure 5 show estimates for GPA rank regressed on the interaction between sibling group size and cousin group size, where the panels in Figure 5 refer to sibling group size, and the x-axis shows cousin group size. Please note that Figure 5 is based on two regression models, one for maternal cousins, and one for paternal cousins; the panels separating the results by sibling group size are only there to facilitate visualization of the results, and the common reference point in both models is children with zero cousins in a two-child sibling group. Figure 5 shows that children from one-child sibling groups tend to have worse GPA scores, and that only children who have any cousins also do worse than only children without any cousins. Amongst those in two-child sibling groups, those with zero or two cousins do better than those with either one, or three or more cousins. However, in larger sibling groups, with three or more children, there is little in the way of a clear pattern of advantage or disadvantage by sibling group size and cousin group size. Full tables of results can be found in Supplementary Tables S14 and S15. We have also examined an interaction where we use ten categories for both sibling group size and cousin group size, but these models only return noisy estimates with no clear discernable pattern in sibling groups with more than two children.

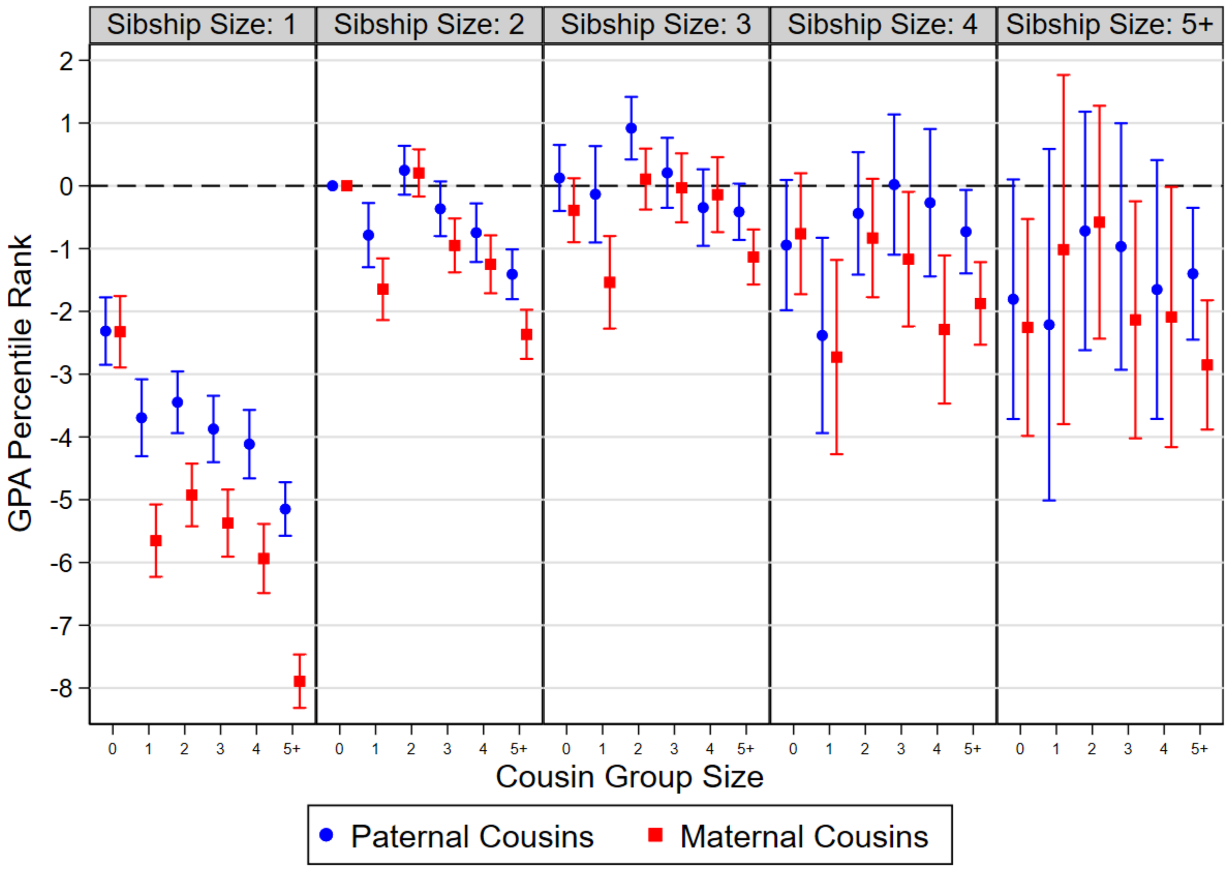

Figure 5. Estimates for the relationship between sibling group size, cousin group size, and grade point average (GPA) rank at age 16 amongst Swedish men and women, born 1972-2003. Based upon estimates from Models 12 and 13.

Educational Level of Grandparents and Parents

To examine whether the educational level of grandparents or parents moderate the association between GPA rank and cousin group characteristics, we have also conducted analyses stratified by the educational level of the parents, maternal grandparents, and paternal grandparents. However, we found little evidence to suggest that the patterns differed by the education level of the parents or grandparents. These results can be seen in Table 2. There were some indications that the negative effects of larger cousin group size were stronger in families with lesser educated parents and grand-parents, but no evidence that cousin order effects varied by parental or grandparental education levels.

Table 2. Estimates for cousin order and cousin group size by grandparental and parental educational level.

			Educational level							
			Low				High			
Family relationship	Model	Variable	b	se	95% CI	N	b	se	95% CI	N
Maternal grandparents	1	Combined cousin order	-0.14	0.02	-0.19, -0.09	1,176,781	-0.11	0.06	-0.22, 0.01	237,816
	2	Maternal cousin order	-0.10	0.04	-0.18, -0.02	1,176,781	-0.08	0.10	-0.27, 0.11	237,816
	2	Paternal cousin order	-0.07	0.04	-0.14, 0.01	1,176,781	-0.07	0.09	-0.25, 0.12	237,816
	3	Maternal cousin order	-0.45	0.03	-0.51, -0.39	1,182,171	-0.48	0.08	-0.63, -0.33	243,007
	4	Paternal cousin order	-0.18	0.03	-0.24, -0.12	1,265,177	-0.23	0.08	-0.40, -0.07	260,663
	5	Maternal cousin order	-0.55	0.16	-0.87, -0.23	178,181	-0.62	0.51	-1.62, 0.39	27,580
	6	Paternal cousin order	0.09	0.19	-0.27, 0.45	186,858	0.04	1.09	-2.11, 2.18	30,159
	9	Combined cousin group size	-0.21	0.01	-0.23, -0.20	1,309,843	0.02	0.02	-0.02, 0.06	273,834
	10	Paternal cousin group size	-0.28	0.02	-0.32, -0.24	1,182,171	-0.07	0.06	-0.18, 0.04	243,007
	11	Maternal cousin group size	-0.41	0.02	-0.45, -0.37	1,265,177	-0.03	0.09	-0.21, 0.14	260,663
	14	Maternal cousin group size IV estimate	-0.33	0.11	-0.54, -0.12	393,461	-0.50	0.42	-1.32, 0.32	35,032
	14	Paternal cousin group size IV estimate	0.00	0.10	-0.20, 0.20	392,805	-0.63	0.42	-1.46, 0.21	34,453
Paternal grandparents	1	Combined cousin order	-0.10	0.03	-0.15, -0.05	1,148,099	-0.17	0.06	-0.29, -0.04	217,156
	2	Maternal cousin order	-0.09	0.04	-0.17, -0.01	1,148,099	-0.21	0.10	-0.41, -0.01	217,156
	2	Paternal cousin order	-0.05	0.04	-0.13, 0.03	1,148,099	-0.11	0.10	-0.30, 0.09	217,156
	3	Maternal cousin order	-0.43	0.03	-0.50, -0.37	1,226,946	-0.46	0.09	-0.63, -0.28	234,805
	4	Paternal cousin order	-0.20	0.03	-0.26, -0.14	1,182,245	-0.29	0.08	-0.44, -0.14	227,987
	5	Maternal cousin order	-0.52	0.17	-0.86, -0.19	185,052	-0.13	1.13	-2.35, 2.08	28,098
	6	Paternal cousin order	0.01	0.18	-0.33, 0.36	172,008	0.61	0.56	-0.50, 1.71	25,997
	9	Combined cousin group size	-0.21	0.01	-0.23, -0.20	1,298,529	0.02	0.02	-0.02, 0.06	253,264
	10	Paternal cousin group size	-0.26	0.02	-0.31, -0.22	1,226,946	0.04	0.09	-0.15, 0.23	234,805
	11	Maternal cousin group size	-0.39	0.02	-0.43, -0.35	1,182,245	-0.26	0.06	-0.38, -0.15	227,987
	14	Maternal cousin group size IV estimate	-0.30	0.11	-0.52, -0.09	365,485	-0.25	0.44	-1.11, 0.61	29,117
	14	Paternal cousin group size IV estimate	-0.17	0.11	-0.38, 0.03	367,664	0.07	0.43	-0.78, 0.92	30,410
Parents	1	Combined cousin order	-0.13	0.03	-0.18, -0.07	939,011	-0.10	0.03	-0.16, -0.03	645,251
	2	Maternal cousin order	-0.07	0.05	-0.16, 0.02	939,011	-0.14	0.06	-0.25, -0.03	645,251
	2	Paternal cousin order	-0.11	0.04	-0.20, -0.02	939,011	0.05	0.05	-0.05, 0.16	645,251
	3	Maternal cousin order	-0.39	0.04	-0.46, -0.31	899,991	-0.46	0.05	-0.55, -0.37	655,651
	4	Paternal cousin order	-0.19	0.04	-0.26, -0.12	918,205	-0.17	0.05	-0.26, -0.08	673,886
	5	Maternal cousin order	-0.66	0.18	-1.00, -0.31	155,329	-0.77	0.37	-1.50, -0.03	72,419
	6	Paternal cousin order	0.04	0.20	-0.35, 0.42	153,393	0.43	0.45	-0.44, 1.31	73,831
	9	Combined cousin group size	-0.25	0.01	-0.27, -0.23	939,649	-0.02	0.01	-0.04, 0.01	707,590
	10	Paternal cousin group size	-0.26	0.03	-0.31, -0.21	899,991	-0.15	0.04	-0.23, -0.08	655,651
	11	Maternal cousin group size	-0.42	0.03	-0.47, -0.36	918,205	-0.14	0.04	-0.22, -0.06	673,886
	14	Maternal cousin group size IV estimate	-0.33	0.10	-0.53, -0.13	341,609	-0.21	0.17	-0.54, 0.11	189,724
	14	Paternal cousin group size IV estimate	-0.13	0.10	-0.33, 0.06	340,761	0.04	0.15	-0.26, 0.33	190,287

Table 3. Effect of cousin group size on GPA rank of children using twin birth in cousin group to an aunt or uncle after the index person's birth as an instrument, cohorts born 1972-1981.

Cousin Group		β	S.E.	95% CI	N
Maternal	First-stage	3.17	0.08	3.00, 3.33	532,701
	Second-stage	-0.27	0.09	-0.46, -0.09	532,701
Paternal	First-stage	3.35	0.10	3.14, 3.55	532,413
	Second-stage	-0.06	0.09	-0.24, 0.12	532,413

Twin Births in Maternal and Paternal Cousin Groups

Finally, we examine whether an arguably exogenous shock to cousin group size, a twin birth to an aunt or uncle, has any impact on GPA scores. We run models where we only use twin births that happened after the birth of the index person. We run these models separately by maternal and paternal cousin groups. The results from these models are shown in Table 3. The first-stage estimates consistently show that a twin birth to an aunt or uncle increases the size of the cousin group by over three children. The 2SLS estimates of the effect of changes to cousin group size induced by a twin birth to an aunt or uncle indicate that an increase in maternal cousin group size has a statistically significant negative effect on GPA rank, lowering GPA rank by 0.27. However, an increase in paternal cousin group size does not have a significant effect on GPA rank. Overall the estimates from these instrumental variable analyses corroborate the results shown in Figure 4 that suggests that larger cousin group size decreases GPA rank, and are also consistent with the previous results that indicate that maternal cousin group characteristics are more consequential than paternal cousin group characteristics.

Robustness Checks

Given that the testing regime, related to GPA measurement, changed over the cohorts that we study, we re-estimated models 1-13 on separately for cohorts born 1972-1981, and 1982-2003. We find the pattern of results to be very similar regardless of the testing regime. The results from these analyses can be seen in Supplementary Figures S1 to S8. We have also estimated Models 1-15 separately by sex, to investigate whether the patterns differ for men and women. We find that the results are very similar for men and women. The results from these supplementary analyses are plotted in Supplementary Figures S9-S16 and Supplementary Tables S16 and S17.

One potential concern with our analysis is the possibility of a high degree of correlation between birth order and cousin order. Although the results from Models 5, 6, 7, and 8 avoid such concerns by examining cousin order amongst 'only children', and by fully interacting cousin order and birth order, we have also conducted additional robustness checks. In these additional analyses, we define cousin order as being 'shared' by siblings if no cousins were born during the interval between the birth of the two (or more) siblings. For example, if three siblings were born first, second, and third in their cousin group, and then a maternal cousin was born fourth, the three siblings will share the mean of their cousin order, in this case cousin order 2. The results from these additional analyses are consistent with our estimation of a negative effect of cousin order on GPA, and can be seen in Supplementary Table S18.

DISCUSSION

The results of this study suggest that ordinal position within the broader cousin group, and cousin group size, are both associated with GPA at the end of compulsory school in Sweden, which is an important predictor of later educational and socioeconomic achievement (Erikson and Jonsson 1998; Hällsten 2010; Cyrenne and Chan 2012; French et al., 2015). Net of all shared factors in the sibling group, or cousin group, we find that first-borns cousins have the best outcomes in terms of GPA rank, and tenth-or later born cousins have the worst outcomes. Our results indicate a monotonic decrease in mean GPA percentile rank by cousin order. Overall, we also find that larger cousin group size is associated with a lower GPA rank as well, with the potential exception of those with two cousins. Our estimates based upon a twin birth to a maternal aunt or uncle corroborate the negative association that we estimated in our cousin fixed effects models. We observe clear differences in the patterns of results by whether we examine cousin order and cousin group size in the maternal line or paternal line. In general, we observe stronger cousin order and cousin group size patterns amongst maternal cousins than we do amongst paternal cousins. Maternal grandparent ties are typically stronger than paternal grandparent ties due to the normative role of women as kin-keepers (Eisenberg, 1988; Rossi and Rossi, 1990; Chan and Elder, 2000; Kalmijn et al., 2019), and stronger ties to maternal siblings, and particularly maternal aunts, may be more likely as well.

There has been a robust scholarly debate as to whether there are family effects on SES-related outcomes that do not work directly through parents. The extant literature is mixed as to whether non-dynastic influences, e.g. the contributions of aunts and uncles, are consequential. However, most of this work has focused upon examining associations between measured characteristics of grandparents and grand-offspring net of parents' values on these variables. Other recent work uses a variance decomposition method to assess the unmeasured similarity of cousins' net of sibling correlations, while correcting for measurement error. The approach presented herein is distinct and focuses on family composition rather than achieved status variables to assess the salience of extended kin family dynamics on attainment. Cousin order is random within the group (i.e. deploying cousin-fixed-effects), and we use instrumental variable regression (using twin births to an aunt or uncle as an IV) to assess the causal impact of cousinship size. Our results provide robust support for the hypothesis that the kin network beyond the nuclear family does influence educational achievement and attainment processes, as the concepts cousin order and cousin group size only have salience in the context of the extended family. If such subtle effects as cousin order do indeed matter for educational achievement, then it is not a great leap to hypothesize that other dimensions of the extended family matter as well. This study, then, should provide much grist for future research in other contexts and along other dimensions by which extended kin may influence status attainment and demographic processes.

The magnitude of the differences in test scores by cousin order and cousin group size may be put into perspective using a comparison to previous work examining GPA rank. Hällsten and Pfeffer (2017) examined how parental and grandparental wealth affected GPA ranking in Sweden, and found in cousin fixed effects models that, when comparing individuals whose grandparents were at the 90th and 10th percentiles of the wealth distribution, grandchildren were predicted to be ranked at the 55th and 45th GPA percentile, respectively. When comparing individuals whose *parents* were at the 90th and 10th percentiles of the wealth distribution, grandchildren were predicted to be ranked at the 55th and 47th GPA percentile, respectively (Hällsten and Pfeffer, 2017). The strength of the association between cousin group characteristics and GPA rank vary by estimation strategy, but in cousin fixed effects models we find that, relative to first-born cousins, second-born maternal cousins are ranked 1.04 places lower, fifth-born cousins are ranked 2.17 places lower, and tenth or later born cousins are ranked on average 4.97 places lower. Our sibling comparison models also estimate the mean gender difference in GPA rank to be approximately 12 percentile points. We might therefore suggest that, for instance, the effect of being a fifth-born cousin is approximately 20% of the difference of having parents/grandparents in the 10th vs 90th wealth percentile, and approximately 17% of the gender difference in GPA rankings. More importantly, these results indicate that extended kin influence the outcomes of grandchildren, nieces, and nephews, as cousin order and cousin group size only have salience beyond the nuclear family environment.

The results of this study may also have relevance in related fields of research. For one, the correlation between cousin order and cousin group size with birth order and sibling group size implies that studies examining the effects of birth order and sibling group size on status attainment may be partially capturing the effects of the extended family. For instance, in models not presented here, we find that the estimated effects of birth order on GPA are weaker when adjusting for cousin order, as part of what is driving the birth order effect may be the fact that first-borns within a sibling group are amongst the early-born cousins, and therefore likely to receive a greater degree of attention from grandparents, aunts, and uncles than later-born siblings and cousins. Likewise, research examining how grandparents, aunts, and uncles affect status attainment examining vertical transmission, or horizontal transmission, should consider that there may be greater variance in educational and socioeconomic outcomes amongst grandchildren from larger cousin groups.

A potentially interesting extension to this research would be to examine whether the patterns that we observe by cousin order and cousin group size would vary by the residential proximity or survival status of grandparents, aunts, and uncles. If extended kin provide additional care, or invest time and attention in their grandchildren, nieces, or nephews, then this may moderate the relationship between cousin order and cousin group size. Nevertheless, estimating the potential moderating role of extended kin by survival status and geographical proximity is theoretically and empirically challenging. For instance, the geographical proximity of grandparents could either increase or decrease the negative effect of cousin order on later school outcomes depending on whether the grandparents live closer to the first-born grandchildren, or the later-born grandchildren. Furthermore, despite the many strengths of population register data, we have no direct measures of kin interaction; the survival status of grandparents, or the residential proximity of extended kin cannot inform us about the degree of contact, and nor does living slightly further away mean that there is no meaningful contact with extended kin. Recent research has also highlighted the fact that residential proximity and survival status of extended kin can be collider variables in multigenerational research (Breen, 2018).

Modernization theory posits the waning importance of extended kin as economic development proceeds, household size declines and co-residence with non-nuclear family members decreases in frequency. In light of this, one might expect the impact of non-first-degree relatives on status attainment processes or human capital acquisition to be minimal in post-industrial, Western societies. This expectation of null effects of extended kin on children's outcomes might be particularly strong for a society such as Sweden over the past half century given the outsized role that the state plays in meeting the basic needs of its citizenry (and children in particular), thereby reducing the need for grandparents, aunts, and uncles to play critical roles in a focal child's care and development. On the contrary, however, we observe that cousin order and cousin group size are indeed associated with educational performance in high school even in contemporary Sweden. Although multigenerational households are rare in Sweden, the high contemporary degree of lifespan overlap between grandparents and grandchildren means that grandparents currently have an unusually widespread opportunity to spend time with their grandchildren, and this might contribute towards our finding that cousin order and cousin group size are associated with educational performance. We find it plausible that cousin order and cousin group size may be at least as likely to influence educational outcomes in countries that provide less institutional support for families than Sweden, and in countries where multigenerational households are more common, and multigenerational contact patterns even greater.

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