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Birth order and college major in Sweden

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BIRTH ORDER AND COLLEGE MAJOR IN SWEDEN

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ABSTRACT

Previous research on birth order has consistently shown that later-borns have lower educational attainment than first-borns, however it is not known whether there are birth order patterns in college major. Given empirical evidence that parents disproportionately invest in first born children, there are likely to be birth order patterns attributable to differences in both opportunities and preferences, related to ability, human capital specialization through parent-child transfers of knowledge, and personality. Birth order patterns in college major specialization may shed light on these explanatory mechanisms, and may also account for long-term birth order differences in educational and labour market outcomes. Furthermore, given that within-family differences in resource access are small compared to between-family differences, the explanatory potential of these mechanisms has the potential to say much more about inequality production mechanisms in society at large. Using Swedish population register data and sibling fixed effects we find large birth order differences in university applications. First-borns are more likely to apply to, and graduate from, medicine and engineering programs at university, while later-borns are more likely to study journalism and business programs, and to attend art school. We also find that these birth order patterns are stronger in high SES families. These results indicate that early life experiences and parental investment shapes sibling differences in ability, preferences, and ambitions even within the shared environment of the family.

INTRODUCTION

Life begins in the family. Parental socioeconomic background and investment, as well as genetic inheritance, plays an enormous role in shaping opportunity structures, and therefore the educational and socioeconomic trajectories that they will follow in life. Siblings share fifty percent of one another's genes, and they also typically live in the same home and grow up in the same neighbourhood. Despite these similar endowments, there is a great deal of variance in sibling outcomes (Björklund and Jäntti 2012). Part of this sibling divergence is attributable to different experiences within the family. While parents report that they treat their children very similarly, sibling reports, corroborated by independent observers, suggest that there are substantial differences (Reiss et al. 2009). One consistent marker of sibling differences within the family is birth order. Studies have shown that later-born siblings perform worse than first-borns, and these differences are attributable to the social environment within the family rather than any biological differences between siblings (Kristensen and Bjerkedal 2007; Barclay 2015a). Parental investment may be one of these social environment factors. For example, mothers are less likely to seek pre-natal care for later-borns than first-borns, and are also less likely to breastfeed later-borns (Buckles and Kolka 2014). In Sweden, parents take more parental leave for first-born children than later-borns (Sundström and Duvander 1999), and parents in the United States with two children have been found to spend up to 30 minutes more quality time per day with first-borns than with second-borns of the same age (Price 2008).

This evidence of differential treatment by birth order would suggest that variation in parental investment translates into measurable differences between siblings in the long run. Indeed, studies that have compared siblings within the same family have consistently shown that later-born siblings have a lower grade point average in school, a lower likelihood of making educational transitions, lower completed educational attainment, and a lower IQ (Black, Devereux, and Salvanes 2005; Kantarevic and Mechoulan 2006; Bjerkedal et al. 2007; Härkönen 2014; Barclay 2015a; Barclay 2015b; Rohrer, Egloff and Schmukle 2015). Although birth order explains relatively little cross-sectional inequality between families (Björklund and Jäntti 2012), analyzing the long-term consequences of birth order can help unravel important inequality generating mechanisms. That is the chief motivation of our research. Given that the differences in resources available to siblings within families are dwarfed by the social inequality across families, the mechanisms that produce birth order effects are clearly a critical component of the production of inequality in society at large. The clear and substantial birth order patterns identified by previous research are a consequence of inequitable resource distribution within the family (Hertwig, Davis, and Sulloway 2002). Disadvantage early in the life course has the potential to accumulate over time, leading to clear and measurable differences in socioeconomic and health outcomes later in life (Phillips and Shonkoff 2000). Beyond the family, cumulative advantage processes are a key dimension of the production of inequalities in society as a whole (Merton 1968; DiPrete and Eirich 2006 Willson, Shuey, and Elder 2007), and a wealth of research has shown that it is not only absolute differences in access to resources that matters, but that relative differences are critical even when the absolute level of resource availability is high (Marmot 2004). Using the microcosm of the family to study these inequality generating processes provides an excellent opportunity to isolate the effect of relative advantage net of shared genetics, the shared contextual environment, and, furthermore, to do so from the very beginning of the lifecourse.

Although the negative relationship between birth order and educational attainment has been observed consistently, the long-term advantages attributable to spending longer in the education system are not necessarily clear without a consideration of college major. College major has an important impact on future earnings, with those in the United States choosing natural science and business majors earning greater amounts, even after adjusting for individual ability (Arcidiacono 2004). As will be reviewed in the following sections, past research suggests that college major is likely to vary by birth order, but this has not been tested empirically before. In this study we use a unique data resource to examine the relationship between birth order and college major, as well as college graduation data. With data on both applications and graduation we have information on initial preferences as well as the eventual pathway taken, the latter of which will be influenced by experience and academic performance within the tertiary education system. In addition to examining how the specific subject-major varies by birth order, we also examine whether first-borns are more likely to choose majors with higher expected earnings and higher occupational prestige, and whether later-borns are more likely to choose majors that carry greater risks in terms of future career progression, as measured by variance in expected earnings.

Educational Choices

The average difference in educational attainment between a first and a second-born sibling at age 30 in Sweden is approximately one third of a year, and between a first and a third-born sibling, a little less than half a year (Barclay 2015a). A number of theories have been proposed to explain why later-born children should do worse than their older siblings. Two theories that have attracted particular scientific attention are the resource dilution hypothesis (Blake 1981), and the confluence hypothesis (Zajonc 1976). While both theories state that later-born children should perform less well than their older siblings, the resource dilution hypothesis argues that relative to later-born children in the same family, earlier born children have a cumulative advantage in terms of access to finite parental resources, such as financial resources, but more particularly, quality time. The confluence hypothesis argues that earlier born children outperform their younger siblings because the average degree of intellectual stimulation within the household decreases as more infants enter the household, and that this intellectual stimulation is key for cognitive development. Both the resource dilution hypothesis and the confluence hypothesis predict greater cognitive ability for first-borns. In Western Europe and the United States there is a negative relationship between birth order and cognitive ability (Bjerkedal et al. 2007; Barclay 2015b; Rohrer et al. 2015), and that advantage suggests that earlier born siblings should be more likely to be accepted to, and graduate from, STEM subjects than later-borns. If first-borns are more likely to study subjects at university that lead to advantageous career trajectories, this would serve to increase the divergence in the post-university socioeconomic trajectories that first and later-borns tend to follow.

However, net of cognitive ability, past work also suggests that later-borns are more likely to choose study pathways that are more risky and offer greater opportunities to express creativity. Such pathways may also be characterized by a greater payoff in the event of success. In *Born to Rebel*, Frank Sulloway (1996) argued that competition for parental investment amongst children causes siblings to adapt their behaviour and develop a personality that would allow them to occupy particular niches within the family. Following Adler (1928), Sulloway (1996) argued that first borns and only children are likely to be more conservative due to the period of time when they were the only child within the home and where they were the sole focus of parental care. This, he argued, leads first-borns to identify with power and authority, and to become more conservative and socially dominant than their later-born siblings. Later-born children, finding that they are disadvantaged from the very beginning in terms of size and strength, are naturally more inclined to develop a personality that is questioning of authority. Furthermore, in the scramble for parental investment, later-borns are forced to become more creative, original and follow risks in order to attract that investment. Applied to the question of how a college major is chosen, Sulloway's work suggests that later-born siblings would be more likely to choose creative subjects at university, as well as university majors associated with greater variation in expected earnings.

While academic psychology journals are replete with studies on the relationship between birth order and personality, creativity, and risk-taking, relatively few of these studies have used the methodological gold standard for this avenue of research, which is the within-family sibling comparison. Studies that compare siblings across different families have been criticized on the grounds that the reported correlations are spurious due to confounding by unobserved factors that differ between families (Rodgers 2001a). The few studies on birth order and personality that have used a sibling comparison approach report that first-borns are more conscientious (Paulhus, Trapnell, and Chen 1999; Beer and Horn 2000, Healey and Ellis 2007), and score higher on neuroticism (Cole 2013), while later-borns score higher on extraversion (Dixon et al. 2008), and openness to experience (Healey and Ellis 2007). Other studies using within-family designs have found that first-born siblings have higher educational aspirations than later-borns (Bu 2014). However, it should be noted that the samples used in these studies on birth order and personality are typically both small and non-representative, and some studies using within-family comparisons have found no personality differences by birth order (Rohrer et al. 2015). Furthermore, although the application of Sulloway's ideas to the selection of college major does have some face validity, on greater reflection it is not clear that we should assume that creativity and college major are necessarily closely aligned, as all subjects offer opportunities to innovate in some way.

Studies investigating the relationship between personality and vocational choices show that individuals tend to choose occupations that match their personality, and that they are more satisfied, and achieve more, when they do so (Holland 1996). A positive match is characterized by a correspondence between the skills and temperament of an individual, and the demands of the occupational environment (Holland 1985). This approach has also been extended to the choice of college major, finding that a positive match between personality and college major is linked to greater achievement, and lower dropout rates (Allen and Robbins 2008). Although there is some variation, studies on the relationship between the Big Five personality traits and college major tend to yield relatively consistent results. Those who study natural sciences and applied sciences, such as engineering, score higher on conscientiousness and lower on openness to experience than humanities, arts, and social science majors (Kline and Lapham 1992, Van der Molen, Schmidt, and Kruisman 2007). Social science majors demonstrate higher scores on extraversion than humanities or natural science majors, but lower scores on extraversion than business or arts majors (Corulla and Coghill 1991; Harris 1993; De Fruyt and Mervielde 1996), while medical students also score high on extraversion (Lievens et al. 2002). Although each of these studies were based on a sample of college students who had already decided upon a major, which allows for the possibility that personality is influenced by the experience of studying a certain major, similar results for the relationship between the Big Five traits and preference for college major were found amongst high school students planning to apply to university (Balsamo, Lauriola, and Saggino 2012).

Overall, research on the relationship between birth order and personality, and personality and college major (Balsamo et al. 2012), suggests that first-borns should be more likely than later-borns to study natural and applied sciences, while later-borns should be more likely to study arts, business, and social sciences, and medicine: Studies demonstrating that first-borns have greater cognitive ability than later-born siblings (Bjerkedal et al. 2007; Barclay 2015b) would suggest that first-borns would be more likely to study natural and applied sciences, though this approach would predict that first-borns would be more likely to study medicine than later-borns. Research indicating that first-borns are more ambitious than later-born siblings (Bu 2014), suggests that first-borns might be more likely to pursue college majors that lead to professional careers. Theories predicting that first-borns should be more conservative (Adler 1928; Sulloway 1996) also suggest that first-borns may be more likely to apply to majors that are linked to a stable professional career, such as medicine, or law, and majors associated with lower potential volatility in future earnings. Given Sulloway's (1996) predictions concerning the degree to which first-borns are likely to identify with parents relative to later-borns, we also examine whether first-borns are more likely to choose the same degree and field of study that their parents pursued.

Human Capital and Occupational Specialization

Although most theories concerning how a first-born advantage emerges imply that this advantage transpires unintentionally, parenting strategies may also be consciously, or subconsciously, biased towards the first-born. One reason for this is a cultural legacy of primogeniture, where undivided bequests were given to the first-born son in many societies. While legal primogeniture is obsolete in modern European societies, vestiges of this cultural practice may linger in contemporary parental behavior. Assuming such a parental strategy existed, it would be most rational to invest in the child best endowed in terms of skills and abilities. A recent study using US data shows that high SES parents target investment in the highest achieving child, though this is less true for low SES parents (Grätz and Torche 2015). Given previous literature showing how first-borns tend to be the best-endowed children, a parental investment strategy that focuses on one child will exacerbate the advantages for first-borns. Another motive that has been suggested for primogeniture is that parents may favor the first-born because they have a larger generational overlap with them (Silles 2010). This greater overlap means that parents can help and monitor the career of the first-born, and also have a chance to reap the benefits of that investment before they die.

Parents not only invest time and money into their children, but also transfer specific skills. There is a strong tendency for children to take up the same occupations as their parents, which explains social reproduction (Jonsson et al. 2009). One reason for this is that they may have a comparative advantage in those occupations in terms of occupation specific skills as a result of absorbing information and knowledge from the parents about their occupations as they grow up (Laband and Lentz 1983). Although we know little of birth order effects on such specialization, we could expect a link if the parents favour the first-born. First, the cumulative advantage in academic skills that first-borns may already have makes them a target for investments in such occupation specific skills. Second, generational overlap may make it easier to help the first-born and for them to reap the benefits of such help. Third, if investment in skills is more productive the younger a child is (Heckman 2000), the first-born will have an absolute advantage over his or her siblings since only they were able to get undivided parental attention at the youngest ages.

Contextual Factors: Swedish Educational System

Education in Sweden is state funded at all levels, and tertiary education is free for Swedish citizens (Halldén 2008; Högskoleverket 2012). In Sweden family resources are therefore less important for the transition to tertiary education than in other contexts, such as the United States. The Swedish education system is divided into three sections: (1) 9 years of compulsory schooling (*grundskolan*); (2) three additional years of secondary school (*gymnasium*); and, (3) the tertiary section (Halldén, 2008). Tertiary education in Sweden today consists of two parts. The first is a traditional university education, with degrees at the Bachelors (*kandidatexamen*), Magister (*magisterexamen*), Masters, Licentiate, and Doctoral levels. The second part is a vocational tertiary education (*Högre yrkesutbildning/Högskolor*) (Halldén 2008). Students in tertiary education are eligible for financial support from the

Swedish state for living costs in the form of study grants and student loans with low interest rates (Högskoleverket 2012), minimising the need for reliance on family resources for maintenance. In 2012 approximately 33% of the Swedish population had undergone post-secondary education, which was slightly higher than the OECD average (Högskoleverket 2012).

DATA

In this paper we use Swedish administrative register data to address birth order effects on educational choices. To study the influence of birth order we link children and parents via the multigenerational register (Statistics Sweden, 2010), which holds information on parents for individuals born in 1932 and later. Using information on birth year and month, and parents' identity, we construct birth order. We define a sibling group as a set of individuals that share a biological mother and a father. The multigenerational register also allows us to match other parental characteristics such as mother's age at the time of birth of the individual, as well as the socio-economic characteristics of the parents.

Tertiary Choice Data – Applications and Graduations

For the educational choice, we use a unique data source that contains individuals' applications for university in Sweden, where all admission to university is centralized. With the central 'applicants and admission register', we have complete information on all aspects of the choice, i.e., the *programs* included and their rank within the individual application, and whether the applicant was admitted. A program is a predetermined line of study that will lead to a degree in a specific area, if successful. This is very different from the US system, for example, where BA degrees cover a much broader range of subjects. Not all tertiary studies are organized as programs; one can instead choose to study specific *courses*, which lasts for one semester, and which can be combined into a degree (under some formal rules). Most areas allow both modes of study, but professional degrees (e.g., to become a physician) are limited to program study. While we also have access to course applications in the 'applicants and admission register', it is less clear what degree these individual course studies will eventually lead to. We have thus concentrated on program applications, even though this creates a selection of the more dedicated or focused students. Since we will miss out the least ambitious choices, which is more likely to happen for later-borns according to our expectations, our estimates will therefore tend to be conservative.

For the analyses of programs, we analyze cohorts born between 1982 and 1990, resulting in an effective sample size of 105,381 (see Table A3). The application data exists for the years 2001-2012, which means that every cohort has at least three years where we can observe any application (assuming graduation from upper-secondary school at age 19). Since one can re-apply infinite times, we construct two choice variables: (a) the highest ranked program in the first of the applications we can observe, and (b) the last observed program among those programs the applicant got admitted to. The first is likely to capture more pure (and perhaps less informed) preferences, whereas the second captures both learning because of tertiary studies and adjustment to one's realistic chances, as well as a tighter link to what education the individual is likely to end up pursuing. In this sense, these variables are the endpoints of a continuum of possible ways to measure choice. We then record the program as coded to the nomenclature SUN2000 (The Swedish version of the international ISCED9-97, Statistics Sweden, 2000) and code this to an aggregate classification, as shown in Table A2. This coding first places similar educations in terms of field of study in the same category, but also sorts educations by length, prestige and admission requirements. For example, the scheme separates between short and long teaching programs, which captures differences between, for example, pre-school and upper-secondary school teachers, and short and long engineering programs. Long engineering refers to 'civilingenjör' (Master in engineering), which is 4.5 years of study with a theoretical focus and which is preparatory for research, while short engineering refer to 'högskoleingenjör', (i.e., bachelor of science of engineering), which is 3 years of study and features less mathematics and a more practical focus in the curriculum

Based on the education code in SUN2000, we can also match the program to conditions of graduates in the labor market. We use this to compute expected outcomes, that is, those conditions that the pursuit of the program on average will lead to historically. This is important in order to grasp the consequences of a specific choice in terms of measurable inequality. Here we measure expected mean level of full-time earnings[1], the variance of

[1] Earnings data comes from population level tax records. We truncate the annual earnings to above SEK 120,000 in 2003 prices, i.e., more than 10,000 SEK per month (or some USD 1400 or GBP 833 per year, assuming typical exchange rates of 7 SEK per USD and 12 SEK per GBP) to capture full time earnings. Due to wide ranging collective bargaining with minimum wages, individuals' earnings this low do not have employment for the full year.

expected earnings[2], expected occupational prestige[3] and a measure of the expected level of non-employment[4]. The expected earnings variance and expected level of non-employment are intended to measure educational risk. We base the expected outcomes on the actual labour market performance of individuals' aged 30-32 in the years 2009-2012, and for the earnings measures we control for gender, immigration, birth year and the presence of children in the household.

In order to test parent-child transfer of education specific preferences, we construct measures for whether the educational choice matches with any of parents' field of education (using data from the population wide education register). The SUN2000 separates between level and field, the former contains 3 digits, and the latter 3 digits and also a letter. We construct a measure of matching degree, in which both level and field should match on 3 digits, and two measures of matching fields on 3 and 2 digit levels. We use annual data on parents' education from 1990 to 2012 in order to record any match (this will also capture if parents themselves upgrade their education).

This data is also linked to school registers containing previous school grades, and one control variable will be the grade point average (GPA) from upper-secondary school (transformed to z-scores).

One caveat with the choice data is that applications for some specific high prestige art schools are missing (they do their own admission based on tests rather than grades and are therefore absent from the central administration system). We can however capture art school students in graduation data, and create a graduation dataset for the birth cohorts 1960-1987. This dataset is identical to the application data as outlined above, except that information on GPA is missing.

Generic Coding

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[2] The earnings risk per SUN code is calculated as $R = \sum \left(\frac{X-\bar{X}}{\bar{X}}\right)^2 / n$ following Berkhout, Hartog et al. 2010, Eq 7.). This is similar to the coefficient of variation, i.e., variance relative to average level of earnings. We use full earnings distribution here (in log form with the addition of a small constant to include zeroes) in order to capture variations related to under- and unemployment.

[3] This data is based on the population level occupation register (Statistics Sweden 2004), where occupations are coded to 3-digit ISCO-88(com). We have matched the ISCO codes to the Treiman scale (SIOPS, see Treiman 1977) using keys provided by Ganzeboom (Ganzeboom and Treiman 1996).

[4] Given the fixed wage structure discussed in footnote 1, we compute non-employment as annual earnings below 120,000. This measure captures the proportion of non-employed for each degree.

Because we use family fixed effects, information on parents' characteristics become redundant, even though the data are very rich in such measures. In order to assess effect heterogeneity due to social standing, we code social class origin using the EGP on the basis of censuses (1980, 1985 and 1990; EGP is coded on the basic of occupation codes), and divide individuals into a high and low class (leaving children of farmers and entrepreneurs out of this comparison). For this educational choice data the size of the EGP I class is very big (simply because the service class is over-represented in further education and the data is conditional on an application for university). As a result we separate between EGP I and EGP II, III, VI and VII.

METHODS

For the study of educational choice, one would ideally analyse the aggregated choice scheme with a multinomial logit model. It is however essential for birth order effects to be established within the family (Rodgers 2001b), which the standard multinomial model disallows. We have attempted an estimator which implements fixed effects into the multinomial model, but without success as the likelihood function will not converge.[5] We therefore give priority to the fixed effects, and use a more crude estimator in the form of independent linear probability models (LPM), where each program is coded as a separate 0/1 outcome..

We thus use linear fixed effects models for all outcomes, including both binary and continuous outcomes. We prefer LPM over non-linear models such as the logit specification, because only the former allows direct comparisons of coefficients across models and groups (Mood 2010), and that is a specific aim of our study. Average marginal effects from logit models are comparable, but are then close to identical to unstandardized coefficients from LPM, so little is won (see also Angrist and Pischke 2009:103-107). The LPM is a consistent estimator even for binary outcomes (Angrist and Pischke 2009:47,51), our data is very large, and with heteroskedasticity robust standard errors, the often cited inference problem due to heteroskedastic residuals in the LPM is mitigated. In all models, we use cluster-robust standard errors using the shared sibling group ID as the cluster group. Stock and Watson

[5] The femlogit estimator in stata, see Pforr (2014) and Chamberlain (1980).

(2008) showed that simple heteroskedasticity-robust standard errors are inconsistent in fixed effect models, which is what we use, but that cluster-robust standard errors work with these models, and are also robust for heteroskedasticity (Stock and Watson 2008).

All model specifications include a control for mother's age at birth (one year dummies) and the individuals' birth year (also one year dummies).[6]

RESULTS

College Major

The results for applications to a specific college major can be seen in Table 1, based on within-family sibling comparison models. Table 1 shows the probability of applying to each of the college majors, with, and without, adjusting for high school GPA. As can be seen, later-born siblings are more likely to apply to teacher programs, business programs, and journalism programs. First-borns are more likely than later-borns to apply to the more prestigious long engineering programs, as well as health-related professional programs that provide medical training. For the most part these results are not conditional on ability, though when we adjust for GPA, the birth order differences in applications to teacher programs largely disappear. Interestingly, most of these differences in application probabilities by birth order increase, or decrease, monotonically by birth order, and it is not a simple distinction between first-borns and all other later-born siblings. In general, the estimated coefficients show that the differences by birth order are large and substantial, particularly when considered in light of the baseline probability of applying to these programs (see mean of the outcome in the bottom row of Table 1). For example, second-borns are 2.5 percentage points less likely to apply to medical training programs than first-borns, and fifth-borns are 7.7 percentage point less likely. Given that the baseline probability of applying to medical training programs is 8.1%, this is a 31% difference in relative terms between the first and second-borns, and a 95% difference between first and fifth-borns. The difference between first and third-borns is approximately equivalent to the gender difference in applying to medical programs that is

[6] Although maternal age and year of birth are very high correlated within each family, our results for birth order are consistent either with both variables included in the models, or without the inclusion of one or the other variable.

estimated in Table 1, and equivalent to more than one standard deviation in high school GPA according to the estimate for GPA in the model for applying to medical training programs, which is a very substantial difference. In relative terms second-borns and third-borns are respectively 14% and 25% more likely to apply to business programs than first-borns. Furthermore, in relative terms, second-borns are 23% more likely than first-borns to apply to journalism programs, while third-borns and fourth-borns are respectively 55% and 73% more likely to do so.

*** Table 1 Approximately Here ***

The results in Table 2 are based upon the same sample as the results in Table 1, but focus on the last program that university applicants were admitted to. Approximately 37% of university applicants in our sample got admitted to a program other than their first choice. Here we see that there are some differences in the birth order patterns. After adjusting for GPA, later borns remain significantly more likely to apply for business programs, and significantly less likely to apply for engineering and medical programs, but are now also more likely to apply for social and behavioural science programs. Furthermore, they are no longer more significantly likely to apply to journalism programs, and the strength of the birth order patterns are somewhat attenuated overall. The difference between the patterns for the first application to university, and the final program to which they are admitted are likely to reflect some kind of a learning process within the family between the first and last application, whereby first borns, parents, and later borns revise their expectations in response the first round of university admission decisions.

*** Table 2 Approximately Here ***

The results in Table 3 show the results for first choice applications to specific college majors where we stratify our analyses by the social class of origin of the applicants. We choose to focus on university applications from individuals in the upper and lower ends of the EGP class scheme so as to highlight any social class differences in university applications by birth order. As Table 3 shows, the effects that we described in Table 1 are largely concentrated amongst those from a high EGP background. For individuals from low EGP backgrounds, the only birth order effects that persist are the lower probabilities for later-borns of applying to long engineering and professional health related programs that provide medical training, and the higher probability of applying to business programs. Amongst individuals from high EGP backgrounds, we see that later-borns are more likely to apply to teacher training, journalism, and business programs, and first-borns are more likely to apply to long engineering and professional health related programs. Furthermore, the size of the estimated coefficients for the differences by birth order are similar to those estimated across applicants from all social class backgrounds shown in Table 1.

*** Table 3 Approximately Here ***

Table 4 shows the estimates from models that examine how choice differences are associated with later inequality. In other words, we examine whether there are birth order differences in applying to programs that have, for example, greater expected earnings potential, or are expected to lead to different levels of occupational prestige. As Table 4 shows, the choice differences are associated with later inequality by birth order. Relative to first-borns, the expected earnings of second-borns, based on the college programs that they apply to, are 2.2% lower, and are 2.9% lower for third-borns. After adjusting for high school GPA, measured at age 16, we see that the pattern persists, but the estimated coefficients are slightly smaller: relative to first-borns, the expected earnings of second-borns are 1.6% lower, and are 2.0% lower for third-borns. Table 4 also shows the estimates from models that examine expected earnings risk (*variation)* by birth order. We find neither substantial nor significant birth order effects. Table 3 shows that later-born siblings also choose college majors that are expected to lead to lower occupational prestige than first-borns, and this pattern also persists and is statistically significant after adjusting for high school GPA. To make a comparison between the estimates for birth order and high school GPA on expected occupational prestige, the difference between a first and a second-born is equivalent to 33% of one standard deviation of high school GPA, and the difference between a first and a third-born is equivalent to 47% of one standard deviation. As can be seen in the final 2 columns, later-borns siblings are also more likely than first-borns to apply to college majors that have a higher risk of unemployment.

*** Table 4 Approximately Here ***

Table 5 repeats the analyses presented in Table 4, but stratified by social class. In a similar pattern to the results seen in Table 3, we find that the birth order effects are largely concentrated amongst those from a high EGP social class background, while birth order effects are much weaker amongst siblings from families with a low EGP social class. Amongst siblings from a high socioeconomic status background, first-borns are substantially more likely to apply to college majors that have higher expected earnings. The same applies to siblings from a low SES background, but the percentage difference is almost half the size, and is not statistically significant beyond birth order three. Models examining earnings risk again show no birth order pattern. In terms of occupational prestige, birth order effects are much stronger amongst siblings from high SES families. Amongst siblings from low SES families, there are barely any significant differences in expected occupational prestige by birth order. Finally, we find that there are birth order differences in the expected likelihood of unemployment in terms of the college majors that siblings apply to in high SES families, but not in low SES families.

*** Table 5 Approximately Here ***

Table 6 shows the results from analyses examining birth order effects on human capital specialization. For the first choices made in university applications, it can be seen that later-borns are less likely to follow in their parents' footsteps, but this pattern is very weak and is not statistically significant. The only exceptions are the results where we analyse broader orientations, where the difference between second and first-borns is statistically significant. However, when we study the university program that the applicant was finally admitted to, a more clear and significant pattern emerges for degrees and broad fields of study. This pattern of results suggests that when choices become more constrained and individuals are forced to become more realistic, they tend to fall back on family resources. Many are not admitted to their top choice (Hällsten 2010), and our results suggest that in such circumstances first-borns are more likely than later-borns to make choices that reflect the pathway that the parents took. This change of tack might reflect either differences in academic ability or greater education-specific transfers of knowledge from parents to first-borns.

*** Table 6 Approximately Here ***

Table 7 shows the results from analyses examining whether birth order differences in choosing the same degree of field of study as parents varies by social class background. Our results show that there are no statistically significant differences in the likelihood of choosing the same degree or field of study as the parents by birth order for individuals from either high or low EGP backgrounds when looking at first choice university applications. However, when looking at the last program to which applicants were admitted, we find that there are birth order differences in degree choice amongst siblings from high socioeconomic status backgrounds, but not amongst siblings from low socioeconomic status backgrounds. This pattern of results makes sense given that parents from the lower social classes usually do not have any tertiary educational specialization to pass on. These results underscore the fact that these specialization effects are very contingent on socioeconomic status and social opportunity. From these results we are able to conclude that amongst siblings from those social classes who have specific educational orientations and expertise to pass on, first and earlier born siblings are more likely to draw upon that knowledge and expertise when choices become more constrained by the reality of getting accepted to university.

*** Table 7 Approximately Here ***

We return to the question of art studies in Table 8. Here we examine graduation, either from an art school or with an art degree (also including those issued by universities not specialized in art). With the graduation data, we find evidence of later-borns being slightly more involved in arts. The effect may appear weak, but considering the average rate of of art school degrees of 0.009 (0.9 percent), third-borns are almost twice as likely as first-borns to graduate from an art school. Within the wider definition of art degrees more generally, the gradient is even stronger in relative terms. Hence, while we found no birth order gradient in terms of preferences for art programs in our earlier analyses of university applications, shown in tables 1 to 4, there is such a gradient for graduation from art schools and with art degrees. As with our previous analyses of the choice data, we also find that the birth order gradient is clear amongst siblings from high social class families, but there are no meaningful differences by birth order amongst siblings from low social class families.

*** Table 8 Approximately Here ***

DISCUSSION

Although previous studies have shown that first-borns spend longer in the educational system, no previous research has examined whether there are horizontal differences in educational pathways by birth order. This study has shown that when comparing siblings within the same family, first-borns are more likely to study more prestigious college majors, college majors with greater expected earnings, and college majors associated with greater expected occupational prestige. What’s more, those differences persist net of previous academic performance, as measured by high school GPA. It is important to note that the Swedish education system provides free tertiary education, so it is not that later-borns are unable to pursue medical training due to, for example, the draining of family financial resources available for education. Given the setting that our data is drawn from, we expect that these results could be even more pronounced in a context such as the United States where tuition fees are high. High tuition fees might reduce the opportunities for later borns to attend college more generally, and to pursue expensive graduate degrees, such as medicine, more particularly.

We also found clear differences in the birth order patterns by socioeconomic status, as the effects were substantially stronger amongst siblings from high SES families than amongst siblings from low SES families. This finding is somewhat counterintuitive. One potential explanation for our findings is that parents in the highest SES families, at least in the US, reinforce advantage to a greater extent for high ability children than lower ability children through additional investment and cognitive stimulation (Grätz and Torche 2015). First-borns have exclusive access to parent investment and attention when they are born. This gives them an early headstart, and due to the compound interest that accrues to early advances in language and cognitive development (Stanovich 1986; Sénéchal and LeFevre 2002; Heckman 2006), they are more likely to be seen as having high ability when they are children, which parents will then reinforce further. Empirical research from the United States using time-use data suggests that over the ages 4-13 in two-child families in the United States, a first-born will have approximately 2,230 more hours of quality time with parents than a second-born will (Price 2008). Such variation, estimated as a 40% difference, is likely to be very difficult for a second-born to catch up on. In general, high socioeconomic status parents have been found to spend more quality-time with their children than low socioeconomic status parents (Guryan, Hurst and Kearney 2008). A Matthew effect where gains accrue faster to those who already have much could explain the SES differences in social class attainment and occupational prestige by birth order.

Nevertheless, to the extent that cognitive ability is correlated with high school GPA, we find that this factor does not mediate the relationship between birth order and majoring in engineering, medicine, journalism, or business. Recent research using a within-family comparison design has reported that first-borns have greater educational *aspirations* than later-born siblings (Bu 2014). If first-borns are more ambitious than later-borns, this could contribute to the explanation for why they tend to apply to college majors with greater expected earnings, and college majors that lead to professional careers. This greater ambition could also explain why birth order effects are stronger for first choice applications than they are for the last admitted program, as first borns might overestimate their abilities, or have parents who overestimate their abilities. This higher level of ambition might be a consequence of greater parental investment and support, which might be particularly true in high SES families (Grätz and Torche 2015).

We also found clear social class differences in college major choices by birth order. One explanation for the SES differences in college major applications may be related to the insurance function of private wealth (Pfeffer and Hällsten 2012), where those from more privileged backgrounds feel that they are better able to take risks because they have a private safety net. Individuals raised in low SES families may feel less comfortable about pursuing subjects such as journalism, or art, as a university education for many low SES individuals is a potential ticket for upwards social mobility. This may be why we observe that the birth order differences in pursuing engineering, or medicine, are clear in both high and low SES families, while birth order differences in studying journalism and graduating with art degrees are only clear amongst siblings from high SES families. Alternatively, this variation could be explained by differences in culture by social class of origin. Parents in low SES families may see clear value in pursuing traditional subjects such as engineering or medicine, but might be far more critical of their children if they suggested that they would pursue less traditional university programs, and there is empirical evidence for such sorting in the United States (Goyette and Mullen 2006).

The results from our analyses of the likelihood of studying the same subject as the parents by birth order relate to Sulloway's sibling niche differentiation model as well theories about human capital specialization. We found that first-borns are more likely than later-borns to end up pursuing the same university degree as their parents, and that this was particularly true in high social class families. This pattern of results is inconsistent with Sulloway's assertion that birth order affects the degree of alignment with parents, as his sibling niche differentiation model would suggest that first-borns from families of all social classes would be more likely to follow the parents than later-borns. Instead our results are more consistent with theories concerning human capital specialization, which argue that the degree to which individuals draw upon specialization resources depends on the extent to which those resources are beneficial to them. In high social class families, entering the same microclass as the parents means achieving high occupational prestige, and first-borns are more likely to do that than later-borns. However, in low social class families, entering the same occupational microclass as the parents' means achieving low occupational prestige. In high social class families it makes sense that first-born siblings are more likely than later-borns to draw upon the resources offered by parents and to follow them into the same occupational microclass as those parental resources regarding specialization are far more beneficial and attractive in high social class families than they are in low social class families.

A surprising dimension of our results was that overall birth order effects were weaker for last admitted programs than for first choice programs, but that first borns were more likely to study the same subject as the parents for the last admitted program than for the first choice application. The former pattern of results is likely to reflect a learning process by which first borns, who are documented to be ambitious, lower their expectations after the initial round of university decisions if they are unsuccessful. Parents and later born siblings are also likely to learn from observing the first application of the first born, and adjust their own expectations accordingly, meaning that birth order effects are weaker for the last admitted program. However, when first borns are forced to readjust their expectations, they draw upon relatively greater parent-child transfers of human capital and are at that point more likely to apply to the same degree program that at least one of the parents followed.

These results are also important for theorizing on the production of inequality in society more broadly. If birth order can be seen as a proxy for time spent with the parents, then we find that greater exposure is associated with more ambitious choices and better labor market outcomes, as well as a greater transfer of specialization, to the extent that such specialization is associated with favorable labour market outcomes. The results related to specialization are especially interesting since what is known about such transfers concerns both the quality and quantity of parent-child relations; that is, they are related to how much time the child spends with the parent(s), the emotional quality of the interaction, as well as the extent of activities related to the parent's profession or other special skills or abilities the parent might have. Looking across families rather than within them, parental exposure varies enormously, independent of birth order. Our results suggest that parent-child relations and parental exposure for the child have very far reaching consequences, in line with, for example, Coleman's (1988) arguments for social capital effects, which implies that documented variation in time spent with children by parental socioeconomic status (Guryan, Hurst and Kearney 2008) is even more consequential than previously realized. The birth order effect can also be thought of as a particular consequence of parental investment in the very first years of life. Recent research on the technology of skills formation has shown that the marginal returns to investment in children diminish rapidly with increasing age (Heckman 2006; Knudsen et al 2006). This explains why it is so difficult for second and later-born siblings to catch up on the first-born as they never have exclusive access to the same level of resources, but this also speaks to the broader production of inequality by parental socioeconomic status. It is not only time investments in children that vary by parental socioeconomic status (Guryan, Hurst and Kearney 2008), but also the degree to which children are encouraged to learn and develop through exposure to vocabulary, books, and other interactive stimuli (Mol and Bus 2011; Cartmill et al. 2013; Weisleder and Fernald 2013). Previous studies have shown that variation in school quality accounts for relatively little variation in academic performance (Coleman et al. 1966), and that most of those socioeconomic differences in performance are produced within the family, beginning well before first school attendance. The fact that birth order within a shared family environment can produce such differences provides an indication of how important these early life investments must be across different families.

While this study has many strengths, there are some limitations. Although the use of siblings fixed effects adjusts for all shared time-invariant factors within the family, and reduces residual confounding to a great degree, not all factors that vary between siblings are adjusted for. To a certain extent, of course, that is a crucial part of our assumption about the way that birth order shapes the experience within the family, but some factors such as parental income may change over time, and have a different impact on parental investment on children at different ages. Although we do not control for changes to parental income or occupation over time, other studies that have controlled for time-varying parental income and social class have found that these controls make very little difference to within-family estimates for birth order (Barclay and Myrskylä 2016). Another limitation is that the specific registers that we have access to do not contain information on birth weight. Previous studies have shown that first-borns have lower birth weight than later-borns (Magnus, Berg, and Bjerkedal 1985), and that birth weight is positively related to cognitive ability, educational attainment, and earnings (Black, Devereux, and Salvanes 2007). However, it can be argued that a lower birth weight is a consequence of birth order rather than a confounder variable, and that it is not therefore necessarily to adjust for it to identify the causal effect of birth order on later life outcomes. Either way, the lack of control for birth weight means that we are probably obtaining a conservative estimate of birth order on the later life outcomes that we address in this study. Furthermore, it was not possible for us to test whether personality factors mediated the relationship between birth order and educational choices as we did not have any information on personality available for the birth cohorts that we study.

In conclusion, our study has shown that birth order matters, but more importantly this study highlights the importance of the inequality generating mechanisms. When birth order produces such substantial differences in both preferences and attainment between siblings despite the fact that differences in access to financial resources and social and cultural capital are so much greater between families than within families, the overall inequality generating potential of those mechanisms is abundantly clear.

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Table 1. Choice of First Tertiary Program, with and without control for upper-secondary GPA.

	Teacher long	Teacher short	Arts	Humanities	Social and behavioral sci.	Journalism and information	Business	Law	Life sciences, environment	Physics, Maths, Statistics	Computing	Long engineering	Short Engineering	Professions, health related	Short health	Social services
Female	0.040***	0.011***	0.001	0.009***	0.022***	0.003	-0.013***	0.022***	0.009***	-0.003*	-0.044***	-0.176***	-0.091***	0.047***	0.109***	0.052***
Birth order: 2	0.013**	0.003*	0.002	0.002	0.004	0.010***	0.023***	-0.005	-0.004	0	0	-0.045***	0.001	-0.025***	0.017***	0.002
Birth order: 3	0.022*	0.006*	0.001	0.003	0.014*	0.024***	0.040***	-0.002	-0.008	0	0.001	-0.073***	-0.001	-0.044***	0.015	0.001
Birth order: 4	0.026	0.01	0.006	0.006	0.021	0.032**	0.036*	-0.002	-0.007	0	0.005	-0.086***	-0.008	-0.054***	0.017	-0.001
Birth order: 5	0.062*	0.018	0.002	0.013	0.003	0.019	0.046	0.002	-0.006	-0.007	0.01	-0.068**	-0.032	-0.077***	0.016	-0.001
Birth order: 6	0.051	-0.002	0.021	-0.013	0.007	0.057	0.055	-0.026	0.01	-0.022	0.05	-0.04	-0.028	-0.043	-0.02	-0.055
Birth year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maternal age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Individuals	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404
# Parent FE	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041
Adjusted R2	0.006	0.004	0	0.002	0.003	0.002	0.001	0.003	0.003	0	0.02	0.069	0.034	0.009	0.034	0.017
Mean of Y	0.093	0.011	0.009	0.019	0.05	0.044	0.161	0.059	0.022	0.013	0.027	0.175	0.069	0.08	0.124	0.045
Female	0.055***	0.014***	0.002	0.010***	0.023***	0.007***	-0.012***	0.014***	0.010***	-0.003**	-0.039***	-0.200***	-0.085***	0.030***	0.119***	0.057***
Birth order: 2	0.008	0.002	0.002	0.002	0.004	0.009**	0.023***	-0.001	-0.004*	0	-0.002	-0.036***	-0.001	-0.018***	0.013**	-0.001
Birth order: 3	0.013	0.005	0.001	0.003	0.014*	0.022***	0.040***	0.003	-0.008	0	-0.001	-0.059***	-0.005	-0.034***	0.009	-0.002
Birth order: 4	0.015	0.007	0.005	0.005	0.021	0.029**	0.036*	0.005	-0.008	0.001	0.001	-0.067***	-0.012	-0.042**	0.01	-0.005
Birth order: 5	0.049*	0.016	0.002	0.012	0.002	0.016	0.046	0.01	-0.006	-0.006	0.006	-0.048	-0.037	-0.063**	0.007	-0.005
Birth order: 6	0.034	-0.005	0.02	-0.014	0.006	0.053	0.055	-0.016	0.009	-0.021	0.044	-0.013	-0.035	-0.023	-0.031	-0.062
GPA (z-score)	0.055***	0.014***	0.002	0.010***	0.023***	0.007***	-0.012***	0.014***	0.010***	-0.003**	-0.039***	-0.200***	-0.085***	0.030***	0.119***	0.057***
Birth year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maternal age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Individuals	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404	98,404
# Parent FE	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041	50,041
Adjusted R2	0.023	0.008	0.001	0.002	0.003	0.004	0.001	0.011	0.003	0.001	0.025	0.096	0.038	0.033	0.039	0.021
Mean of Y	0.093	0.011	0.009	0.019	0.05	0.044	0.161	0.059	0.022	0.013	0.027	0.175	0.069	0.08	0.124	0.045

Note: Models are separate linear probability regressions for applications to the described the program (coded 0/1). * p<0.05, ** p<0.01, *** p<0.001

Table 2. Choice of Last Admitted Tertiary Program, with and without control for upper-secondary GPA.

	Teacher long	Teacher short	Arts	Humanities	Social and behavioral sci.	Journalism and information	Business	Law	Life sciences, environment	Physics, Maths, Statistics	Computing	Long engineering	Short Engineering	Professions, health related	Short health	Social services
Female	0.055***	0.018***	-0.001	0.007***	0.019***	0.006***	-0.006	0.013***	0.011***	-0.004***	-0.047***	-0.138***	-0.124***	0.025***	0.123***	0.043***
Birth order: 2	0.012**	0.002	0.001	0.002	0.010**	0.003	0.012*	-0.002	-0.008**	0.002	-0.001	-0.029***	-0.004	-0.017***	0.013**	0.003
Birth order: 3	0.019*	0.005	0	0.002	0.022**	0.01	0.024*	-0.002	-0.016**	0.001	0.002	-0.042***	-0.012	-0.032***	0.014	0.005
Birth order: 4	0.021	0.008	-0.001	0.002	0.042***	0.009	0.029	0.005	-0.022**	0.007	-0.001	-0.048**	-0.02	-0.041***	0.003	0.008
Birth order: 5	0.047	0.022	0.006	0.006	0.025	0.009	0.012	0.004	-0.016	0.003	0	-0.043	-0.036	-0.054**	0.007	0.008
Birth order: 6	0.071	0.006	0.01	0.002	0.003	0.049	0.022	0.052	-0.018	-0.017	0.032	-0.081	-0.013	-0.052	-0.052	-0.013
Birth year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maternal age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Individuals	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944
# Parent FE	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118
Adjusted R2	0.01	0.007	0.001	0.001	0.003	0.001	0.001	0.002	0.002	0.001	0.021	0.048	0.046	0.005	0.037	0.015
Mean of Y	0.112	0.018	0.006	0.02	0.062	0.037	0.163	0.037	0.027	0.016	0.031	0.149	0.103	0.053	0.13	0.037
Female	0.074***	0.022***	0	0.009***	0.020***	0.008***	-0.008*	0.004*	0.013***	-0.004***	-0.042***	-0.163***	-0.120***	0.011***	0.131***	0.044***
Birth order: 2	0.005	0.001	0.001	0.001	0.009**	0.003	0.012*	0.001	-0.009***	0.002	-0.003	-0.020***	-0.005	-0.013***	0.011*	0.002
Birth order: 3	0.008	0.002	0	0.001	0.021**	0.008	0.025*	0.003	-0.016**	0.001	-0.001	-0.028**	-0.015	-0.025***	0.01	0.004
Birth order: 4	0.007	0.005	-0.002	0.001	0.040***	0.007	0.03	0.011	-0.023**	0.007	-0.005	-0.030*	-0.023	-0.032**	-0.002	0.008
Birth order: 5	0.035	0.019	0.006	0.005	0.024	0.007	0.014	0.01	-0.017	0.003	-0.003	-0.026	-0.039	-0.045**	0.002	0.007
Birth order: 6	0.052	0.001	0.009	0	0.001	0.047	0.025	0.06	-0.019	-0.017	0.026	-0.056	-0.018	-0.038	-0.059	-0.013
GPA (z-score)	-0.066***	-0.016***	-0.002***	-0.006***	-0.006***	-0.008***	0.008***	0.028***	-0.005***	0	-0.019***	0.086***	-0.015***	0.047***	-0.026***	-0.002
Birth year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maternal age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Individuals	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944	98,944
# Parent FE	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118	50,118
Adjusted R2	0.032	0.014	0.001	0.002	0.003	0.002	0.001	0.012	0.003	0.001	0.027	0.078	0.047	0.028	0.04	0.015
Mean of Y	0.112	0.018	0.006	0.02	0.062	0.037	0.163	0.037	0.027	0.016	0.031	0.149	0.103	0.053	0.13	0.037

Note: Models are separate linear probability regressions for applications to the described the program (coded 0/1). * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 3. Choice of First Tertiary Program by Social Class (EGP).

	Teacher long	Teacher short	Arts	Humanities	Social and behavioral sci.	Journalism and information	Business	Law	Life sciences, environment	Physics, Maths, Statistics	Computing	Long engineering	Short Engineering	Professions, health related	Short health	Social services
High EGP																
Female	0.030***	0.008***	0.002	0.008***	0.025***	0.006**	-0.008*	0.020***	0.010***	-0.002	-0.038***	-0.183***	-0.075***	0.053***	0.100***	0.044***
Birth order: 2	0.016**	0.002	0.002	0.002	0.006	0.010**	0.019**	-0.003	-0.004	0	0	-0.049***	0.006	-0.030***	0.023***	0.002
Birth order: 3	0.024*	0.004	0.003	0.005	0.019*	0.025**	0.032*	-0.006	-0.008	0	-0.004	-0.086***	0.007	-0.050***	0.034**	0.001
Birth order: 4	0.023	0.002	0.007	0.008	0.029*	0.031*	0.007	0.001	-0.007	0.002	-0.006	-0.101***	0.015	-0.066***	0.045*	0.009
Birth order: 5	0.022	0.007	0.001	0.02	0.024	0.015	0.025	0.019	0	-0.001	-0.001	-0.078*	-0.017	-0.083*	0.037	0.009
Birth order: 6	0.011	-0.005	0.028	-0.021	-0.059	-0.003	0.069	0.004	0.028	-0.021	0.018	-0.089	-0.023	-0.025	0.107	-0.019
Birth year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maternal age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Individuals	62,058	62,058	62,058	62,058	62,058	62,058	62,058	62,058	62,058	62,058	62,058	62,058	62,058	62,058	62,058	62,058
# Parent FE	31,426	31,426	31,426	31,426	31,426	31,426	31,426	31,426	31,426	31,426	31,426	31,426	31,426	31,426	31,426	31,426
Adjusted R2	0.005	0.004	0.001	0.002	0.005	0.002	0.001	0.003	0.003	0.001	0.018	0.07	0.027	0.011	0.033	0.016
Mean of Y	0.078	0.007	0.009	0.019	0.052	0.042	0.167	0.064	0.022	0.014	0.025	0.203	0.064	0.09	0.108	0.036
Low EGP																
Female	0.059***	0.017***	0	0.008***	0.015***	-0.004	-0.019**	0.024***	0.008**	-0.004*	-0.058***	-0.162***	-0.117***	0.037***	0.128***	0.069***
Birth order: 2	0.003	0.007*	0.002	0.004	0.003	0.008	0.030***	-0.011	-0.007	-0.001	0	-0.032***	-0.005	-0.014*	0.01	0.003
Birth order: 3	-0.004	0.014*	-0.003	0.002	0.012	0.019	0.049**	-0.005	-0.012	0	0.012	-0.043**	-0.011	-0.036**	0.001	0.003
Birth order: 4	0.003	0.028**	0.002	0.005	0.018	0.025	0.072**	-0.005	-0.013	-0.005	0.015	-0.042	-0.046*	-0.026	-0.017	-0.012
Birth order: 5	0.076	0.028	0	0.003	-0.015	0.01	0.076	0.002	-0.01	-0.022	0.011	-0.045	-0.045	-0.056	-0.015	0.001
Birth order: 6	0.044	0.024	0.021	-0.015	0.062	0.086	0.061	-0.072	-0.013	-0.05	0.075	0.036	-0.01	-0.035	-0.123	-0.093
Birth year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maternal age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Individuals	28,359	28,359	28,359	28,359	28,359	28,359	28,359	28,359	28,359	28,359	28,359	28,359	28,359	28,359	28,359	28,359
# Parent FE	14,517	14,517	14,517	14,517	14,517	14,517	14,517	14,517	14,517	14,517	14,517	14,517	14,517	14,517	14,517	14,517
Adjusted R2	0.01	0.005	0.002	0.003	0.003	0.003	0.003	0.005	0.003	0.002	0.029	0.071	0.048	0.01	0.037	0.021
Mean of Y	0.121	0.018	0.008	0.019	0.048	0.049	0.142	0.049	0.02	0.012	0.032	0.126	0.076	0.064	0.155	0.063

Note: Models are separate linear probability regressions for applications to the described the program (coded 0/1). * p<0.05, ** p<0.01, *** p<0.001

Table 4. Expect outcomes of Choice of First Tertiary Program.

	Expected full time earnings[a]		Earnings risk[b]		Expected occupational prestige[c]		Expected level of non-employment[d]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Female	-0.056***	-0.071***	-0.014***	-0.013***	1.144***	0.352***	-0.004***	-0.002
Birth order: 2	-0.022***	-0.016***	0.001	0.001	-1.136***	-0.858***	0.006***	0.005***
Birth order: 3	-0.029***	-0.020***	0.001	0.001	-1.662***	-1.230***	0.009**	0.008*
Birth order: 4	-0.030***	-0.020**	0.002	0.002	-2.109***	-1.542***	0.011*	0.009
Birth order: 5	-0.031**	-0.020*	0	-0.001	-2.357***	-1.801**	0.001	-0.001
Birth order: 6	0.004	0.016	-0.011	-0.011	0.169	0.779	-0.006	-0.007
GPA (z-score)		0.050***		-0.001*		2.590***		-0.007***
Birth year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maternal age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Individuals	101,069	101,069	101,112	101,112	101,131	101,131	101,163	101,163
# Parent FE	50,305	50,305	50,310	50,310	50,309	50,309	50,312	50,312
Adjusted R2	0.104	0.163	0.016	0.016	0.028	0.071	0.025	0.027
Mean of Y	5.683	5.683	0.08	0.08	52.799	52.799	0.138	0.138

Note: [a] in log units [b] Risk calculated on full earnings distribution (see text for details) [c] SIOPS is scaled 20-78, [d] scaled 0/1. The expected outcomes are based on highest ranked alternative in the first tertiary choice, and defined for specific program (not the scheme of clustered programs). * p<0.05, ** p<0.01, *** p<0.001

Table 5. Expect outcomes of Choice of First Tertiary Program by Social Class (EGP)

	Expected earnings[a]		Earnings risk[b]		Expected occupational prestige[c]		Expected level of non-employment[d]	
	EGP high (1)	EGP low (2)	EGP high (3)	EGP low (4)	EGP high (5)	EGP low (6)	EGP high (7)	EGP low (8)
Female	-0.054***	-0.057***	-0.012***	-0.017***	1.041***	1.309***	-0.001	-0.010***
Birth order: 2	-0.024***	-0.014***	0.001	0.001	-1.321***	-0.703***	0.007***	0.004
Birth order: 3	-0.035***	-0.015*	0.002	0.001	-2.112***	-0.802	0.014**	0.004
Birth order: 4	-0.035***	-0.012	0.003	-0.001	-2.486***	-0.641	0.016*	0.001
Birth order: 5	-0.03	-0.013	0.004	-0.011	-3.437**	-0.268	0.019	-0.027*
Birth order: 6	-0.009	0.041	-0.013	-0.018	-1.762	2.666	0.004	-0.035
Birth year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maternal age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Individuals	63,437	29,381	63,466	29,394	63,472	29,407	63,493	29,414
# Parent FE	31,561	14,621	31,564	14,622	31,564	14,622	31,565	14,623
Adjusted R2	0.108	0.096	0.015	0.021	0.028	0.03	0.029	0.019
Mean of Y	5.696	5.66	0.082	0.078	53.228	52.066	0.139	0.138

Note: [a] in log units, [b] Risk calculated on full earnings distribution (see text for details), [c] SIOPS is scaled 20-78, [d] scaled 0/1. The expected outcomes are based on highest ranked alternative in the first tertiary choice. * p<0.05, ** p<0.01, *** p<0.001

Table 6. Choice of Same Degree or Field as Parents

	Choice of First Tertiary Program			Last admitted program		
	Degree	Field of study, 3 digit	Field of study, 2 digit	Degree	Field of study, 3 digit	Field of study, 2 digit
	(1)	(2)	(3)	(4)	(5)	(6)
Female	0.007***	-0.013***	-0.034***	0.010***	-0.001	-0.019***
Birth order: 2	-0.004	-0.008*	-0.013*	-0.005*	-0.007	-0.015**
Birth order: 3	-0.004	-0.008	-0.021	-0.010*	-0.007	-0.024*
Birth order: 4	-0.004	-0.002	-0.021	-0.012	-0.007	-0.033
Birth order: 5	-0.011	-0.004	-0.045	-0.02	-0.018	-0.076*
Birth order: 6	-0.019	-0.064	-0.102*	-0.019	-0.048	-0.089
Birth year	Yes	Yes	Yes	Yes	Yes	Yes
Maternal age	Yes	Yes	Yes	Yes	Yes	Yes
# Individuals	105,381	105,381	105,381	105,381	105,381	105,381
# Parent FE	50,412	50,412	50,412	50,412	50,412	50,412
Adjusted R2	0.001	0.001	0.002	0.002	0	0.002
Mean of Y	0.031	0.107	0.263	0.031	0.107	0.268

* p<0.05, ** p<0.01, *** p<0.001

Table 7. Choice of Same Degree or Field as Parents by Social Class (EGP)

	Choice of First Tertiary Program						Last admitted program					
	Degree		Field of study, 3 digit		Field of study, 2 digit		Degree		Field of study, 3 digit		Field of study, 2 digit	
	High EGP	Low EGP	High EGP	Low EGP	High EGP	Low EGP	High EGP	Low EGP	High EGP	Low EGP	High EGP	Low EGP
Female	0.008***	0.007***	-0.008*	-0.019***	-0.024***	-0.053***	0.012***	0.009***	0	0	-0.010*	-0.034***
Birth order: 2	-0.007	-0.002	-0.007	-0.011	-0.014	-0.008	-0.007*	-0.001	-0.004	-0.008	-0.012	-0.018
Birth order: 3	-0.006	-0.003	-0.007	-0.016	-0.026	-0.014	-0.015*	-0.002	-0.008	-0.004	-0.03	-0.011
Birth order: 4	-0.007	0.002	0.001	-0.011	-0.029	-0.017	-0.019	-0.001	-0.007	-0.004	-0.041	-0.026
Birth order: 5	-0.028	0	0.007	-0.031	-0.065	-0.033	-0.043*	0.002	-0.024	-0.014	-0.118**	-0.056
Birth order: 6	-0.055	-0.004	0.023	-0.114*	-0.077	-0.118	-0.075*	0.02	0.038	-0.072	-0.087	-0.091
Birth year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maternal age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Individuals	66,195	30,565	66,195	30,565	66,195	30,565	66,195	30,565	66,195	30,565	66,195	30,565
# Parent FE	31,626	14,656	31,626	14,656	31,626	14,656	31,626	14,656	31,626	14,656	31,626	14,656
Adjusted R2	0.001	0.003	0.001	0.002	0.002	0.006	0.002	0.004	0.001	0.001	0.001	0.004
Mean of Y	0.044	0.008	0.121	0.082	0.286	0.226	0.044	0.01	0.121	0.081	0.295	0.226

* p<0.05, ** p<0.01, *** p<0.001

Table 8. Birth order effects on art school graduation.

					Graduating from art school				Graduating with art degree			
	Graduating from art school		Graduating with art degree		High EGP		Low EGP		High EGP		Low EGP	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Female	0.002***	0.002***	0.004***	0.004***	0.002***	0.002***	0.001	0.001	0.005***	0.005***	0.001	0.001
Birth order: 2	0.002***		0.006***		0.003**		0.001		0.007***		0.004*	
Birth order: 3	0.004**		0.008***		0.005*		0.002		0.011***		0.004	
Birth order: 4	0.005*		0.012***		0.007*		0.004		0.017***		0.003	
Birth order: 5	0.005		0.012		0.01		0.005		0.022*		0.005	
Birth order: 6	0.017		0.025*		0.028		0.008		0.028		0.023	
Birth order (linear)		0.002**		0.005***		0.003**		0.001		0.006***		0.002
Birth year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maternal age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Individuals	280,953	280,953	256,871	256,871	170,641	170,641	81,112	81,112	160,454	160,454	70,843	70,843
# Parent FE	130,701	130,701	128,522	128,522	78,550	78,550	38,473	38,473	77,884	77,884	37,325	37,325
Adjusted R2	0.000	0.000	0.002	0.001	0.001	0.001	0.000	0.001	0.002	0.002	0.003	0.002
Mean of Y	0.009	0.009	0.017	0.017	0.01	0.01	0.006	0.006	0.02	0.02	0.013	0.013

Note: source data is graduation register until 2012, cohorts born 1960-1987.

Table A1. Descriptive Statistics for Educational Choice Sample.

	Mean	SD	min	max	count
Female	0.54	(0.4984)	0	1	105,381
Birth order: 2	0.4394	(0.4963)	0	1	105,381
Birth order: 3	0.1394	(0.3463)	0	1	105,381
Birth order: 4	0.0288	(0.1672)	0	1	105,381
Birth order: 5	0.0057	(0.0750)	0	1	105,381
Birth order: 6	0.0011	(0.0334)	0	1	105,381
GPA (z-score)	0.6092	(0.8419)	-4.2479	2	105,381
Expected earnings	5.6832	(0.1494)	4.8507	6	101,069
Earnings risk	0.0805	(0.0665)	0	1	101,112
Expected occuaptional prestige (SIOPS)	52.799	(8.8608)	20	78	101,131
Expected level of non-employment	0.1384	(0.1104)	0	1	101,163
Choice of First Tertiary Program (0/1)					
Degree	0.0307	(0.1726)	0	1	105,381
Field of study, 3 digit	0.1066	(0.3086)	0	1	105,381
Field of study, 2 digit	0.2629	(0.4402)	0	1	105,381
Last admitted program (0/1)					
Degree	0.0311	(0.1737)	0	1	105,381
Field of study, 3 digit	0.1068	(0.3089)	0	1	105,381
Field of study, 2 digit	0.2684	(0.4431)	0	1	105,381

Table A2. Coding of Choice Scheme with Expected Outcomes.

Choice scheme	No. first choices	Admission rate	GPA among the last admitted[a]	Average of expected earnings[b]	Earnings risk[c]	Average of expected occupation al prestige[d]	SD of expected occupational prestige[d]	Average of expected level of non-employment (0/1)
Teacher long	9190	0.168	0.255	5.593	0.011	57.189	8.64	0.018
Teacher short	1095	0.177	0.087	5.532	0.042	52.119	5.19	0.151
Arts	874	0.149	0.521	5.488	0.164	45.384	12.272	0.322
Humanities	1854	0.213	0.44	5.461	0.180	46.612	13.686	0.379
Social and behavioral sci.	4977	0.146	0.522	5.593	0.122	48.736	12.379	0.239
Journalism and information	4316	0.142	0.484	5.594	0.095	47.885	11.385	0.2
Business	15875	0.142	0.665	5.730	0.085	48.763	9.89	0.134
Law	5799	0.106	1.137	5.824	0.050	64.628	11.617	0.074
Life sciences, environment	2163	0.173	0.572	5.580	0.118	52.165	13.997	0.232
Physics, Maths, Statistics	1271	0.181	0.663	5.612	0.172	54.789	16.2	0.271
Computing	2672	0.193	0.076	5.704	0.092	49.46	9.645	0.143
Long engineering	17304	0.174	0.992	5.817	0.080	55.749	11.628	0.112
Short Engineering	6862	0.21	0.449	5.758	0.086	49.702	10.718	0.115
Professions, health related	8031	0.061	1.38	5.863	0.058	69.984	7.854	0.089
Short health	12279	0.117	0.571	5.541	0.053	48.754	7.595	0.13
Social services	4477	0.077	0.611	5.564	0.063	49.171	7.807	0.12
Total	99039	0.145	0.635	5.694	0.073	53.753	10.026	0.126

[a] GPA is unconditional z-scores within graduation years [b] Earnings are in log form, truncated to values above 120,000 (see text) and residualized for year, age, gender immigration status, gender and presence of children in the household, and the interaction of gender and children, [c] same as [b], but not truncated; risk is measured as variance relative to level of earnings (see text), [d] SIOPS-scores.

Table A3. Case counts, Choice data.

	No. cases after event	
Event	Admission, born 1982-1990	Graduation, born 1960-87
Cohort cut	1,219,701	3,968,192
Emigrated	1,202,554	3,918,298
Death	1,194,514	3,883,406
Select relevant set sizes	826,171	2,513,129
GPA, upper-secondary school	625,612	
TE Program choice file	280,506	
TE graduation file		613,227
Social background (EGP)	278,391	601,897
Select relevant set sizes (re-applied)	106,308	282,583
Drop large set sizes (>6)	105,381	280,953

Note: any deviations from the last figure to the estimated model are due to further internal missings on either outcomes or controls

Table A4. Sensitivity analyses

	Educational choice		
	Choice of degree category	Expected outcomes	Degree/field inheritance
Gender	F stronger gradient in teacher long/short, M stronger gradient in long engineering M negative gradient for law, F n.s. gradient F negative gradient for professions, M n.s. gradient	Stronger gradient for M than F in expected earnings and SIOPS	No gender difference, except last admission field two digit inheritance, where F has gradient, not M
Set size	The gradient become very noisy for larger set sizes due to much smaller sample	Gradients are similar, but less significant for larger set sizes due to much smaller sample	Gradients are noisy across set sizes due varying sample sizes
Remove birth year	No substantial difference	No substantial difference	No substantial difference

Note: 'gradient' refers to birth order gradient, M = Male, F = Female.