Does Sibling Gender Composition Affect Gender-Stereotypic Choice of Education?

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April 14, 2017

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Abstract

Using population data from Denmark, I study how sibling gender composition affects gender-stereotypical choices of tertiary education. To identify the causal effect of sibling gender, I focus on a sample of firstborn children who all have a younger biological sibling (same mother and father). The randomness of the younger siblings' gender, conditional on the first child's gender, allows me to estimate the causal effect of having a younger gender-discordant relative to a same-sex sibling. Overall, I find that having an opposite sex sibling makes educational choices more gender-stereotypical for both men and women. The findings are generally similar for the likelihood of enrolling and completing any degree as well as a degree at the tertiary level within respectively a typical female field and the traditionally male-dominated field of Science, Technology, Engineering, and Mathematics (STEM). However, although men are more likely to enroll in a tertiary STEM degree, they are not more likely to complete a such degree, suggesting that they become over-confident in their choice of study. Consequently, having a gender-discordant sibling causes men and women to opt out of fields that are traditionally dominated by the opposite gender. This pattern is compatible with a story about identity or parental gender-specific investments.

JEL classification: I21, J16, J31

Keywords: Gender-stereotype, educational choice, sibling composition, STEM, tertiary education.

* I am thankful for helpful comments and suggestions from Mette Ejrnæs, Miriam Gensowski, Mette Gørtz, Nikolaj Harmon, Claus Thustrup Kreiner, Søren Leth-Petersen, Shelly Lundberg, Torben Heien Nielsen, Marco Piovesan, and Heather Royer, as well as seminar participants at the University of Copenhagen.

1 Introduction

Although men continue to participate in the labor force at higher rates and receive higher pay than women, more women than men now attend tertiary education across almost all OECD countries —on average, 54 pct. of new entrants are female (OECD, 2016). Yet, women are heavily overrepresented in some fields and men in others. While 75 percent of new entrants in tertiary education within Health are female, 70 percent are male within Science and Engineering. Differences in talent or academic achievement in secondary school cannot explain this gender segregation in field of study (e.g. Fortin et al., 2015). At the same time, an ongoing political and academic debate concerns how to get more people to study and subsequently work within the field of Science, Technology, Engineering, and Mathematics (STEM), as this field is the major source of innovations and economic growth in the long run (Atkinson and Mayo, 2010; Peri et al., 2015). Therefore, it is essential to better understand what shapes people's preferences for field of study and in particular why men and women continue to make gender-stereotypic choices.

This paper takes a step towards a better understanding of men's and women's education decisions by investigating how sibling gender composition affects gender-stereotypic choices in tertiary education. Siblings are close peers and their gender might, therefore, have an important impact on the individual's formation of preferences, perceptions, and interests. The direction of such influence is, however, ambiguous. To study this question, I use Danish administrative data on cohorts born between 1960 and 1988. To identify the causal effect of sibling gender, I focus on a sample of firstborn children who all have a younger biological sibling (same mother and father). The randomness of the younger siblings' gender, conditional on the first child's gender, allows me to estimate the causal effect of having a younger gender-discordant relative to a same-sex sibling.

This paper distinguishes itself from the literature in four important ways. First, to the best of my knowledge, I am the first to causally identify the effect of sibling gender on field of study, as previous studies have considered the number or fraction of male and female siblings without accounting for potential endogenous fertility and have almost entirely focused on attainment rather than field of education (e.g. Anelli and Peri, 2014; Butcher and Case, 1994; Conley, 2000; Hauser and Kuo, 1998; Kaestner, 1997; Oguzoglu and Ozbeklik, 2016). Second, the large sample size —around 235,000 observations for each gender—makes the detection of even small effects possible; this is in contrast to previous studies often finding insignificant, but imprecisely estimated effects using samples of 1,000–10,000 observations. Third, the dataset allows me to link all children to their parents, eliminating concerns regarding measurement error in the sibship composition, and attrition only occurs in the rare case of out-migration or death. Fourth, in addition to examining educational attainment within certain fields of education, I also study the probability of any enrollment within a given field and the probability of dropout to reach a more nuanced understanding of the educational process.

Overall, I find that both men and women with a gender-discordant, compared to a same-sex, sibling are more likely to choose a gender-stereotypical education. The findings are generally similar for the likelihood of enrolling and completing any degree as well as a degree at the tertiary level within respectively a typical female field and the traditionally male-dominated field of Science, Technology, Engineering, and Mathematics (STEM). Women (men) are 4–7 (1–2) percent less (more) likely to study within the STEM field and 1–2 (3) percent more (less) likely to study within a typical female program. However, although men are more likely to enroll in a tertiary STEM degree, they are not more likely to complete a such degree, suggesting that they become over-confident in their choice of study. Consequently, having a gender-discordant sibling causes men and women to opt out of fields that are traditionally dominated by the opposite gender. This pattern is compatible with a story about identity or parental gender-specific investments. The observed pattern is compatible with a story about identity or parental gender-specific investments. Heterogeneity analysis reveals that the effects for women are concentrated among those of high-educated parents (especially mothers), lending support to an explanation involving parental (maternal) gender-specific investment. Moreover, the effects are greatest for women from traditional families, in which the father works at least 80 percent of the parents' labor supply during childhood. Finally, the effects are only present for individuals with less than six years to their sibling, suggesting that identity also plays a role.

2 Educational Choice: Why should sibling gender matter?

Why should sibling gender matter for the individual's choice of education? Several different explanations can provide a theoretical prediction for how sibling gender might affect a gender-stereotypic choice of education. In the following, I discuss how having a gender-discordant sibling compared to a same-sex sibling might affect the choice of studying for a typical male (STEM) and typical female (Education/Languages/Secretarial and Office Work/Health/Personal Services) educational degree. The direction of the effect of having a sibling of the opposite gender is however ambiguous.

Having a gender-discordant sibling could decrease the probability of choosing a gender-stereotypical education for two reasons. First, a sibling's gender specific-traits spill-over to the other sibling, such that a girl with a brother gets more masculine traits than a girl with a sister and vice versa for boys (Brim, 1958; Koch, 1955). Second, same sex siblings might reinforce their gender's behavior.

Yet, an opposite gender sibling could increase the probability of choosing a gender-stereotypical education for three reasons. First, the child is more exposed to gender-stereotyped behavior compared to a child with a same sex sibling and therefore more inclined to acquire traditional gender roles; this is similar to the argument in the same-sex education literature that girls feel more free to explore and choose more male dominated fields when being only together with girls in the classroom (Booth et al., 2014; Schneeweis and Zweimüller, 2012). Second, parents might to a greater extent invest gender-specifically when having a child of each gender, i.e. the mother invests in the daughter and the father invests in the son. Third, parental gender-specific role-modeling might be stronger when having a child of each gender; in a family with two children of the same gender both parents might be both children's role models, while in a family with a child of each gender the mother might be the daughter's role model and the father the son's.

Two previous studies have examined whether sibling gender composition and major choice are correlated. Anelli and Peri (2014) show that men are more likely to choose a male male-dominated college major if they have at least one sister. However, their study is associated with two important issues for interpretation. First, they only observe siblings attending the academic high school in Milan, implying that they have to assume that sibling gender composition does not affect the probability of attending this type of secondary education. Second, they do not take into account the likely endogeneity between sibling gender composition and family size. Oguzoglu and Ozbeklik (2016) show that women with fathers in a STEM occupation are less likely to choose of college STEM major if they have brothers compared to sisters. Their explanation for this is that fathers' invest gender-specifically when having at least one son. Their study, however, is also associated with the endogeneity issue in addition to a very small sample size. Due to the latter issue, they only have borderline significant estimates and cannot go into a more detailed analysis.

There is a larger literature examining sibling gender composition and educational attainment. In this literature, budget constraints also play an important role in the discussion of findings. However, in the Danish context, I do not expect strong effects of sibling rivalry on the allocation of scarce resources. Moreover, it is less clear how those constraints should affect the choice of field of study. Previous papers have reached inconsistent findings. Butcher and Case (1994) find that women only with brothers attain more education than women with any sister, while they do not find any effects for men. Their findings are nevertheless only borderline significant and based on very small sample sizes. Later studies have found no, insignificant, or opposite effects (Amin, 2009; Conley, 2000; Hauser and Kuo, 1998; Kaestner, 1997). Thus, previous studies have largely come to different conclusions. These studies, however, suffer from several important issues. The data quality in terms of determining sibling composition, measuring educational attainment, and sample size is a major problem. Moreover, all have the potential problem regarding endogenous fertility. The only convincingly causal study is Peter et al. (2015), studying effect of opposite gender co-twin, but they do not consider major choice.

3 Empirical Methodology

Aim of this study is to estimate causal effects. Previous studies have not dealt with potential endogenous fertility. The gender of current children might affect subsequent fertility —both the decision to get one more child and the spacing to the next child. Table 1 illustrates this point. The estimate in Column (2) shows, for instance, that parents who have a girl and get a boy as the second child are 4.37 percent less likely to get a third child than parents who get a girl as the second child. Moreover, of those parents who get a third child, the spacing between the second and third child is 2.29 months longer for those parents who have mixed-sex children compared to only girls. Another issue concerning the endogeneity of fertility is that parents might have different desire for sibling gender. Even though, the estimates in Column (1) do not show that subsequent fertility depends on the first child's gender, it might be that some parents want girls while others want boys, leaving a net effect of zero. Based on this, I argue that in order to reach causal effects of sibling gender, we can only consider the effect of "future" children's gender on "current" children's outcomes. In other words, we need to condition on the first child's gender and consider how the gender of a subsequent child affects the first child. In contrast, looking at how the gender of the firstborn child affects the outcomes of the second child will not necessarily lead to unbiased estimates, as parents decide whether (and when) to get a second child depending on the first child's gender. Moreover, considering the effect of number of siblings of one gender naturally implies a larger family size and a dummy for any sibling of a certain gender is naturally more likely in large sibship.

Table 1
Gender Composition of Current Children and Subsequent Fertility

Parity	1	2	2	3	3	3	3
Gender Comp		Girl	Boy	GG	GB	BG	BB
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Having at lest one more child							
1^{st} is Boy	0.06						
	(0.09)						
2^{nd} child is Boy		-4.37***	6.17***				
		(0.16)	(0.16)				
3^{rd} child is Boy				-4.21***	-0.08	-0.09	4.78***
				(0.35)	(0.37)	(0.37)	(0.33)
N	791,893	281,484	296,653	45,433	41,548	41,330	52,886
Mean (pct.)	73.7	31.2	32.0	20.7	20.1	19.9	19.7
Panel B: Spacing in months to next child							
1^{st} is Boy	-0.10						
	(0.06)						
2^{nd} is Boy		2.29***	-1.64***				
		(0.21)	(0.20)				
3^{rd} child is Boy				2.23***	2.05***	-0.02	-0.82
				(0.69)	(0.74)	(0.73)	(0.65)
N	584,289	88,037	95,376	9,426	8,371	8,244	10,443
Mean (months)	41.5	53.4	53.8	49.6	49.1	49.3	50.0

All fertility estimates are multiplied by 100. Standard errors in parentheses, clustered at the year-month of birth level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Each Panel-Column presents estimates from separate regressions. The sample consists of couples who get their first child (excluding twin births and children not surviving one year) between 1960 and 1988 and who do not have children from previous relationships. The samples in Columns (2) and (3) consist of couples with respectively a firstborn girl and boy; the sample in Column (4) consists of couples with a firstborn girl and secondborn girl and similarly for the remaining columns. The sample in Panel B is conditional on getting a subsequent child relative to the parity. All models absorb fixed effects for the first child's birth municipality, year-month of birth, second generation immigrant status, maternal age at birth, paternal age at birth, maternal level-field of education,and paternal level-field of education. Models (2)–(7) in Panel A also include spacing dummies (in months) to younger sibling(s).

To estimate the causal effect of sibling gender, I study the effect of the second child's gender on the first child's choice of education. The identifying assumption is that conditional on the gender of the first child, the gender of the second child is as good as random. The empirical specification for the main analysis is:

$$Y_{is} = \alpha_0 + \alpha_1 Opposite\ Sex_s + X_i'\delta + \epsilon_i, \tag{1}$$

where the estimate of interest is α_1, i.e. the effect of having a sibling of opposite sex. Note, that this equation always estimates the effect of the second child's gender of the first child's outcomes, also for families with more than two children. The equation is estimated separately by gender. X_i is a vector of fixed effects for birth municipality, year-month of birth, spacing in months to younger sibling, second generation immigrant status, maternal age at birth, paternal age at birth, maternal level-field of education, and paternal level-field of education.

As balancing check, Appendix Figures A1 and A2 show that, conditional on the first child's gender, parents' socio-economic characteristics do not significantly differ by the gender of the second child from five years before the first child's birth through the year of birth (and in most cases through all 16 years after birth). As parental characteristics cannot predict the second child's gender, these figures support the identifying assumption. This is in terms of each parent's length of education, employment status, and log(earnings) as well as parental cohabitation and marital status. However, in line with Table 1, Graph (c) in Figure A2 illustrates that parents with two mixed-sex children are less likely then parents with two same-sex children to have a third child.[1] This explains the patterns in Graph (e) in Appendix Figure A1 that mothers of gender-discordant children earn 3–5 percent more 5–9 years after the first child's birth compared to mothers of same-sex children.

From this, it is clear that parents with two children of same gender are more likely to get a third child, i.e. larger family size might be potential confounder. Therefore, as robustness check I first estimate the main results on a sample of children from two-child family. However, there is clearly selection into/out of being two-child family, so not completely clean. Second approach is to control for family size.

[1] Appendix Figure A3 illustrates this for the main sample.

To get at potential mechanisms of effect, I study whether effects are heterogeneous with respect to parental education (proxy for potential for parental gender-specific investment), division of labor (proxy for how stereotypic parents are), and spacing (closeness to peer).

4 Data and Institutional Background

I use Danish administrative data on cohorts born between 1960 and 1988.

4.1 Educational System

The key characteristics of the educational system in Denmark, as they relate to this study, are as follows: It is mandatory to attend primary school from age 7 through grade 9 (or through the year the person turns 17 years). In the final year of primary school, students apply for secondary education. This can be one of three options: Academic high school, vocational training, or an optional 10^{th} grade that is formally a continuation of primary school.[2]

A high school diploma gives access to tertiary education. Following the International Standard Classification of Education (ISCED), tertiary education fall into three types: Vocational (two-year college), professional (four-year college), and academic (university).[3] A high school degree is required for four-year college and university admission. Four-year college degrees (called professional bachelor (BA) degrees) are oriented towards specific professions, more practical in nature, and thought to be final degrees; i.e., they typically do not have a natural continuation in terms of further education. In contrast, university degrees are more directed towards research and more academically-oriented jobs and students normally complete with a master's (MA) degree.

[2] After the optional 10^{th} grade, students again have the choice between academic high school and vocational training if they wish to pursue secondary education.

[3] A university bachelor (BA) degree typically takes 3 years and master's (MA) degree takes two additional years. Professional BA degrees typically takes between 3 and 4 years with the majority taking 3.5 years.

4.2 Data and Sample Selection

I use Danish administrative data for the total population from 1980–2015. A key feature about this dataset is that I can link all children to their parents and siblings; thus, I observe the parent's complete fertility history and thereby correctly measure the sibling composition. From 1980 and in some cases back to 1978, I observe every time a person enrolls in an educational program and have information on the characteristics of the program, such as type, level, and field. Moreover, I have annual data on highest completed educational degree as well as annual labor earnings.

Table 2
Descriptive Statistics and Balancing Test by Gender

	Women		Men	
Panel A: Descriptive Statistics				
	Mean	SD	Mean	SD
Opposite Sex Sib	51.15		48.71	
Spacing (months)	33.76	11.97	33.73	11.95
Spacing 9–23 months	22.45		22.48	
Spacing 24–35 months	34.74		34.79	
Spacing 36–47 months	27.50		27.49	
Spacing 48–59 months	15.31		15.24	
# of Full Siblings	1.44	0.71	1.45	0.71
2+ Full Siblings	34.53		35.49	
Mother's age at birth	23.39	3.73	23.42	3.74
Father's age at birth	26.15	4.44	26.15	4.43
Mother's Edu (year)	11.17	2.99	11.18	2.99
Father's Edu (year)	11.98	3.13	11.99	3.12
2^{nd} Gen. Immigrant	1.21		1.17	
Panel B: Balancing Test				
Joint F-statistic	0.99		1.08	
Prob > F	0.52		0.22	
N	228,856		240,902	

Note: Main sample. *SD* shows the standard deviation for non-binary variables. The means for binary variables are shown as percent. The balancing test tests whether family background (dummies for parental age, parental level-field of education, spacing, and immigrant status) can predict having a younger gender-discordant sibling.

I restrict the sample to cohorts born between 1960 and 1988 to allow for sufficient time to enroll and complete an education. Moreover, I only consider firstborn children where I require that the child is both the mother's and father's first child; I exclude children who are first generation immigrants to eliminate concerns about unobserved siblings in the data; I only consider individuals who have at least one full sibling (same mother and father) where the second child is born less than five years after the first, the second child is singleton (i.e. not twin) and survives the first year of life. Finally, I exclude those few people who die before age 30 or who do not live in Denmark between age 25 and 30. This sample of firstborn children is what I refer to as the *main sample*.

Panel A in Table 2 provides descriptive statistics on demographic variables by gender for the main sample. As expected, men and women come from very similar demographic backgrounds. The average spacing to the younger sibling is close to 34 months, mothers are on average 23.4 years at their first birth and fathers are 2.7 years older than the mother. This sample of firstborn children have on average 1.4 younger siblings; around one-third of the sample has at least two siblings. Panel B shows the statistics from a balancing test, testing whether family background (dummies for parental age, parental level-field of education, spacing, and immigrant status) can predict having a younger gender-discordant sibling conditional on birth municipality and year-by-month fixed effects. The coefficients of the family background characteristics are jointly insignificant for both men and women, supporting the identifying assumption that the younger sibling's gender is conditionally random.

4.3 Measuring Gender-Stereotypical Choices of Education

I define a traditionally male field of education as being within the STEM field. I define STEM broadly; following the ISCED codes, the STEM definition includes: Economics (0311); Psychology (0313); Accounting and taxation (0411); Finance, banking and insurance (0412); Management and administration (0413); Natural sciences, mathematics and statistics (05); Information and Communication Technologies (06); Engineering, manufacturing and construction (07); and Agriculture, forestry, fisheries and veterinary (08). I define traditionally female dominated fields of education as: Education (01); Secretarial and office work (0415); Health and welfare (09); Personal services (101); and Hygiene and occupational health services (102). I refer to these fields as *Typical Female*. The results are, however, robust to alternative definitions, such as defining female fields as only including Education and Health and defining STEM more narrowly.

To not potentially confound the results on choice of field of study with the educational level, the main measures of STEM and Typical Female fields include any educational level post primary school (i.e. after grade 9/10). As complementary outcomes, I also consider field of study restricted to the tertiary level.[4]

I consider enrollment through age 27 and completion through age 30, such that people would have time to complete the education.

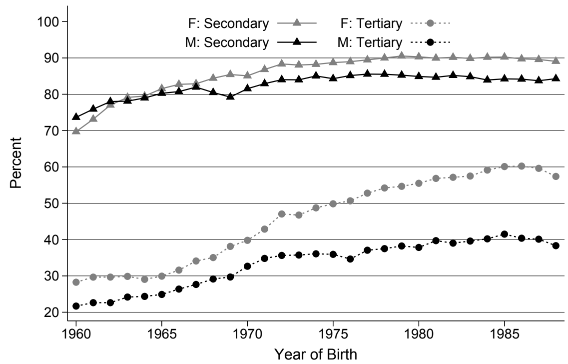
Additionally, to measure gender-stereotypical preferences for field of study for as many individuals as possible, including those who do not complete any post-compulsory education, I consider the male/female share in the first place of enrollment after primary school. For this analysis, I define four dummies indicating whether at least 55 pct. of new entrants in the particular level-by-field during a five year period around the year of entrance were male, at least 75 pct. were male, at least 55 pct. were female, and at least 75 pct. were female.

Figure 1 shows the share of each cohort by gender completing at least secondary and tertiary education as well as the share completing a degree at any level within the STEM and Typical Female fields. As is evident across most OECD countries, women attain more education than men and this difference is particularly pronounced at the tertiary level. The large difference between men's and women's field of study has been quite constant across the entire time period. Of all men, 46 pct. complete a STEM

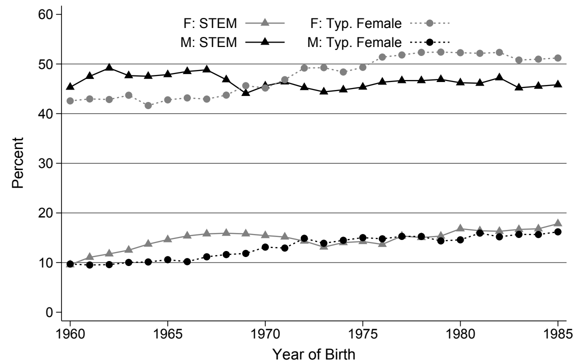
[4]Not reported, the results are also robust to a further restriction excluding vocational types of education at the tertiary level. When only considering field of study at the academic tertiary level, the results still hold for STEM but not for typical female fields, as most degrees within the typical female fields are professional BA degrees or at a lower level.

Figure 1

Educational Attainment and Field of Study by Age 30 by Gender Across Cohorts



(a) Has completed secondary/tertiary education



(b) Any Degree within Typ. Fem. vs STEM

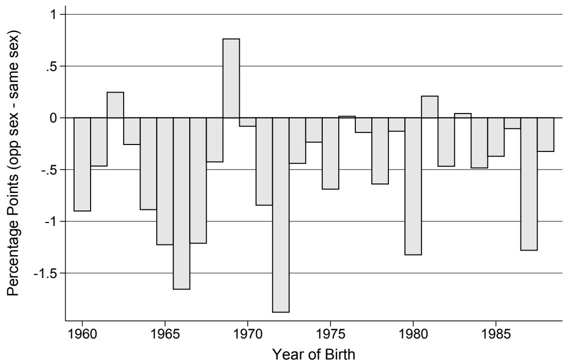
Note: Main sample. Graph (a) illustrates the share of a cohort completing at least secondary and at least tertiary education, respectively. Graph (b) illustrates the share of a cohort completing any degree within restrictively the STEM field and within a typical female field.

degree, while only 13 pct. get a Typical Female degree. In contrast, 15 pct. of women get a STEM degree and 47 pct. get a degree within a Typical Female field.

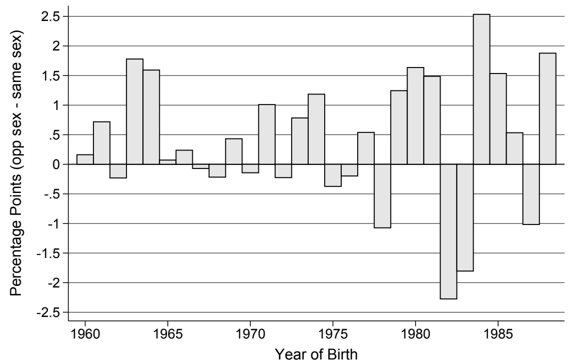
Figure 2 provides some first evidence on the effect of sibling gender composition on educational specialization. The graphs illustrate the difference in the share of a cohort completing a degree within respectively the STEM and Typical Female fields between individuals with an opposite sex sibling and individuals with a same sex sibling. For women, this difference is negative in terms of completing a STEM degree and positive for Typical Female degrees. In other words, Graph (a) suggests that women with a gender-discordant sibling are less likely to complete a typical male education, while Graph (c) points at the opposite in terms of completing a typical female education. Graphs (b) and (d) show the opposite patterns for men.

Figure 2

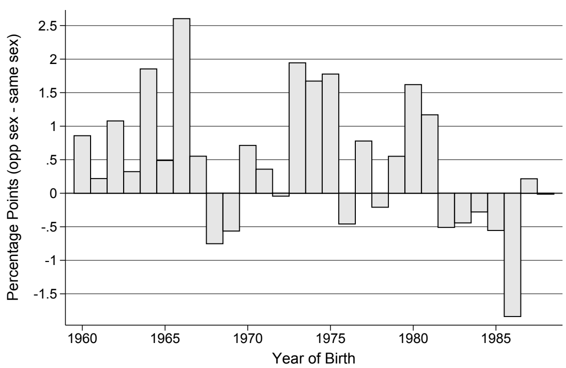
Field of Study by Gender Across Cohorts: Opposite-Same Sex Sibling Differences



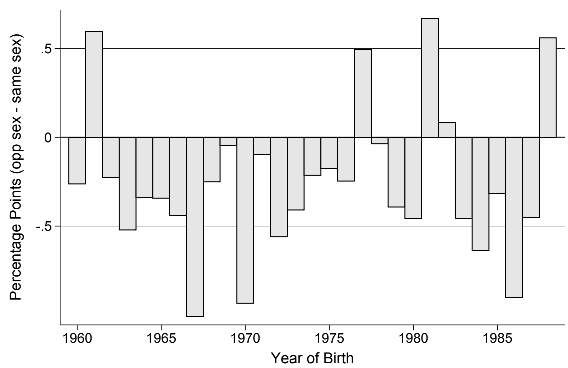
(a) Women: Any STEM Degree



(b) Men: Any STEM Degree



(c) Women: Any Typ. Fem. Degree



(d) Men: Any Typ. Fem. Degree

Note: Main sample. All graphs show the difference between individuals with a gender-discordant sibling and individuals with a same sex sibling. Graphs (a) and (b) illustrate the difference in the share of each cohort completing a STEM degree at any educational level, while Graphs (c) and (d) illustrate the difference in the share of each cohort completing a typical female degree at any educational level.

5 Results

5.1 Studying within the STEM vs Typical Female Fields

Table 3 presents the main results. Women who have a gender-discordant sibling are 2.3 percent less likely than women with a same sex sibling to ever enroll in a program within the STEM field; this number is 3.8 percent in terms of ever completing a STEM degree. At the same, having an opposite sex sibling increases women's likelihood of ever enrolling and ever completing a Typical Female education by around one percent relative to the mean of women with a same sex sibling. The results for women are similar when only considering degrees at the tertiary level, though the effect sizes are larger. For men, the overall results are very similar but going in the opposite direction, meaning that having a sibling of the opposite gender increases the likelihood of choosing a gender-stereotypical education for both men and women.

It is worth pointing out one important difference for men between the results at any level and at the tertiary level. Men with a sister are more likely than men with a brother to enroll in a tertiary STEM program. However, they are not more likely to complete a tertiary STEM degree. The result in Column (7) shows that men with an opposite gender sibling are more likely to enroll in a STEM program at a higher level than the highest level they complete, implying that they are more likely than men with a same sex sibling to dropout from a tertiary STEM education and not complete any education at the corresponding educational level.

Table 3

STEM vs Typical Female Education: Enrollment and Completion

	Any Level				Tertiary Level				
	STEM		Typical Female		STEM			Typical Female	
	Enr	Compl	Enr	Compl	Enr	Compl	Drop	Enr	Compl
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Women									
Opposite Sex Sib	-0.56***	-0.57***	0.44**	0.48**	-0.60***	-0.63***	-0.02	0.42**	0.35**
	(0.18)	(0.15)	(0.20)	(0.21)	(0.14)	(0.12)	(0.10)	(0.19)	(0.18)
Same Sex Mean	24.7	15.0	62.0	46.6	12.3	9.2	6.3	34.0	27.2
Pct. Δ rel. to SS	-2.3	-3.8	0.7	1.0	-4.9	-6.8	-0.3	1.2	1.3
N					228,856				
Men									
Opposite Sex Sib	0.78***	0.47**	-0.36**	-0.26*	0.46***	0.15	0.43***	-0.27**	-0.27**
	(0.19)	(0.20)	(0.16)	(0.14)	(0.16)	(0.14)	(0.14)	(0.13)	(0.11)
Same Sex Mean	62.5	46.1	22.2	13.1	21.9	16.4	15.5	12.2	8.3
Pct. Δ rel. to SS	1.2	1.0	-1.6	-2.0	2.1	0.9	2.8	-2.2	-3.3
N					240,902				

All estimates are multiplied by 100. Standard errors in parentheses, clustered at the year-month of birth level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Main sample. Each Panel-Column presents estimates from separate regressions. All models absorb fixed effects for birth municipality, year-month of birth, spacing in months to younger sibling, second generation immigrant status, maternal age at birth, paternal age at birth, maternal level-field of education, paternal level-field of education, and age at last educational observation. The dependent variables in Columns (1) through (4) indicate programs at any educational level, while Columns (5) through (9) restrict the level to tertiary education. *STEM dropout at the tertiary level* indicates that the individual has enrolled in a STEM program at a higher level than the highest completed educational level (which can be outside the STEM field).

5.2 Enrolling in Male- vs Female-dominated Program

Table 4 shows that the conclusion from the previous subsection holds when studying the male/female dominance at the first place of enrollment after primary schooling. Thus, the effect of sibling gender is already present in the choice of study around age 16. Men and women with a sibling of the opposite gender are more likely to enroll in a program in which their own gender is over-represented compared to individuals with a same sex sibling.

Table 4
First Post-Compulsory Place of Enrollment: Male- vs. Female-Dominated Program

	Male Share (pct.)		Female Share (pct.)	
	> 55	> 75	> 55	> 75
	(1)	(2)	(3)	(4)
Women				
Opposite Sex Sib	-0.49***	0.08	0.75***	0.64***
	(0.17)	(0.06)	(0.20)	(0.19)
Same Sex Mean	16.5	2.5	61.1	29.7
Pct. Δ rel. to SS	-3.0	3.2	1.2	2.2
N	228,066			
Men				
Opposite Sex Sib	0.73***	0.72***	-0.70***	-0.20**
	(0.20)	(0.18)	(0.17)	(0.10)
Same Sex Mean	55.0	33.7	23.1	5.9
Pct. Δ rel. to SS	1.3	2.1	-3.0	-3.4
N	239,533			

All estimates are multiplied by 100. Standard errors in parentheses, clustered at the year-month of birth level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Main sample. Each Panel-Column presents estimates from separate regressions. All models absorb fixed effects for birth municipality, year-month of birth, spacing in months to younger sibling, second generation immigrant status, maternal age at birth, paternal age at birth, maternal level-field of education, paternal level-field of education, and age at last educational observation. The male/female share is measured for the first enrollment after primary school.

5.3 Educational Attainment and Achievement

Table 5

Educational Attainment, Achievement, and Earnings

	Length	Secondary Level				Tertiary Level			Earn-
	(mth)	Enr	Compl	Ac HS	GPA	Enr	Drop	Compl	ings
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Women									
Opposite Sex Sib	-0.31***	-0.01	-0.12	-0.31	-1.61***	-0.34**	0.17	-0.51***	-0.22*
	(0.11)	(0.11)	(0.14)	(0.19)	(0.50)	(0.17)	(0.10)	(0.18)	(0.13)
Same Sex Mean	161.5	94.1	85.0	51.9	4.5	51.4	7.7	43.8	55.2
Pct. Δ rel. to SS	-0.2	0.0	-0.1	-0.6	-36.0	-0.7	2.2	-1.2	-0.4
N	228856	228856	228856	228856	118503	228856	228856	228856	214789
Men									
Opposite Sex Sib	-0.25**	-0.13	-0.23	-0.19	0.48	0.10	0.32***	-0.22	-0.31**
	(0.12)	(0.09)	(0.16)	(0.17)	(0.70)	(0.19)	(0.11)	(0.19)	(0.12)
Same Sex Mean	158.5	93.9	82.1	34.4	6.2	40.4	7.9	32.4	55.5
Pct. Δ rel. to SS	-0.2	-0.1	-0.3	-0.6	7.8	0.2	4.0	-0.7	-0.6
N	240902	240902	240902	240902	82520	240902	240902	240902	225772

All estimates (except for length) are multiplied by 100. Standard errors in parentheses, clustered at the year-month of birth level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Main sample. Each Panel-Column presents estimates from separate regressions. All models absorb fixed effects for birth municipality, year-month of birth, spacing in months to younger sibling, second generation immigrant status, maternal age at birth, paternal age at birth, maternal level-field of education, paternal level-field of education, and age at last educational observation. *Length* measures the length of the highest completed education in months. *Ac HS* indicates completion of academic high school. *GPA* is the grade point average from the academic high school standardized at the year of graduation level for the total population with mean zero and standard deviation of one. *Earnings* measures the annual earnings percentile by gender and birth cohort.

Related to the existing literature examining the effect of sibship gender composition on educational attainment, it is relevant to consider whether the results on field of study are driven by the probability of any educational enrollment and completion. Table 5 shows that having a gender-discordant sibling reduces both men's and women's length of highest completed education by age 30 by 0.2 percent (or 8–9 days). Although this effect is precisely estimated and is statistically significant, it is an economically insignificant effect. There is no effect on the probability of enrolling or completing an education at the secondary level or completing the academic high school [Columns (2) through (4)].

Interestingly, Column (5) shows that having an opposite gender sibling decreases women's achievement (measured as the GPA achieved from the academic high school), while men are not affected. Appendix Table A1 show similar effects for exam performance in Danish (native language) and Math at the end of grade 9 for more recent cohorts. These findings on educational performance might help explain why men with a gender-discordant sibling are no more likely to complete a STEM tertiary education than men with a same sex sibling, although having a gender-discordant sibling increases the probability of enrolling in a STEM program. Put differently, there is no evidence that men with an opposite gender sibling have higher ability and therefore, it is not surprising that they are not more likely to complete a STEM tertiary degree. This suggests that having a sibling of the opposite gender makes men over-confident in their choice of education.

Women with an opposite sex sibling are less likely to enroll in and complete a tertiary education but they are not significantly more likely to drop out. In contrast, sibling gender does overall affect men's likelihood of tertiary enrollment or completion, however, in total men with a gender-discordant sibling are more likely to dropout of tertiary education, again supporting the story about men becoming over-confident when having a sister compared to a brother. Finally, Column (9) shows the effect on the earnings percentile by gender and cohort at age 30. Similarly to Peter et al. (2015), I find that men with a sibling of the opposite gender earn less. Though only borderline significant, I find a similar effect for women. The findings of an earnings reduction might be explained by gender differences in competitiveness. Women are less competitive than men and when competing against men, women typically become less willing to enter competition (Niederle and Vesterlund, 2011). This might explain the negative effect for women. Likewise, if traits spill over to siblings, men with a brother might be more competitive than men with a sister, explaining the effect for men.

5.4 Heterogeneity: Exploring Mechanisms

Table 6

Heterogeneity by Parental Division of Labor: Field of Education

	STEM		Typical Female	
	Enr	Compl	Enr	Compl
	(1)	(2)	(3)	(4)
Women				
Opposite Sex Sib	-0.37*	-0.51***	0.32	0.19
	(0.20)	(0.16)	(0.22)	(0.23)
Opp SS × Traditional	-0.93*	-0.28	0.55	1.48***
	(0.47)	(0.39)	(0.54)	(0.55)
N	224,639			
Men				
Opposite Sex Sib	0.86***	0.64***	-0.35*	-0.32**
	(0.22)	(0.22)	(0.19)	(0.15)
Opp SS × Traditional	-0.16	-0.70	-0.15	0.25
	(0.51)	(0.53)	(0.44)	(0.36)
N	236,534			

Standard errors in parentheses, clustered at the year-month of birth level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Each Panel-Column presents estimates from separate regressions. Main sample, excluding individuals with missing information on parental education. All models absorb fixed effects for birth municipality, year-month of birth, spacing in months to younger sibling, second generation immigrant status, maternal age at birth, paternal age at birth, maternal level-field of education, paternal level-field of education, father works at least 80 pct. of parental labor supply, and age at last educational observation. *Traditional* indicates that parental labor supply during childhood is traditional, defined as the father working at last 80 pct. of the parents' joint labor supply. Field of education is at any level.

In this subsection, I explore whether the effects are heterogeneous with respect to how gender-stereotypical the parents are, proxied by their division of labor supply during childhood, parental education, and spacing the the younger sibling.

Table 7
Heterogeneity by Parental Education: Field of Education

	STEM		Typical Female	
	Enr	Compl	Enr	Compl
	(1)	(2)	(3)	(4)
Women				
Opposite Sex Sib	0.72*	0.24	0.09	-0.23
	(0.37)	(0.31)	(0.42)	(0.43)
Opp SS $\times$ Mom $\geq$ HS	-2.28***	-1.66***	1.57**	2.21***
	(0.69)	(0.57)	(0.78)	(0.80)
Opp SS $\times$ Dad $\geq$ HS	-1.19**	-0.52	-0.30	0.58
	(0.52)	(0.43)	(0.58)	(0.60)
Opp SS $\times$ Mom & Dad $\geq$ HS	1.75**	1.00	-0.73	-2.10**
	(0.82)	(0.68)	(0.93)	(0.96)
N	225,020			
Men				
Opposite Sex Sib	0.37	0.40	-0.28	-0.02
	(0.40)	(0.42)	(0.35)	(0.28)
Opp SS $\times$ Mom $\geq$ HS	0.12	-0.49	0.04	-0.14
	(0.75)	(0.78)	(0.65)	(0.53)
Opp SS $\times$ Dad $\geq$ HS	1.30**	0.54	-0.17	-0.24
	(0.56)	(0.58)	(0.48)	(0.39)
Opp SS $\times$ Mom & Dad $\geq$ HS	-1.23	-0.04	0.11	0.03
	(0.90)	(0.93)	(0.77)	(0.63)
N	237,026			

Standard errors in parentheses, clustered at the year-month of birth level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Each Panel-Column presents estimates from separate regressions. Main sample, excluding individuals with missing information on parental education. All models absorb fixed effects for birth municipality, year-month of birth, spacing in months to younger sibling, second generation immigrant status, maternal age at birth, paternal age at birth, maternal level-field of education, paternal level-field of education, mother has at least 12 years of education, father has at least 12 years of education, both mother and father have at least 12 years of education, and age at last educational observation. $\geq HS$ is defined as at least 12 years of education. Field of education is at any level.

Table 6 shows that women's effect of having an opposite gender sibling is heterogeneous by how traditional parents are in their division of labor. Parents are defined as traditional when the father works at least 80 percent of the parents' total labor supply during childhood, which is the case for 18 percent of parents. The effect of having a gender-discordant sibling on the probability of enrolling in a STEM program is more than three times larger for women of traditional parents compared to non-traditional parents, while there is no differential effect for men. Similarly, women with traditional parents are much more likely to complete a Typical Female degree than women with non-traditional parents; in fact, the former group is driving the overall effect.

Table 7 shows that the effects for women are mainly driven by women of high educated mothers. In contrast, the effects for men do not appear heterogeneous in parental education.

Appendix Table A2 shows that the effects to not significantly differ by decade of birth.

Finally, Appendix Figure A4 plots the estimated effects of having a sibling of the opposite gender interacted with birth spacing. For this exercise, I include individuals with up to 15 years to their younger sibling. Overall, the graphs illustrate that the effect is only found for siblings with short spacing, i.e. less than five years.

Overall, these heterogeneity tests suggest that the effects for women are driven by maternal gender-specific investment, stronger gender role models in families with more gender-stereotypic parents, and in families where siblings are relatively close peers as measured by spacing. The effects for men, however, appear inelastic in terms of parental characteristics and are only heterogeneous in spacing to their younger sibling, suggesting that the relevant mechanism for men is sibling interactions rather than parent-child interactions.

5.5 Robustness Checks

The results are robust to alternative definitions of STEM and Typical Female fields as well as to restrictions of the educational level. The results are furthermore robust and very similar when restricting the sample to individuals from two-child families as well as when controlling for family size in the main analysis.

As a placebo test, Appendix Table A3 tests whether the sibling's weekday of birth instead of gender affects gender-stereotypical choice of education. Of all 48 estimates, only one is significant at the five percent level. From this, it is clear that there is no effect of the sibling's weekday of birth.

6 Alternative Strategies

As shown in Section 3, individuals with a sibling of the opposite gender also have fewer siblings on average. This fact raises the inevitable question whether the estimated effects are in fact due to family size rather than sibling gender. Subsection 5.5 mentioned that the main results are robust to restricting the sample to two-child families as well as to controlling for family size. These approaches might, however, lead to biased estimates due to selection issues in the former case and the bad control problem in the latter.

To address the issue with family size and gender composition, I explore two alternative strategies for two samples different from the main sample. The first strategy is to consider the effect of having two opposite sex twins relative to two same sex twins on the first child's outcomes (the twins are born at the second parity). For this strategy, I exclude gender-discordant twins because they will always be dizygotic and might confound the estimates. The second strategy is to examine the effect of a co-twin's gender in a sample of twins. I do this for two samples of twins: first for all twins born at any parity and second, only on the sample of twins born at the first parity. A drawback of this latter approach is that I not have information on whether the twins are mono- or dizycotic.[5]

Table 8 presents the results for the first strategy; i.e. the sample of firstborn children who all have younger twin siblings born at the second parity and the two twins are of same gender but not necessarily monozygotic. Importantly, the twins' gender does not

[5] Peter et al. (2015) show that in their sample of Swedish twins born between 1926 and 1958, the effects are overall similar for men both when including all twins and when excluding monozygotic twins. Meanwhile, the results differ for women; when including monozygotic twins, they do not find an effect of a co-twins gender in contrast to when they restrict the sample to only dizygotic twins.

affect parental fertility in the sample of women. Therefore, the effect of sibling gender can in this sample be interpreted as a pure effect of sibling gender without family size potentially confounding the effect. Though only borderline significant, but similar in magnitude to three child families in Table 1, twin gender affects parental fertility decision in the sample of men. Therefore, I only discuss the findings for women here.

Overall, for women, the effect of having two twin brothers instead of two twin sisters are qualitatively similar to the one found in Section 5. Though, the effect sizes are much larger, which is reasonable given it is the effect of having two instead of one sibling of a particular gender. Women who have two twins of opposite gender than her own are four percentage points less likely to enroll in and complete a STEM degree, corresponding to a change of respectively 14 and 24 percent relative to the mean for women with two twin sisters. Similarly, women with gender-discordant twins are 12 percent more likely to complete a Typical Female degree. At the same time, we observe large effects on educational attainment as well; gender-discordant twins reduce women's highest completed education by four months and the probability of completing a tertiary education by 11 percent.

Table 9 shows the results from the second strategy, i.e. the effect of a co-twins gender. In neither the any parity nor the first parity sample of women, the twins' gender composition affects parental subsequent fertility. In the any parity sample of men, there is an effect, however. In contrast, there is no effect on subsequent fertility in the first parity sample of men. Therefore, the results for the first parity samples for both genders should reflect the pure effect of a co-twins gender and not be confounded with the effect of family size. Overall, the effects of having a co-twin of the opposite gender are similar to the main results: Having a gender-discordant twin makes men and women more likely to choose a gender-stereotypical education

Table 8

Twins at 2^{nd} Parity, Effect on Firstborns

	Next	STEM		Typical Female		Male Share (pct.)		Female Share (pct.)		Length	Any	Tert
	Birth	Enr	Compl	Enr	Compl	> 55	> 75	> 55	> 75	(mth)	Enr	Compl
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Women												
Opposite Sex Twins	-0.33	-3.89*	-4.26**	3.36	5.41**	1.40	-0.56	-1.24	-1.08	-4.16***	0.35	-5.23**
	(1.72)	(2.26)	(1.89)	(2.48)	(2.55)	(1.86)	(0.84)	(2.51)	(2.37)	(1.32)	(1.10)	(2.38)
Same Sex Mean	15.0	27.7	17.8	60.5	45.5	16.0	3.0	61.0	31.2	165.5	94.9	48.7
Pct. Δ rel. to SS	-2.2	-14.1	-24.0	5.6	11.9	8.8	-18.4	-2.0	-3.5	-2.5	0.4	-10.7
N	1,559											
Men												
Opposite Sex Twins	-3.01*	4.00*	4.03	1.74	0.11	0.82	1.13	-0.11	0.48	0.67	1.72	-0.56
	(1.73)	(2.38)	(2.48)	(2.03)	(1.63)	(2.41)	(2.32)	(2.04)	(1.05)	(1.40)	(1.12)	(2.15)
Same Sex Mean	17.1	62.3	47.3	21.0	12.6	56.9	35.4	21.6	4.6	158.3	93.7	31.9
Pct. Δ rel. to SS	-17.6	6.4	8.5	8.3	0.9	1.4	3.2	-0.5	10.5	0.4	1.8	-1.8
N	1,664											

Standard errors in parentheses, clustered at the family level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Sample of firstborn children who have two same sex twins as younger siblings born at the second parity. Each Panel-Column presents estimates from separate regressions. All models absorb fixed effects for birth county, year of birth, second generation immigrant status, maternal level and field of education, paternal level and field of education, and age at last educational observation. The models further control for cubed spacing in months to younger sibling, cubed maternal age at birth, and cubed paternal age at birth. *Next Birth* indicates if the parents get a fourth child. Field of education is at any level. *Any Enr* indicates if the individual enrolls at least once in some program after primary education, corresponding to secondary enrollment.

Table 9

Effect of Co-Twin's Gender

	Next	STEM		Typical Female		Male Share (pct.)		Female Share (pct.)		Length	Any	Tert
	Birth	Enr	Compl	Enr	Compl	> 55	> 75	> 55	> 75	(mth)	Enr	Compl
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Women												
Twin Birth at Any Parity ($N = 15,010$)												
Opp Sex Co-Twin	-0.66	-1.98**	-2.17***	1.40	1.36	-1.79***	-0.45	2.66***	2.64***	-1.88***	-0.67	-2.36***
	(0.59)	(0.78)	(0.64)	(0.91)	(0.92)	(0.67)	(0.30)	(0.92)	(0.86)	(0.51)	(0.51)	(0.85)
Same Sex Mean	25.1	25.0	14.9	60.5	44.9	15.5	2.9	60.5	27.4	159.6	92.4	40.2
Pct. Δ rel. to SS	-2.6	-7.9	-14.6	2.3	3.0	-11.6	-15.5	4.4	9.6	-1.2	-0.7	-5.9
Twin Birth at First Parity ($N = 5,715$)												
Opp Sex Co-Twin	-0.54	-1.48	-2.01*	3.18**	0.89	0.65	0.62	2.34	1.82	-1.83**	-0.16	-2.44*
	(0.35)	(1.31)	(1.09)	(1.50)	(1.56)	(1.13)	(0.48)	(1.53)	(1.47)	(0.89)	(0.74)	(1.46)
Same Sex Mean	42.5	24.9	15.3	61.4	46.3	15.1	2.3	60.6	29.7	161.8	93.8	43.5
Pct. Δ rel. to SS	-1.3	-6.0	-13.1	5.2	1.9	4.3	27.4	3.9	6.1	-1.1	-0.2	-5.6
Men												
Twin Birth at Any Parity ($N = 15,346$)												
Opp Sex Co-Twin	-1.86***	3.40***	1.70*	-0.64	-1.09*	1.97**	2.11**	-1.09	-0.35	-0.41	0.62	-0.68
	(0.60)	(0.90)	(0.93)	(0.74)	(0.60)	(0.93)	(0.88)	(0.79)	(0.42)	(0.55)	(0.51)	(0.81)
Same Sex Mean	25.0	61.3	45.5	21.7	13.1	52.5	33.5	23.1	5.6	156.8	91.7	29.8
Pct. Δ rel. to SS	-7.4	5.5	3.7	-3.0	-8.3	3.8	6.3	-4.7	-6.3	-0.3	0.7	-2.3
Twin Birth at First Parity ($N = 5,795$)												
Opp Sex Co-Twin	-0.40	3.02**	0.97	-1.18	-2.21**	2.02	0.25	-0.24	-0.40	-1.36	1.20	-2.25
	(0.34)	(1.51)	(1.55)	(1.29)	(1.03)	(1.55)	(1.45)	(1.36)	(0.76)	(0.94)	(0.75)	(1.41)
Same Sex Mean	40.8	61.2	45.0	23.7	14.2	51.1	32.4	24.3	6.3	158.6	93.6	32.1
Pct. Δ rel. to SS	-1.0	4.9	2.2	-5.0	-15.6	4.0	0.8	-1.0	-6.3	-0.9	1.3	-7.0

Standard errors in parentheses, clustered at the year-month of birth level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Each Panel-Column-Sample presents estimates from separate regressions. The sample consists of twins born at respectively *any* and *first* parity. All models absorb fixed effects for birth county, second generation immigrant status, and age at last educational observation. The models for the *Any Parity*-sample further absorb fixed effects for year-month of birth, maternal age at birth, paternal age at birth, maternal level-field of education, paternal level-field of education, and parity. The models for the *First Parity*-sample further absorb fixed effects for year of birth maternal level and field of education, paternal level and field of education, and control for cubed maternal and paternal age at birth. *Next Birth* indicates if the parents get a subsequent child. Field of education is at any level. *Any Enr* indicates if the individual enrolls at least once in some program after primary education, corresponding to secondary enrollment.

7 Conclusion

In this study, I have examined whether and how the gender composition of siblings affects the individual's choice of gender-stereotypical education. The analysis shows that having an opposite sex sibling increases the probability that both men and women enroll in and complete a more gender-stereotypical education compared to individuals with a same sex sibling. Thus, the family environment is clearly an important contributor to gender-bias in the choice of education.

References

Amin, V. (2009). Sibling sex composition and educational outcomes: A review of theory and evidence for the uk. *Labour 23*(1), 67–96.

Anelli, M. and G. Peri (2014). Gender of siblings and choice of college major. *CESifo Economic Studies 61*(1), 53–71.

Atkinson, R. D. and M. J. Mayo (2010). Refueling the us innovation economy: Fresh approaches to science, technology, engineering and mathematics (stem) education.

Booth, A., L. Cardona-Sosa, and P. Nolen (2014). Gender differences in risk aversion: Do single-sex environments affect their development? *Journal of economic behavior & organization 99*, 126–154.

Brim, O. G. (1958). Family structure and sex role learning by children: A further analysis of helen koch's data. *Sociometry 21*(1), 1–16.

Butcher, K. F. and A. Case (1994). The effect of sibling sex composition on women's education and earnings. *The Quarterly Journal of Economics 109*(3), 531–563.

Conley, D. (2000). Sibship sex composition: Effects on educational attainment. *Social Science Research 29*(3), 441–457.

Fortin, N. M., P. Oreopoulos, and S. Phipps (2015). Leaving boys behind gender disparities in high academic achievement. *Journal of Human Resources 50*(3), 549–579.

Hauser, R. M. and H.-H. D. Kuo (1998). Does the gender composition of sibships affect women's educational attainment? *Journal of Human Resources*, 644–657.

Kaestner, R. (1997). Are brothers really better? sibling sex composition and educational achievement revisited. *Journal of Human Resources 32*(2).

Koch, H. L. (1955). Some personality correlates of sex, sibling position, and sex of sibling among five-and six-year-old children. *Genetic Psychology Monographs*.

Niederle, M. and L. Vesterlund (2011). Gender and competition. *Annu. Rev. Econ. 3*(1), 601–630.

OECD (2016). *Education at a Glance 2016: OECD Indicators.*

Oguzoglu, U. and S. Ozbeklik (2016). Like father, like daughter (unless there is a son): Sibling sex composition and womens stem major choice in college.

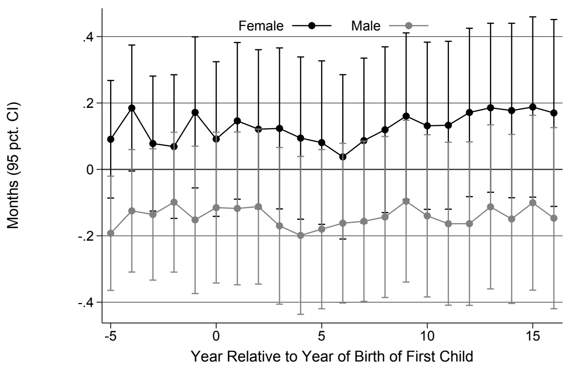
Peri, G., K. Shih, and C. Sparber (2015). Stem workers, h-1b visas, and productivity in us cities. *Journal of Labor Economics 33*(S1), S225–S255.

Peter, N., P. Lundborg, and D. H. Webbink (2015). The effect of sibling's gender on earnings, education and family formation.

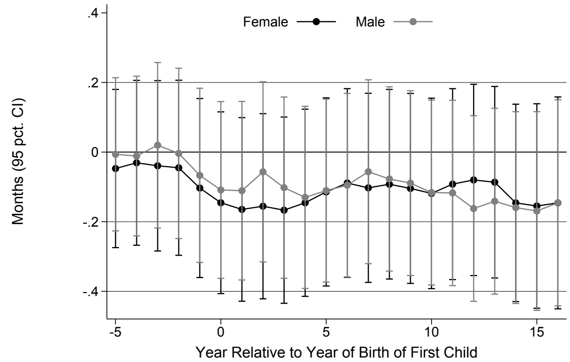
Schneeweis, N. and M. Zweimüller (2012). Girls, girls, girls: Gender composition and female school choice. *Economics of Education review 31*(4), 482–500.

A Appendix

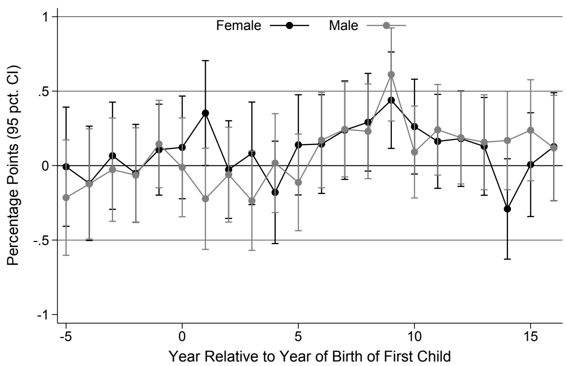
Figure A1
Parental Characteristics by Sibling Gender Composition (Cohorts 1985–2002)



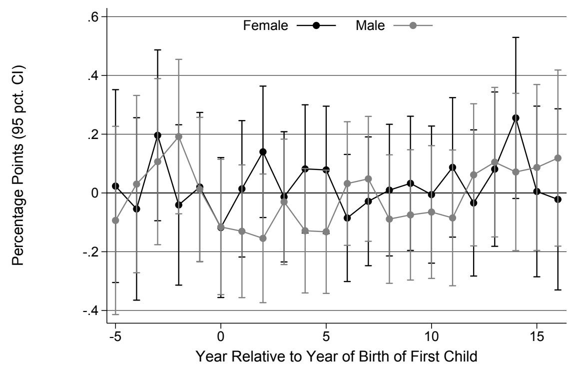
(a) Mother's Edu (months)



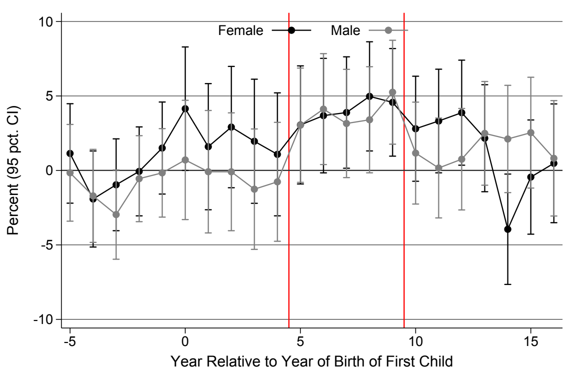
(b) Father's Edu (months)



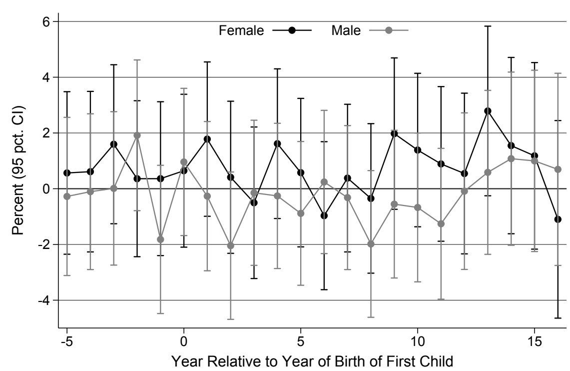
(c) Mother is employed



(d) Father is employed



(e) Mother's log(earnings)

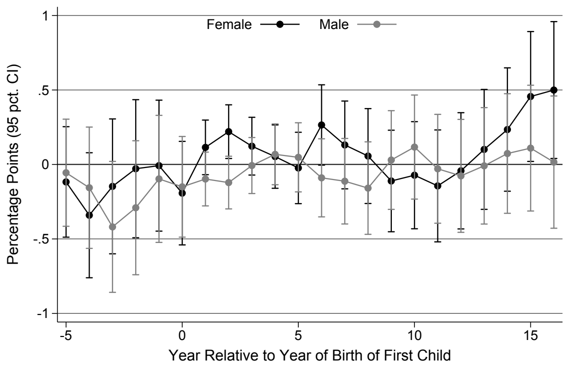


(f) Father's log(earnings)

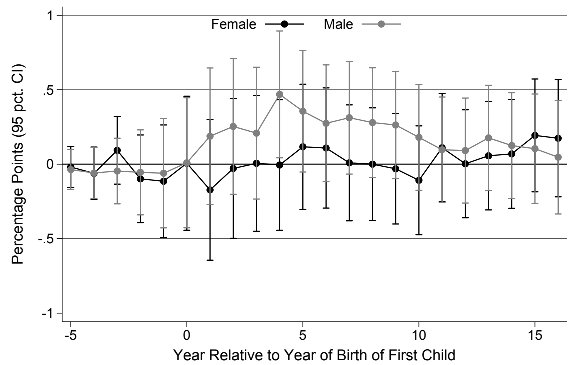
Note: Birth cohorts 1985–2002.

Figure A2

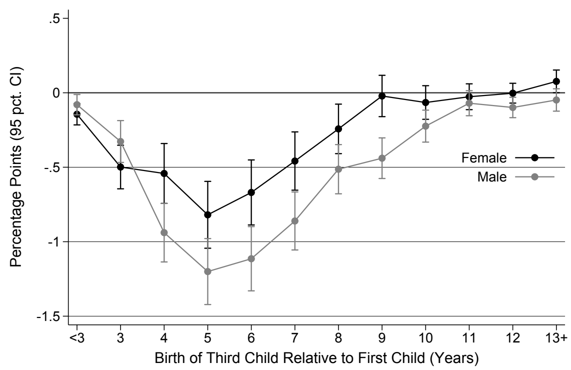
Family Structure and Fertility by Sibling Gender Composition (Cohorts 1985–2002)



(a) Parental Cohabitation



(b) Married Parents

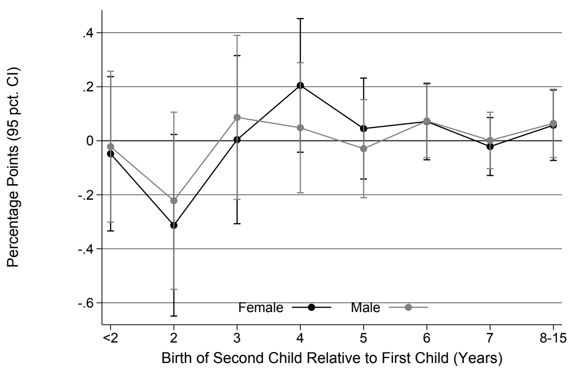


(c) Prob. of Third Child

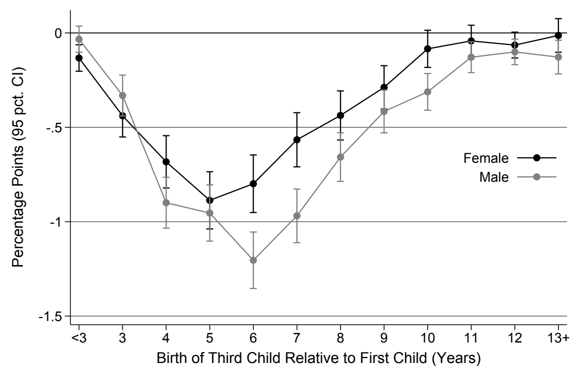
Note: Birth cohorts 1985–2002.

Figure A3

Fertility by Sibling Gender Composition (Main Sample)



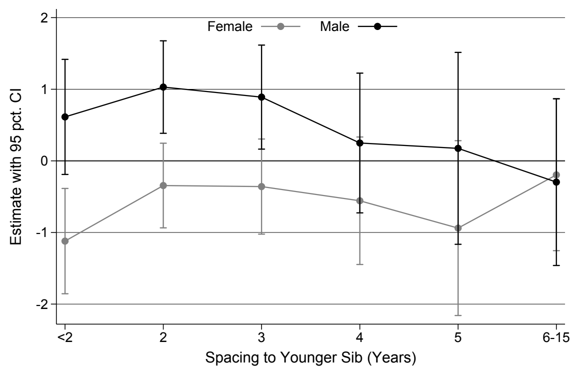
(a) Spacing to Second Child



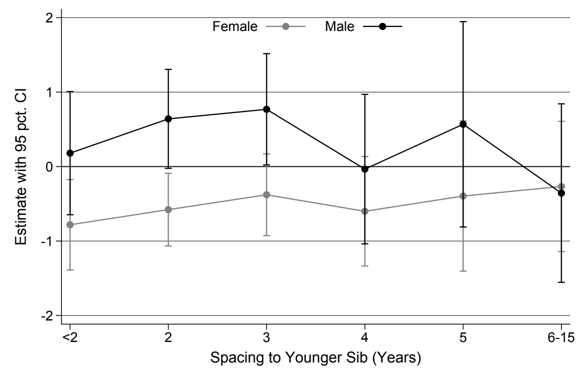
(b) Prob. of Third Child

Note: Birth cohorts 1960–1988 (main sample).

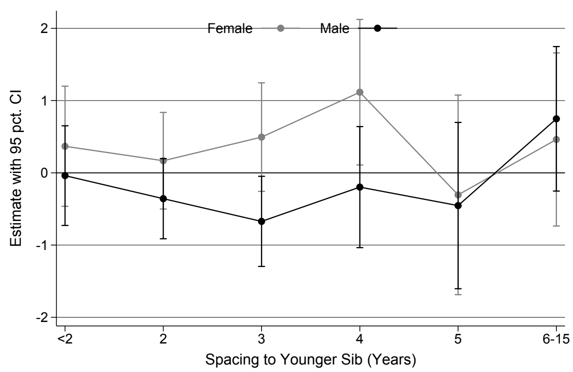
Figure A4
Heterogeneity by Spacing: Field of Education



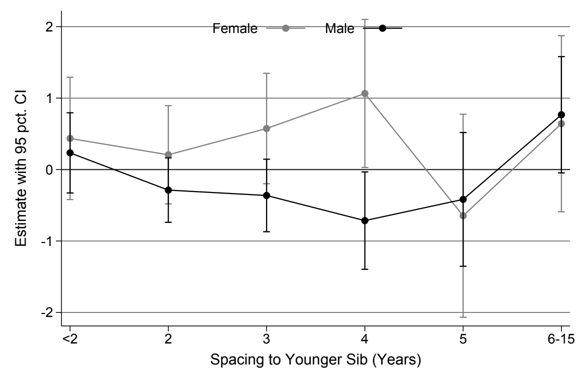
(a) Any STEM Enrollment



(b) Any STEM Degree



(c) Any Typ. Fem. Enrollment



(d) Any Typ. Fem. Degree

Note: Main sample extended to include individuals with spacing to younger sibling of up to 15 years. All graphs show the difference between individuals with a gender-discordant sibling and individuals with a same sex sibling. Graphs (a) and (b) illustrate the difference in the share of each cohort completing a STEM degree at any educational level, while Graphs (c) and (d) illustrate the difference in the share of each cohort completing a typical female degree at any educational level.

Table A1
Educational Achievement

	Has Exam Observation			GPA		
	Danish	Math	Ac. HS	Danish	Math	Ac. HS
	(1)	(2)	(3)	(4)	(5)	(6)
Women						
Opposite Sex Sib	-0.03	-0.07	-0.28	-1.20**	-1.13**	-1.55***
	(0.16)	(0.17)	(0.18)	(0.53)	(0.55)	(0.54)
Mean	91.5	90.7	51.4	40.5	17.9	4.0
N	109,333	109,333	234,965	99,995	99,207	120,674
Men						
Opposite Sex Sib	-0.06	0.01	-0.20	0.16	0.52	0.49
	(0.18)	(0.18)	(0.17)	(0.56)	(0.54)	(0.68)
Mean	87.6	87.4	33.9	-3.5	27.5	6.7
N	116,212	116,212	247,562	101,796	101,599	83,830

Standard errors in parentheses, clustered at the year-month of birth level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The sample for Danish and Math GPA consists of cohorts born between 1986 and 1999 with similar restriction criteria as for the main sample. The sample for the academic high school GPA consists of the main sample. Each Panel-Column presents estimates from separate regressions. All models absorb fixed effects for birth municipality, year-month of birth, spacing in months to younger sibling, second generation immigrant status, maternal age at birth, paternal age at birth, maternal level-field of education, and paternal level-field of education. All *GPA* measures are standardized at the year of graduation level for the total population with mean zero and standard deviation of one. Danish and Math GPA is from the written exams at the end of grade 9.

Table A2

Heterogeneity by Decade of Birth: Field of Education

	STEM		Typical Female	
	Enr	Compl	Enr	Compl
	(1)	(2)	(3)	(4)
Women				
Opposite Sex Sib	-0.81***	-0.64***	0.54*	0.70**
	(0.27)	(0.23)	(0.31)	(0.32)
Opp Sex Sib × 1970–79	0.20	0.05	-0.16	-0.03
	(0.41)	(0.34)	(0.46)	(0.48)
Opp Sex Sib × 1980–88	0.76*	0.22	-0.17	-0.87
	(0.45)	(0.38)	(0.51)	(0.53)
N	228,856			
Prob>F	0.244	0.833	0.924	0.211
Men				
Opposite Sex Sib	0.64**	0.50	-0.35	-0.28
	(0.30)	(0.31)	(0.26)	(0.21)
Opp Sex Sib × 1970–79	0.41	-0.15	-0.03	0.00
	(0.45)	(0.46)	(0.38)	(0.31)
Opp Sex Sib × 1980–88	0.00	0.12	0.03	0.08
	(0.49)	(0.51)	(0.42)	(0.34)
N	240,902			
Prob>F	0.609	0.875	0.988	0.970

Standard errors in parentheses, clustered at the year-month of birth level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Each Panel-Column presents estimates from separate regressions. Main sample. All models absorb fixed effects for birth municipality, year-month of birth, spacing in months to younger sibling, second generation immigrant status, maternal age at birth, paternal age at birth, maternal level-field of education, paternal level-field of education, and age at last educational observation. Field of education is at any level. F-test of whether estimates of opposite sex sibling interacted with decade of birth are jointly significant (p-values reported).

Table A3

Placebo: Singling's weekday of birth

	Women				Men			
	STEM		Typical Female		STEM		Typical Female	
	Enr	Compl	Enr	Compl	Enr	Compl	Enr	Compl
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sunday	0.67**	0.33	-0.51	-0.47	0.04	0.13	0.29	-0.02
	(0.34)	(0.28)	(0.39)	(0.40)	(0.37)	(0.39)	(0.32)	(0.26)
Monday	0.24	0.28	-0.12	-0.36	-0.05	-0.08	0.42	0.29
	(0.33)	(0.27)	(0.37)	(0.38)	(0.36)	(0.37)	(0.31)	(0.25)
Tuesday	0.37	0.30	-0.15	-0.12	-0.08	0.07	-0.01	0.19
	(0.32)	(0.27)	(0.36)	(0.37)	(0.35)	(0.36)	(0.30)	(0.24)
Thursday	0.40	0.28	-0.20	-0.31	-0.53	-0.34	0.45	0.35
	(0.32)	(0.27)	(0.37)	(0.38)	(0.35)	(0.36)	(0.30)	(0.24)
Friday	0.19	0.36	0.04	0.09	0.01	0.03	-0.03	-0.10
	(0.32)	(0.27)	(0.37)	(0.38)	(0.35)	(0.36)	(0.30)	(0.24)
Saturday	0.03	0.30	-0.13	0.11	-0.15	-0.11	0.21	0.14
	(0.34)	(0.28)	(0.38)	(0.39)	(0.36)	(0.38)	(0.31)	(0.25)
N	228,856				240,902			
Prob>F	0.479	0.883	0.872	0.674	0.730	0.908	0.471	0.489

Standard errors in parentheses, clustered at the year-month of birth level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Each Panel-Column presents estimates from separate regressions. All models absorb fixed effects for birth municipality, year-month of birth, spacing in months to younger sibling, second generation immigrant status, maternal age at birth, paternal age at birth, maternal level-field of education, paternal level-field of education, and age at last educational observation. Field of education is at any level. F-test of whether estimates of sibling's weekday of birth are jointly significant (p-values reported).