Brothers, Sisters and STEM-Majoring: Is a Younger Sibling's Choice of College Major Affected by the Firstborn's Sex and Ability in Math?

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Short Abstract

Though women reached parity with men in terms of college attendance, fewer women choose STEM majors. We examine whether the compositional characteristics of a sib-group are associated with a younger sibling's decision to pursue a STEM major in college. Theoretically, we conjoin and extend sociological theories that link sib-group configuration and educational attainment to STEM majoring. Empirically, we use data from the children of the NLSY79-cohort and find that sib-group size is negatively associated with pursuing a STEM major. We show that math ability of the firstborn is positively associated with a sibling's choice of a STEM major in college, but only among same-sex siblings. Finally, number of brothers is positively associated with choosing a STEM major for both girls and boys. Our work is the first to provide evidence about the link between sib-group compositional characteristics and the choice of college major by younger siblings in the U.S.

Extended Abstract

Motivations and Objectives

Though women reached parity with men in terms of college attendance, fewer women choose STEM majors. While inequalities are often understood as occurring between family units, gender inequalities can also operate within these units. With this paper we ask, is the composition of a sib-group associated with a younger sibling's decision to pursue a STEM major in college? We conjoin several theoretical approaches, including the *resource dilution* theory, the social learning aspects of the *role modeling* perspective, and the (revised) *sex minority hypothesis*, to offer explanations for how sibling relationships shape the development of younger siblings' individual preferences and abilities. Extending these theories to STEM majoring, we offer the following research inquiries:

1. Does the likelihood that a younger born sibling chooses a STEM degree vary depending on the size of the sib-group and his/her birth ordering?
2. Is a younger born sibling more or less likely to pursue a STEM degree if their older sibling has high math ability?
3. Is a younger born sibling more or less likely to pursue a STEM degree if their firstborn sibling is the same sex? And if he/she has more siblings of the same sex?
4. Is positive or negative role modeling facilitated best among same- or different- sex siblings?

Using the National Longitudinal Survey of Youth 1979 cohort (NLSY79) and examining the educational outcomes of the offspring of original sample members, our work is the first to provide comprehensive empirical evidence about the link between sib-group compositional characteristics and the choice of college major by younger siblings in the U.S. We show that size and sex composition of a sib-group are important predictors of college-major choice. In accordance with the resource dilution hypothesis, we find that sib-group size is negatively associated with pursuing a STEM major. We show that math ability of the older sibling is positively associated with a younger sibling choosing a STEM major in college, yet this impact is only present when the sibling pair is of the same sex. Combining and extending existing theories that link sib-group configuration and educational attainment to STEM majoring allows us to enrich our understanding of the complex association between sib-group compositional characteristics and choosing to major in STEM in college.

Theoretical Background

Gender Segregation in STEM Fields

Despite women surpassing men in tertiary education attendance and completion, women today are still less likely than men to major in science, technology, engineering and math (STEM) fields, even as they have achieved parity in the fields of medicine, law and chemistry (Beede et al. 2011; Riegle-Crumb et al. 2012; Alon and Gelbgiser 2010; National Science Foundation 2013; Charles and Bradley 2009). As a result, notwithstanding making up nearly half of the U.S. workforce and half of the college-educated workforce, women hold less than 25 percent of STEM-type jobs (Beede et al. 2011). This horizontal gender segregation contributes to persisting income inequality between men and women because STEM occupations tend to be higher paying than the helping and service-type careers in which female college graduates are overrepresented (Charles and Grusky 2004; Beede et al. 2011).

It has been argued that the differential filtration of females into STEM careers is an outcome of differential gender role socialization during childhood and adolescence, exposure to specific tasks and roles models, as well as emotional and financial support for engaging in mathematical and technical activities (see Fouad et al. 2010 for a review). Sociologists and demographers have long recognized that the family is one of the most powerful socializing institutions – it is the first social group into which an individual is born and remains important throughout the life course. Children first learn about gendered social expectations, attitudes and behaviors from within the family. From the moment they are born, parents provide their children with insights and lessons about gender roles, teaching them what it means to be male or female by role modeling and encouraging different behaviors and activities for sons and daughters (Bussey and Bandura 1999; Lytton and Romney 1991; McHale, Crouter, and Whiteman 2003). Role-modeling and motivational encouragement are vivid not only within and throughout parent-offspring interaction, but also between siblings, the main research interest in our paper. At the core of our study is the question of whether and how sib-group compositional characteristics may affect gender differences in STEM majoring later in life. While we do not measure interactions between siblings and influences they may have on each other directly, we do provide a descriptive overview of how a sib-group size and sex composition, as well as firstborn sex and math ability, relate to STEM-majoring among the second-to last-born siblings.

The Influence of Siblings

Even though siblings share genes and also often a similar environment by living at the same home during their childhood, sibling outcomes are greatly diverse (Björklund and Jäntti 2012). This sibling divergence is attributed to different experiences within the family, namely that the social environment within the family is experienced differently for each sibling depending on sibling compositional characteristics. Several social theoretical approaches have been formulated on how sib-group compositional characteristics may affect the amount of schooling and educational attainment. That said, most researchers focus mainly on the advantages attributable to spending longer in the educational system, while studies examining horizontal differences in educational pathways by sibling compositional characteristics are rather rare. In the following, we review this body of research, and extend existing concepts and theoretical approaches to derive our hypotheses about the likelihood that a younger sibling will major in STEM versus another subject area.

There is a deep and longstanding body of research on the association between sibling compositional characteristics and educational attainment (see Steelman et al. 2002 for a review; Buchmann, DiPrete, and McDaniel 2008; Härkönen 2013). This vast research reveals several ways in which sibling group characteristics are associated with educational outcomes. There is widespread agreement in U.S. studies that as the *number of siblings* increases, individual academic achievement declines (Blake 1981, 1986, 1989; Blau and Duncan 1967; Conley and Glauber 2006; Downey 1995, 2001; Featherman and Hauser 1978; Kidwell 1981; Kuo and Hauser 1997; Parcel and Menaghan 1994; Powell and Steelman 1989). Moreover, Firstborn children tend to achieve higher educational attainment than later-born children (Price 2010, 2008; Powell and Steelman 1990, 1993 for the US; Black, Devereux, and Salvanes 2005 for Norway, and more recently Björklund and Jäntti 2012 for Sweden). This negative relationship between *birth order* and educational attainment has also been observed using birth order as a continuous variable (Behrman and Taubman 1986; Black, Devereux, and Salvanes 2005; Booth and Kee 2005, and more recently De Haan 2010).

The negative association between sib-group size and birth ordering is partly explained by the *resource dilution hypothesis*, first proposed by Blake (1981), which predicts that as the number of children in the family increases, the share of parental resources available to each child falls (Blake 1981, 1986, 1989; Downey 2001; Anastasi 1956; Downey 1995; Powell and Steelman 1990, 1993; Price 2008, 2010; Black, Devereux, and Salvanes 2005). Hence, siblings from smaller families and older siblings tend to hold an advantage over siblings from larger families and later-born counterparts in access to parental financial resources (De Hann 2010), time investments (Price 2008), energy, monitoring and supervision efforts (Hotz and Pantano 2015), and engagement in their children's lives. The resource differentiation between siblings results in lower educational attainment for children from larger families and later-born siblings (Price 2010, 2008; Powell and Steelman 1990, 1993 for the US; Black, Devereux, and Salvanes 2005 for Norway, and more recently Björklund and Jäntti 2012 for Sweden). The constraints on available parental financial and time resources for their children are not solely due to sibling group size and birth ordering, but also result from the degree of temporal spacing between siblings. Longer spacing between siblings allows for greater parental investment in older children, contributing to the positive link between spacing and academic outcomes (Price 2010; Kidwell 1981; Powell and Steelman 1990, 1993, 1995; Buckles and Munnich 2012; Galbraith 1982; Bu 2016). Hence, it is necessary for birth spacing to be accounted for when examining siblings' educational attainment.

College major, as a qualitative measure of educational attainment, is an indicator of horizontal educational hierarchy as STEM fields are generally regarded as more prestigious and demanding than non-STEM disciplines. Since the cultivation of STEM skills requires special investments, accordingly we assume that individuals from larger sib-groups and younger siblings to be less likely to choose a STEM major in college. In the only study we know of to test the link between sibling compositional characteristics and college major, Barclay, Hallsten and Myrskyla (2017) use Swedish data to demonstrate that firstborns are more likely to study more prestigious college majors, college majors with greater expected earnings and greater expected occupational prestige, compared with later-born siblings. Since the Swedish education system provides free tertiary education, these results are not mainly driven by the exhaustion of family financial resources. The link between birth ordering and college major, therefore, could be even more pronounced in a context where tuition fees are high, as in the US, the setting of our study. Following the resource dilution argument, we expect that, *sib-group size and birth ordering negatively affect the likelihood of selecting a STEM-major in college. Individuals from larger sib-groups and younger siblings are less likely to choose a STEM major in college, compared with older siblings and those from smaller families*.

The dynamics of parental resource distribution are not the only mechanism affecting siblings' differential outcomes, also important are siblings' direct experiences with one another. Siblings can have direct effects on one another's development and attainments when they serve as social partners and *role models* during everyday interactions. Siblings, especially at early ages, spend the majority of their time with one another, playing, bonding, arguing and quarrelling. This strong social attachment can be regarded as a positive experience when older siblings' constructive social behavior promotes the formation of pro-social skills and conflict resolution strategies. Brim (1958) describes the social learning process, finding that older siblings are much more influential role models than younger siblings. Reviewing several studies, Dunn (1983) reported that, by the second year, second-born children imitate many behaviors of their older siblings. During their childhood, children have unique opportunities throughout interactions with older siblings to develop their social-cognitive skills, such as emotion understanding, negotiation, persuasion, and problem solving (Brown, Donelan-McCall and Dunn 1996, Dunn 2007, Howe, Rinaldi, Jennings and Petrakos 2002). In adolescence, siblings contribute to individuals' academic engagement (Bouchey, Shoulberg, Jodl and Eccles 2010).

Following the perspective of social learning via sibling modeling, we expect a younger sibling to learn from and imitate the characteristics of an older sibling. As such, older siblings with high interest/ability in science and math will encourage younger siblings to develop and improve the same set of skills. That said, however, individuals may choose to pursue interests and abilities that are explicitly different from their older sibling. Siblings may see one another as foils, hence they select different niches in the family and develop distinct qualities. Role modeling, thus, can be 'positive' or 'negative', leading either to imitation or to distancing and oppositional development. We offer two alternative hypotheses: *Growing up with firstborn math skilled sibling, individuals are more likely to opt for a STEM major in college.* Alternatively, *high math skilled firstborn sibling will push his/her younger sibling to opt for a non-STEM major in college.*

Most of literature on the relationship between sibling compositional characteristics and educational outcomes focuses mainly on size, birth order and spacing but mostly ignores the sex composition of the sibling group. The scarce existing research on the relationship between the sex composition of a sib-group and educational attainment focuses mainly on the amount of educational attainment and yields mixed results (Conley 2000; Powell and Steelman 1990, 1989; Butcher and Case 1994; Kaestner 1996, 1997; Kuo and Hauser 1997). Powell and Steelman (1990), for example, found that there is no effect of sex composition on standardized test scores, and that both brothers and sisters have negative effect on grades. Nevertheless, the same authors found in another study that number of brothers negatively affects parental financial contributions to college expenses, while number of sisters does not (Powell and Steelman 1989). Butcher and Case (1994) showed that women raised with more brothers do significantly better than those raised with sisters, whereas amongst men the parallel effects were insignificant. In reply, Hauser and Kuo (1998) disagreed with Butcher and Case's interpretation of their own results, casting doubt on their findings of an effect of gender composition of the sibling group but rather a mix of negative and positive coefficients for the presence of sisters. Taking race into account, Kaestner (1997) showed that among black adults, those who grew up with a sister or who had relatively more sisters had greater levels of educational attainment than black adults with no or fewer sisters. For Whites, no effects of sibship gender configuration on attainment or achievement were found.

Furthermore, many of the studies focus on explaining differences in educational attainment between family types (i.e. at the family-level of analysis), which, as Breen and Gabay-Egozi (2013) point out, assumes that the effects of sibling group compositional characteristics are the same for women and men. In the few studies we know of that did explicitly investigate how sex composition of a sibling group relates to educational attainment, none accounted for the possibility that the impacts of sib-group composition may be experienced differently by girls and boys, nor did any offer theoretical explanations for their results (Powell and Steelman 1989, 1990; Butcher and Case 1994; Kaestner 1997; Kuo and Hauser 1997; Bu 2016).

One exception is Conley's (2000) finding that kids raised with siblings of the opposite sex have a lower level of educational attainment than their same-sex peers with same-sex siblings. Conley (2000) suggests that it is relatively disadvantageous to have siblings of the opposite sex, as same-sex siblings stimulate a competitive environment, which pushes children to perform better. Competition, following Conley, describes the propensity for siblings of the same sex to compete with one another in similar tasks, leading to higher outcomes compared to individuals who lack a same-sex sibling. Higher educational attainment is the result of this positive competition as same-sex siblings push one another further than they would otherwise go. Conley's theory is related to the sex-minority hypothesis proposed by Rosenberg (1965)[1], as it is advantageous to be similar to siblings in terms of sex because of the competition this arrangement invites. Following Conley's *(revised) sex minority hypothesis* we expect that, a younger girl with a firstborn sister (and with sisters) is more likely to opt for a STEM major in college than a younger girl who was raised with a firstborn brother (and with other brothers). Similarly, a younger boy with a firstborn brother (and with other brothers) is more likely to opt for a STEM field than a boy who was raised with a firstborn sister (and with other sisters).[2]

The sibling group is a dynamic social institution, and it is not immediately clear how all these theories may interact with one another. Examining together the role-modeling perspective and the same-sex competition approach exposes the possibility that some theoretical predictions may mediate or moderate others and that the theoretical approaches are not necessarily mutually exclusive, nor are the necessarily competing explanations for sibling dynamics. For example, social psychology research suggests that the role-modeling impacts of older siblings is enhanced when siblings are in a same-sex configuration (Brim 1958, Koch 1960). For example, at age 3 both boys and girls with same-sex older siblings acted more 'sex-typed' than children with older opposite-sex siblings (McHale et. al. 2003, 2012). Following this line of reasoning, we further hypothesize that, the effect of math skilled firstborn sibling on the likelihood a younger sibling to opt for a STEM major in college to be more pronounced with same-sex siblings.

A limitation of focusing on structural variables, however, is that the social and psychological processes purported to account for sibling compositional characteristics effects are indirect. Thus, we do not directly address mechanisms to explain gender differences in STEM majoring, but aim to offer an

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[1] According to Rosenberg's (1965) sex minority hypothesis, which it is argued without direct empirical support, parents will have a greater attachment to children who are a minority with respect to the sex in the sibling constellation, as they enjoy a special status in contrast to children in same-sex sib-group. In other words, Rosenberg's theory predicts that girls with only brothers have better educational outcomes than girls who were raised with sisters since the former occupy a position of privilege.

[2] Having said that, however, one may reject the positive framing that Conley attached to the competition amongst same-sex siblings. It is possible for competition between siblings to be non-collaborative and even adversarial, leading to less positive (or other) outcomes. We continue our analysis while acknowledging this possibility.

empirical test for the possible link between sibling compositional characteristics and college major, currently under-researched in the social demographic literature. Focusing on college major choice, a gendered educational outcome that takes place rather late in life, provides an illuminating perspective of whether sibling compositional characteristics - size, birth order, sex-composition, and firstborn math skills - have a lifelong effect on young siblings' college educational choices.

Data and Analytical Strategy

We use data from the *National Longitudinal Survey of Youth* 1979 cohort (NLSY79) and examine the educational outcomes of the offspring of original female sample members. Excluding any individuals with missing information on the variables of interest yielded an analytic sample of 2,154[3] non-firstborn children (only 2nd, 3rd and 4th borns) - 1,052 females and 1,102 males - from 1,543 households. Among the 1,543 households, 1,130 households are contained co-residential siblings respondents. We account for dependence between co-residential siblings using cluster for household ID and sample weights as provided by the NLSY79.

Our main *dependent variable* is an indicator that measures whether or not a respondent's first declared major for college is a STEM-field. Following other studies, we grouped programs of science, technology, engineering, mathematics and doctoral-track medicine as STEM majors, while a course of study focusing on the humanities, social sciences, and clinical or health sciences (non doctoral-track) were considered non-STEM majors (Morgan, Gelbgiser, and Weeden 2013). Among our 2,154 young sibling sample members, 1,319 attended college, 306 of them in STEM fields, whereas 835 had no college experience.

Our analysis includes six key *independent variables* accounting for sib-group compositional characteristics and the firstborn's math ability. First, we considered three measurements of sib-group configuration related to resource dilution: s*ib-group size* ranging from 2 to 4 siblings, *birth ordering* to signify the focal child birth position within the sib-group, and *birth spacing* that expresses the age distance between the eldest sibling and the focal child[4], coded as a continuous variable measured in months. Next, we accounted for the same-sex competition hypothesis by constructing two measurements of sib-group sex composition: the *sex of the firstborn* (male coded as 1, female as 0), and the *number of brothers* in a sib-group. Finally, we accounted for the role modeling perspective by including a measure of the latent *math ability for firstborn sibling* during early adolescence, which is based on scores from the math subtest of the Peabody Individual Achievement Test (PIAT). The PIAT is a widely used measure of academic achievement for children aged 5-15 and is generally considered to be highly reliable (Center for Human Resource Research 2009). Our measure of math ability relies on siblings' standardized test scores when

[3] Most attritions are attributed to missing values for mathematic ability during early adolescence for firstborn sibling (299 respondents were wiped out from our sample) and respondents (additional 192 dropped).
[4] We tested for alternative measurement of birth spacing expressing the age distance between the eldest sibling and the youngest child, which yielded similar results (not shown).

they were between the ages 10-14. We used the most recent standardized score assessment available within that age bracket, and centered the scores to the mean.

Important controls in our analysis include various measures of individual and parental characteristics: child's birth cohort, race/ethnicity, and math ability, mother's education, number of parents in the household, measurement for mother's occupation that captures her employment status *and* occupational gender-orientation when the focal child was between the ages 6-14, and family income (logged and adjusted to constant dollars) while the focal child was aged 6 to 10.

Modeling Strategy

The guiding overarching research question of this paper is whether or not the compositional characteristics of the sib-group are associated with a younger sibling's decision to pursue a STEM major in college. [5] As mentioned above, we distinguish between three educational attainments, but mainly have an interest in the college-related ones, as the non-college-attending category was accounted for selection into college. We estimated four nested multinomial logit models, presented in Table 3, each predicting the log-odds that a focal sibling chose a STEM-major rather than non-STEM fields (or non-college attendance) as a function of sib-group compositional characteristics and important controls. The coefficients from all models represent the partial association between the log-likelihoods of choosing a STEM major in college rather than non-STEM and an independent variable, holding other observable traits constant. All models were estimated using the appropriate weights as provided by the NLSY79 with standard errors clustered on household ID in order to account for dependence between co-residential siblings.

Results

Table 1 presents the number of focal children in our sample by sib-group size, birth ordering and the sex of the firstborn sibling for the entire sample and for girls and boys separately. The distribution of sib-group compositional characteristics was similar for girls and boys; about 43% were from 3-child families, 31% from 2-child families, and the remaining 25% were raised in 4-child households. Amongst our 2,154 sample members, the majority were second born sibling, 25% were the third born sibling in their families, and only 5% were the youngest out of 4-child families. Finally, our female and male respondents had an equal likelihood of having a brother or a sister as their firstborn sibling.

[Table 1 about here]

In Table 2 we present the means (and standard deviations) for dependent and independent variables for girls and boys with p-values associated with the differences in these means. The results show, as expected, that young female and male siblings were rather similar on measured demographic characteristics, but differ in the main social outcome, educational curricular choice. Whereas girls were more likely to attend college, boys were more likely than girls (0.16 vs. 0.12, p=0.016) to choose STEM

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[5] The effects on the other two possible educational choice contrasts (STEM versus no college, and non-STEM versus no college) are not reported here and can be obtained by request from the authors.

fields in college, whereas girls compared to boys (0.59 vs. 0.36, p=0.000) tended to choose non-STEM major.

[Table 2 about here]

Table 3 contains estimates from four multinomial logistic regression models, predicting the log-odds that a focal sibling choses a STEM-major as a function of sib-group compositional characteristics and potential confounders. Our final model, Model IV, points to the following findings: a younger sibling raised in smaller families was more likely to opt for a STEM major in college compared to larger families ($e^{-0.413}$ =0.662, p=0.010), giving support to the resource dilution perspective in the context of college curricular decision-making. Interestingly, and unexpectedly, both girls and boys were equally affected by the number of brothers in their household: with each additional brother in a sib-group, a young sibling was 1.48 more likely to choose a STEM major in college ($e^{0.414}$ =1.513, p=0.040). Considering same-sex competition via role modeling, Model IV indicates that for female respondents, firstborn sister's math ability was positively correlated with choosing a STEM major ($e^{0.039}$ =1.04, p=0.005), whereas having a firstborn brother with high mathematic ability slightly reduced his younger sister's likelihood of choosing a STEM major ($e^{0.039}$ =1.04, p=0.005, and interaction term $e^{-0.053}$ =0.95, p=0.002). Among male respondents we find that a firstborn math skilled male sibling was positively influential on his brother's educational decision ($e^{0.039}$ =1.04, p=0.005, and two interaction terms: $e^{-0.056}$ =0.95, p=0.001 and $e^{0.087}$ =1.09, p=0.000), whereas a firstborn female with high math ability reduces a little the chances of her brother to choose a STEM major ($e^{0.039}$ =1.04 and interaction term $e^{-0.056}$ =0.95, p=0.001). The results indicate that the positive boost associated with competition among same-sex siblings (STEM choice) was via positive role-modeling (firstborn with math skills), at least for girls.

[Table 3 about here]

To facilitate the presentation of our findings, we graphed the parameter estimates in Model IV to present conditional marginal effects of firstborn sex and math ability on educational curricular attainment, for girls and boys (Figure 1). Figure 1 clearly shows that the effect of firstborn math ability was the highest and positive for same-sex dyads, but for opposite-sex pairs the effect was much lower and even negative. According to the confidence band in Figure 1, younger girls with firstborn sisters were statistically different from opposite-sex siblings but not different from younger boys with firstborn brothers. Oldest sibling math ability, therefore, was a positive influence for same-sex siblings, mainly for young females. We also graphed the parameter estimates in Model IV to present adjusted predicted probabilities of selecting a STEM major in college by firstborn sex and math ability for girls and boys, holding all other individual and family background characteristics effects to their means (Figure 2). The results presented in Figure 2 concur with the above discussion, but nonetheless provide a more realistic depiction of the way same-sex competition stimulation and role modeling were associated with STEM major choice. Girls (boys) with a high-achieving firstborn sister (brother) were more likely to opt for a

STEM major than girls (boys) raised with a high-achieving firstborn brother (sister). Remarkably, the effect of same-sex firstborn started lower for girls compared to boys, but had a steeper positive, eventually overcoming the parallel effect among boys.

[Figure 1 & Figure 2 about here]

Discussion

Sociologists' and economists' investigations of the impact of sibling structures – the number of siblings, birth ordering and spacing, and sib-group sex composition – have mostly been limited to outcomes like test scores, years of completed education and high school or college completion (see Steelman et al. 2002 for a review, 2002; Buchmann, DiPrete, and McDaniel 2008; Härkönen 2013). However, the ways in which sibling compositional characteristics are associated with longer-term outcomes such as choosing college major is scarcely being researched (but see Barclay et al. 2017).

The strong and persistent perception of STEM fields as 'male' activities calls for an investigation of boys' and girls' earliest gendered environments, and how they may be associated with later substantive educational choices such as college major. We therefore investigated whether the composition of a sibling group was associated with younger siblings' choice to pursue a STEM major in college. Our modeling strategy allowed us to simultaneously detect patterns in focal children's college curricular choices by sex composition of the sib-group, size, parity, spacing and firstborn mathematic ability. Overall, we found that the mechanisms operating through sib-group compositional characteristics accounted for long-term differences in college curricular choices between boys and girls. Specifically, our results confirmed the resource dilution hypothesis (relating to sib-group size) and illuminate the way in which same-sex competition stimulation enhances "positive" curricular outcome with role modeling (relating to same-sex firstborn with math skills). Interestingly, moreover, number of brothers amongst girls served as a counterbalance to a high math-achieving firstborn brother, which was associated with lower STEM-majoring chances, whereas for boys more brothers further secured a STEM major choice.

One of the main limitations of this study is that it only articulates population-level patterns but does not extend to an explanation of the mechanisms and social processes that cause the patterns we observe. Our findings conform a same-sex synergy, for example, but it is not clear exactly how this plays out, whether via competition, collaboration, or negative role-modelling. Despite that, however, the patterns we observed raise some interesting questions about the underlying mechanisms and the ways these are not necessarily mutually exclusive. Certainly, future work must build on sibling compositional characteristics yet dig deeper into more qualitative information about the home environment, parental investments and involvement, as well as interactions among siblings. One reasonable pathway could occur if parents prepare their home environment and adapt parenting practices differently depending on the sex of their first child. The ways in which this could be meaningful for subsequent children are myriad: gendered toys, clothes, child-geared equipment like furniture or sports equipment, games, family activity routines (e.g. soccer & chess versus ballet & arts and crafts), parenting styles established in the family (e.g. encouraging exploration versus enforcing safety), and interactions with same-sex friends of the older child all form a 'parenting infrastructure' that is established after the first child is born, and this could have downstream spillover effects that set a gendered tone for subsequent children.

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Table 1: Respondents' sib-group compositional characteristics by gender

Sibling configuration	Total	Girls	Boys
Sib-group size			
2-child families	674	341	333
3-child families	942	449	493
4-child families	538	262	276
Birth ordering			
2^{nd} born	1,502	743	759
3^{rd} born	543	255	288
4^{th} born	109	54	55
Sex of firstborn			
Male	1,094	547	547
Female	1,060	505	555
Total	2,154	1,052	1,102

Table 2: Means (standard deviations) and proportions of respondents' educational choice, sib-group compositional characteristics, and other individual and family background characteristics by gender

	Range	*All* mean	std.	*Focal Girls* mean	std.	*Focal Boys* mean	std.	*Gender means differences* Δ (p-value)	
Educational choice									
College STEM field	0, 1	0.14	0.35	0.12	0.33	0.16	0.37	0.016	*
College non-STEM field	0, 1	0.47	0.50	0.59	0.49	0.36	0.48	0.000	***
No college attending	0, 1	0.39	0.49	0.29	0.45	0.48	0.50	0.000	***
Focal Child Math Score	-35.4 - 34.6	-1.70	13.53	-2.13	13.04	-1.30	13.98	0.155	
Firstborn Male	0, 1	0.51	0.50	0.52	0.50	0.50	0.50	0.274	
Firstborn Math Score	-35.2 - 34.8	-1.59	13.50	-1.28	13.32	-1.89	13.67	0.294	
Sib-group size (#of siblings)	1 - 3	1.94	0.75	1.92	0.75	1.95	0.74	0.468	
Number of male siblings (brothers)	0 - 3	0.99	0.79	1.01	0.79	0.97	0.79	0.223	
Birth Ordering	2 - 4	2.35	0.57	2.35	0.57	2.36	0.58	0.516	
2nd sib (%)	0, 1	0.70	0.46	0.71	0.46	0.69	0.46	0.376	
3rd sib (%)	0, 1	0.25	0.43	0.24	0.43	0.26	0.44	0.312	
4th sib (%)	0, 1	0.05	0.22	0.05	0.22	0.05	0.22	0.881	
Months b/t Oldest and Focal	-35.3 - 161.7	17.51	34.19	16.11	33.51	18.85	34.80	0.063	
Cohort									
Before 1975	0, 1	0.003	0.05	0.003	0.05	0.003	0.05	0.955	
1975-1979	0, 1	0.09	0.28	0.08	0.27	0.09	0.29	0.375	
1980-1984	0, 1	0.35	0.48	0.37	0.48	0.33	0.47	0.061	
1985-1990	0, 1	0.56	0.50	0.55	0.50	0.57	0.50	0.193	
Race									
White Non-Hispanic	0, 1	0.41	0.49	0.41	0.49	0.41	0.49	0.975	
Hispanic	0, 1	0.22	0.40	0.20	0.40	0.23	0.42	0.142	
Black	0, 1	0.37	0.48	0.38	0.49	0.36	0.48	0.221	
Two-Parent Family	0, 1	0.66	0.48	0.65	0.48	0.67	0.47	0.314	
Family Income (logged)	0 - 11.68	8.22	0.88	8.22	0.94	8.23	0.82	0.757	
Mother's Education									
Less than HS	0, 1	0.11	0.31	0.10	0.30	0.11	0.32	0.457	
HS Grad	0, 1	0.49	0.50	0.51	0.50	0.48	0.50	0.136	
Some College	0, 1	0.27	0.44	0.26	0.44	0.28	0.45	0.450	
College	0, 1	0.13	0.34	0.13	0.33	0.14	0.34	0.594	
Mother's Occupation									
Male-type Occupation	0, 1	0.03	0.16	0.02	0.14	0.03	0.17	0.228	
Female-type Occupation	0, 1	0.07	0.25	0.07	0.26	0.07	0.25	0.584	
Unemployed	0, 1	0.12	0.33	0.13	0.33	0.12	0.32	0.389	
Out of labor force	0, 1	0.64	0.48	0.63	0.48	0.64	0.48	0.673	
Missing	0, 1	0.15	0.36	0.15	0.36	0.15	0.36	0.935	
Ns		2,154		1,052		1,102			

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

Table 3: Multinomial logit models predicting college STEM major (vis-à-vis non-STEM major) by sibling compositional characteristics (N=2,145)

	II	III	IV	IV
Male	0.606***	0.427~	0.426~	0.660*
	(0.159)	(0.251)	(0.250)	(0.265)
Math ability	0.029***	0.030***	0.028***	0.027***
	(0.007)	(0.007)	(0.007)	(0.007)
Sib-group configuration effects under the resource dilution hypothesis				
Number of siblings	-0.134	-0.388***	-0.392*	-0.413**
	(0.125)	(0.158)	(0.158)	(0.161)
Birth order	0.132	0.158	0.164	0.180
	(0.200)	(0.200)	(0.200)	(0.202)
Spacing b/w oldest to focal child	0.001	0.004	0.001	0.0004
	(0.003)	(0.003)	(0.003)	(0.003)
Sib-group configuration effects under framing same-sex siblings competition stimulation				
Firstborn Male		-0.391	-0.394	-0.193
		(0.314)	(0.314)	(0.317)
Firstborn Male X Male		0.220	0.208	-0.131
		(0.414)	(0.413)	(0.427)
Number of brothers		0.389*	0.382~	0.414*
		(0.199)	(0.198)	(0.202)
Number of brothers X Male		0.098	0.106	0.063
		(0.252)	(0.252)	(0.255)
Sib-group configuration effects under the role modeling perspective				
Firstborn math ability			0.005	0.039**
			(0.007)	(0.014)
Same-sex sibling competition via role modeling				
Firstborn math ability X Male				-0.056***
				(0.016)
Firstborn math ability X Firstborn male				-0.053**
				(0.017)
Firstborn math ability X Firstborn male X Male				0.087***
				(0.023)
Constant	-2.406**	-2.291	-2.205	-2.384
	(1.576)	(1.633)	(1.631)	(1.647)
Chi-square	292.15***	306.43***	303.43***	324.72***
Pseudo R^2	0.142	0.145	0.149	0.154
Adjusted for socio-demographic and socio-economic background	Yes	Yes	Yes	Yes

Standard errors in parentheses
*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, $^{\sim}$ $p < 0.1$

Figure 1: Conditional marginal firstborn math ability effects on choosing a STEM major, by firstborn sex and respondent's sex

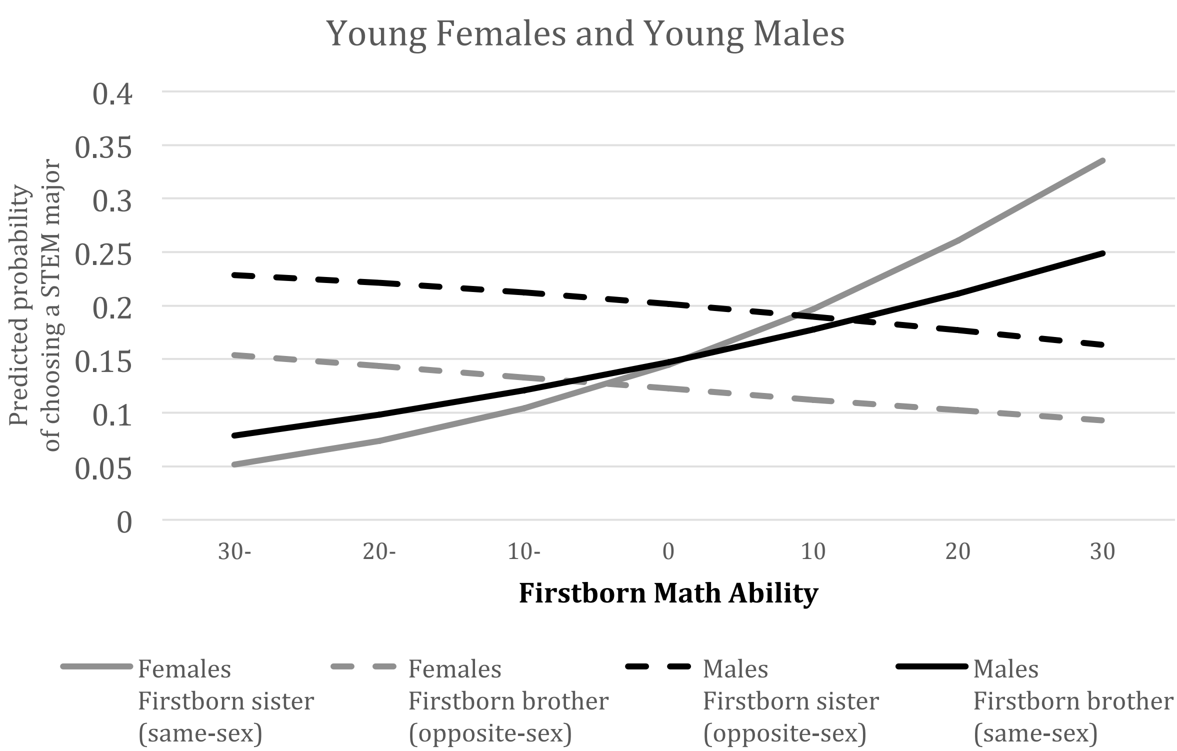

Figure 2: College STEM major attainment (adjusted predicted probability) by firstborn sex and math ability, separately for young females and young males