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# *"Setting the Tone": Sex of the First Child and Educational Outcomes of Subsequent Siblings*

## ABSTRACT

Despite the large influx of women into higher education, gender segregation in STEM college majors persists. Sibship composition has been a major focus in explaining vertical gender differences in educational attainment, yet studies looking at sibling dynamics in understanding horizontal gender segregation have been rare. We close this gap, suggesting a new line of thought. We hypothesize that the sex of the first child 'sets the tone' for a gendered environment in the family, which subsequently impacts gendered self-concepts, interests and eventually choice of college major of subsequent siblings. Using data from the *NLSY79 Youth and Children*, we investigate whether second born girls with older brothers are more likely to choose a college major in a predominantly male field, compared to girls with older sisters. In particular, we examine whether having an older brother increases the likelihood for girls with above average math skills to choose STEM majors.

## INTRODUCTION & BACKGROUND

While the participation of women in tertiary education has steadily increased over the last decades to surpass that of men in many developed nations (Buchmann, DiPrete, and McDaniel 2008; Buchmann and DiPrete 2006), marked horizontal gender segregation persists in higher education regarding the field of study (Charles and Bradley 2009; National Science Foundation 2013). Since the 1970s, women have achieved parity in fields such as medicine, law, biology and chemistry, yet their participation in science, technology, engineering, and mathematics (henceforth STEM-fields) lags far behind men's. Women's underrepresentation in STEM-fields occurs in the US (DiPrete and Buchmann 2013; Mann and DiPrete 2013) and in many other western educational systems (Barone 2011; Charles and Bradley 2009).

Recent evidence suggests that this enduring gender segregation cannot be attributed to gender disparities in math skills or prior achievement. Not only has the gender gap in math test scores narrowed substantially or disappeared (Catsambis 2004; DiPrete and Buchmann 2013; Hall et al. 1999; Hyde et al.

2008; Hyde and Mertz 2009; Leahey and Guo 2001; Riegle-Crumb et al. 2012) the literature also suggests that prior achievements explain very little of the gender gap in STEM majors in the US (Mann and DiPrete 2013; Riegle-Crumb et al. 2012). Given this background, it has recently been argued that persistently gendered outcomes in college major and occupations need to be seen as choice based (Jacobs et al. 2004). Therefore, so the argument, attempts to understand this persistent gap should focus on the question of which social and structural forces may lead females to often pursue careers *other than* those in math and physics oriented STEM fields, even if they are just as qualified (Jacobs et al. 2004).

Our paper focuses on the role of the family, an important social force in the gender socialization of children, for shaping gendered self-concepts and subsequent educational and career choices. Specifically, we will examine the role of the sex of the first born child in a family for choices in educational careers of younger siblings, proposing a new theoretical approach which we call *'Setting the Tone'*. This is the idea that the gender of the first child in a family 'sets the tone' for a gendered family environment, which in turn affects the gender socialization and the development of gendered self-concepts not only for this child itself, but also the socialization of subsequent children. We hypothesize that this effect may unfold through indirect and direct pathways. The indirect effect is a 'pre-gendered' home environment, formed and developed by the parents based on the sex of the first child. This may occur through the availability of 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 that have been established in the family based on the gender of the first child (e.g. encouraging exploration versus strictly enforcing safety), and interactions with friends of the older child (who may predominantly be of the same sex as the first born child). Direct effects include the interaction among the siblings themselves. Accordingly, girls who are born into families with one or more older brothers would be raised in and be exposed to an environment that is pre-gendered as 'male', in contrast to girls who are first born children or have one or more older sisters (and no older brothers). Our hypothesis says that these girls with older brothers will be more likely to develop interests in and self-concepts which include activities and domains gendered as male, through this early life exposure, and subsequently be more likely to choose educational trajectories that are gendered as 'male' such as math or engineering. We hypothesize that the same mechanism should hold vice versa, so that boys with (an) older sister(s) would have a higher probability of entering fields that are predominantly female or socially constructed as female.

Our paper will test these hypotheses empirically in two ways. Using data from the *NLSY79 Children and Young Adults* files we will, in a first step, examine whether girls with older brothers are more likely to choose a college major in a predominantly male domain, compared to girls with older sisters or with no older siblings. In particular, we will focus on second born children from families with two kids only and

third born children in families with two previous kids of the same sex. We will also test whether the same scenario may apply for boys with older sisters, with regards to predominantly female fields of study in college. In a second step, we will then investigate whether girls with above average math test scores are more likely to choose STEM majors when they have older brothers versus older sisters, all else equal.

## PREVIOUS LITERATURE

### *The Family and Its Role for Educational Outcomes*

So far, research preoccupied with the role of the family for children's educational outcomes in general and STEM career choices in particular has focused predominantly on the interaction between parents and children. It has, for example, been shown that high parental SES or parental education are associated with children's academic math achievements and girl's choices to take up a college major in a STEM discipline (Ware, Steckler, and Leserman 1985; Wang and Degol 2013). Less, however, is known about whether and how siblings may affect each other directly or indirectly with regards to the field of study or college major choice.

Those studies which have investigated the relationship between sibling structures and educational outcomes have focused on explaining the quantitative side of educational attainment, such as years of education completed or college completion, for example by investigating the effect of birth order, birth spacing, sibship size or sibship sex composition on educational attainment (see Steelman et al. 2002 for a review; Buchmann, DiPrete, and McDaniel 2008; Härkönen 2013). This literature usually argues that the sibship composition affects children's educational outcome either via the dilution of parental resources (Anastasi 1956; Blake 1986) or via the direct intellectual influence of siblings on each other (Zajonc 1976). According to the dilution hypothesis, the larger the family, the greater the dilution of resources as the family has more mouths to feed, more children to help with their homework, as well as tuitions to pay. Consequently, each child receives fewer resources towards their educational progress. Under the confluence model a child's development is molded by the intellectual atmosphere to which he/she is exposed in the family setting. This is thought to occur either via depressing the intellectual climate in the family through the arrival of younger siblings (Zajonc 1976) or enhancing it for younger children through the presence of older siblings ('confluence model') (Zajonc and Sulloway 2007). The former logic suggests that a family with a lot of children or one with many spaced close together in age results in a relatively inferior intellectual climate since children dominate the environment as opposed to adults who have a greater influence on the intellectual milieu of a small family. The second logic implies that younger siblings are more intellectually mature than older siblings at the same chronological ages.

Another line of thought assumes that older siblings tutor younger ones, to the advantage of the older sibling who can make intellectual gains though teaching their younger siblings (Härkönen 2013). These perspectives take no notice of the sex of the respondent as the same dynamic play-out for men and women. The sociological literature suggests two alternative competitive theoretical explanations to account for the possibility of a differential impact of sibling configuration by the sex of a child.

Additionally, considering the possibility of a differential impact of sibling configuration by the sex of a child, the sociology literature provides two competitive theoretical explanations. Rosenberg's Sex Minority Hypothesis (1965) argues that 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 sibling configuration. Hence, the theory predicts that a girl with only brothers have better educational outcomes than a girl who was raised only with sisters. The empirical evidences for this "special child" hypothesis argument, however, are more related to psychological dynamics, such as self-esteem, parent-child ties, and adolescent perceptions of parental orientations, than to successful educational outcomes per se (Rosenberg 1965; Kidwell 1981; Smith 1984). Alternatively, Conley (2000) suggests the Revised Sex Minority Hypothesis, accordingly it is more disadvantageous to have siblings of the opposite sex, as same-sex children stimulate a competitive environment, which pushes them to perform better. Sex minority children may find their gender-specific needs unmet and may suffer from socialization by the family that conflict with sex role expectations within the educational system. Conley found that men with sisters do worse, with respect to years of schooling, than women with sisters (Conley 2000).

To the best of our knowledge, there is, however, no study yet which examines the effect of the gender of the first child on younger siblings with regards to subsequent qualitative educational outcomes, particularly not with respect to horizontally gendered educational interests and choices.

*The Importance of Siblings*

Studies in social psychology have shown that siblings play a central role in affecting each other's developmental trajectories, specifically with respect to children's gender development (McHale, Updegraff, and Whiteman 2012, McHale , Crouter and Whiteman 2003). For example, one study suggests that the sex of the older children is predictive of gendered behavior of the younger sibling; both boys and girls with same sex older siblings acted more sex-typed than children with older opposite-sex siblings at age 3 (Rust et al. 2000). A qualitative study found that the interaction of sibling dyads varied by their sex constellation, and that younger girls who had older brothers or younger boys with older sisters did exhibit the least amount of 'gender stereotyping' among school aged children (Stoneman, Brody, and MacKinnon 1986). Accordingly, in a recent review piece in the *Journal of Marriage and Family*, McHale, Updegraff

and Whiteman have called for a stronger focus of family scholars on sibling relationships and on "sibling influences on child and adolescent development" (2012: 914).

*Gender and College Major*

As mentioned above, gender differences in average math skills during the school years have basically disappeared[1], redirecting the focus in understanding horizontal gender segregation in education towards structures and experiences which influence girls and boys choices later in life.

Concerning educational preferences and choices, a student's self-assessed competence at math and sciences is considered as a possible explanation for the gender differentiation in college major selection. Female students undervalue their competencies in mathematics in comparison to males, as they expect to perform worse in science and math, even after adjusting for their performance levels (Correll 2001). This gender-differentiated self-belief discourages female students from pursuing quantitative majors even when they have strong mathematics backgrounds (Correll 2001; Eccles 1994).

Further, gender differences in college major are assumed to reflect in part gender differences in occupational tastes and preferences. The few empirical models of STEM major selection in which measures of detailed occupational plans were included show that this is an important predictor. Boys, compared to girls, are more likely to expect to work in science or engineering (Janis E. Jacobs et al. 2002; Legewie and DiPrete 2012). Girls perceive STEM-fields as less instrumental for their dual role (Eccles, Adler, and Meece 1984) and prefer courses that require emotional and nurturing skills, namely the humanities and social sciences (J. E. Jacobs et al. 1998). This gender-differentiated personal STEM orientation is decisive for the later gender gap in STEM bachelor degrees (Morgan, Gelbgiser, and Weeden 2013).

We thus argue that it is of particular importance to conduct studies which address factors and mechanisms that shape girls educational and occupational aspirations and self-concepts. Sibship composition is widely accepted explanation of the impact of family structure in explaining vertical gender differences in educational attainment, yet studies looking at sibling dynamics in understanding horizontal gender segregation have been rare. We intend to close this gap.

[1] That said, however, the variability of mathematics skills is greater among males than among females, which in turn produces a preponderance of males at the highest levels of performance (Hyde et al. 2008). Also, it's been shown that girls have an advantage in reading assessments (Marks 2008).

## DATA AND ESTIMATION STRATEGY

*Data*

The data for our analyses come from the NLSY79 Children and Young Adults files. The NLSY79 Child and Young Adult cohort is a longitudinal project that follows the biological children of the women in the NLSY79, a national longitudinal sample of youth who were born between 1957 and 1964. To date, a total of 11,504 children have been identified as born between 1973 and 2012 to interviewed NLSY79 mothers. As of the 2010 interview round, the NLSY79 women had attained the ages of 45 to 53, and most children and Young Adults are finished with adolescence.

The NLSY79 Child-Young Adult files contain comprehensive child data of math and reading skills and cognitive/developmental assessments throughout childhood, coupled with longitudinal information on family background, household composition, educational background of members of the household, selected social-psychological scales, etc. This provides us a unique opportunity to examine the linkages between sibship sex composition and educational outcome. In fact, the data allows us to incorporate many measures that have been shown to play a role in educational trajectories and choice of college major, such as parental gender role attitudes, parental education and occupation, socio economic status, and, most importantly, math and reading achievement throughout childhood and adolescence. We will in particular investigate whether previous math skill assessments interact with the sex of the first born sibling in predicting second-born siblings' field of study choice in college.

*Models and Analytical Strategy*

We will use linear probability models (LPMs) to estimate:

1) Whether growing up with an older brother versus an older sister affects girls' likelihood of selecting[2] a STEM major in college.
2) Whether growing up with an older brother versus an older sister significantly interacts with girls' math skills (assessed at several times during elementary and middle school) in predicting girls' likelihood of selecting a STEM major.

[2] The literature that examines gender segregation in STEM participation in college distinguishes between entry and eventually graduating in STEM majors. The NLSY79 Child and Young Adult Cohort survey has asked respondents from 2000 on for the study discipline they have majored in or are currently majoring in. While it is possible to track changes in major choice over time for respondents who were still enrolled in college after 2000, we don't yet know whether there are enough case numbers to distinguish between the two outcomes. Thus, we currently plan to treat *being currently enrolled* in a major and *having graduated* in a major as the same outcome.

More specifically, our comparison groups will be:

1) Families with two children: Second born girls with a opposite sex first born sibling versus second born girls with a same sex first born sibling
2) Families with three children: Third born girls with two older brothers versus third born girls with two older sisters or third born girls with mixed-sex older siblings.

## ROBUSTNESS CHECKS AND LIMITATIONS

We don't expect that boys with a first born sister experience a similar effect of growing up in an environment gendered as 'female' on the likelihood to select a STEM-major, i.e. having a lower probability of selecting STEM college majors in college. This is because boys have been shown to encounter greater support for participating in STEM-related activities in school environments, which may counteract an early home environment gendered as 'female'. We hypothesize, however, that second born boys with a first born older sister may be more inclined to enter study fields typically viewed as female, such as the humanities or nursing or other caring disciplines. We will test for this empirically as a robustness check to our primary hypothesis.

While we make the theoretical distinction between indirect and direct effects of the sex of the first born child on subsequent siblings, we cannot net for this directly with the data at hand. There are no measurements on sibling interactions or the degree of gendering of the home environment. This is a limitation to our study. Nonetheless, the data is very rich and allows us to test our hypothesis while controlling for many factors that have been shown to be related to later career choices.

## CONCLUSION AND CONTRIBUTION

The consequences of curricular gender segregation for gender economic inequality are fairly straight forward, since STEM fields are generally more economically rewarding than non-STEM fields (Charles and Grusky 2004). The literature suggests that students in STEM majors are exposed to the idea of pursuing a STEM career early in their education, long before their college career begins. A student's family is considered to be a primary source of interest in and motivation towards a STEM career. While socioeconomic status, family income, and parental education and occupation account for gender differences in educational career choice, sibship sex composition has so far been ignored as an important contributing factor by the literature aimed at understanding horizontal gender segregation in education. We suggest a new line of thought, which is that the sex of the first born child 'sets the tone' for a

gendered home environment, which will impact gendered-self concepts of the next born sibling. We therefore examine whether second born girls with older brothers display a higher likelihood of entering STEM-fields, and whether having an older brother positively mediates the strength of girls math assessment scores in predicting STEM major choice. Our contribution will enrich our understanding of why gender segregation in the field of study persists by focusing on the role of the sex of the first sibling, which is a so far under researched aspect in the social demographic literature.

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