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Understanding Sibling Influences: The Effects of Number and Sex of Siblings on Educational Outcomes

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Understanding Sibling Influences:
The Effects of Number and Sex of Siblings on Educational Outcomes

by

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Abstract

This study attempts to re-examine the impact of siblings on the education of men and women resembling the study done by Butcher and Case (1994). Additionally, I extend the analysis to examine the effect of sibling sex composition on individual's college major choices using data from Wisconsin Longitudinal Study (WSL). The OLS regression result indicates that opposite sex siblings are more harmful to years of education compared to same sex siblings for both men and women. My findings suggest that additional sisters significantly reduce years of education more for men than the effects of additional sisters for women. Sibling sex composition does not affect an individual's choices of major fields. This result shows that the decision on major fields reflects most likely the preferences of the student rather than influences of their social environment.

Table of Contents

1. Introduction

Family structure is an important driver of childhood development. Moreover, it is a key determinant of the wellbeing and social mobility in a child's later life. The economic quantity-quality model developed by Gary Becker and later extended by his colleagues (Becker 1960, Becker and Lewis 1973, Becker and Tomes 1976) explains the negative correlation between family income and family size. Their model has been largely used to support studies in the effects of family size on children's educational attainment. Studies in economics of the family suggest that children from larger families have a lower average educational level compared to children from smaller families. This should come as no surprise as we may expect that greater family size may negatively affect child outcomes due to resource dilution. Even though effects of family size have been largely studied, relatively little has been done to analyze within-family variations.

Within recent decades, researchers have been interested in variables that extend beyond the effects of sibship sizes. A child's education may be affected by other components of the family structure, such as: birth order (the child's birth position in the family), child spacing (the time intervals separating the births of siblings), and sex composition (the relative numbers of boys and girls in sibling groups). Overall, this line of research has found consistent findings except for the latter.[2] Butcher and Case (1994) studied the effect of sibling sex composition on the educational attainment of men and women born in the United States between 1920 and 1961. Their results indicated that among women, those who grew up in households with brothers obtained more

[2] Studies in sibling sex composition are further discussed in the literature review.

education than women raised with any sisters. Their study is interesting because it identifies an overlooked determinant of educational attainment, suggesting that standard estimates underestimate the returns to education for women. However, many researchers are skeptical of their findings. Furthermore, replications of their studies are often found to have conflicting results.

The purpose of this study is to re-examine the relationship between sibling sex composition and educational outcomes using data from the Wisconsin Longitudinal Study (WLS). The hypothesis is that a child with more siblings of the same sex would benefit more than of the opposite sex. The reason is that we may relate better with siblings from the same sex and may even be more open to asking for help in terms of academia when needed. Alternatively, same sex siblings may also benefit parents because less gender specific goods have to be bought therefore reducing overall family expenditures. Males are expected to be more negatively impacted by opposite sex siblings compared to females. Additionally, I would broaden previous literature by examining the effects of sibling sex composition on college major choices.

The outline of the paper is as follows: Section 2 reviews previous studies; Section 3 describes the data and the explanatory variables, Section 4 outlines the empirical approaches and regressions, Section 5 and 6 discusses findings, and Section 7 concludes.

2. Literature Review

There exists an extensive theoretical and empirical literature that postulates the negative correlation between child quantity and quality within a family. Empirical analyses of the effects can be found in the economics literature (Hauser and Sewell 1985; Behrman and Taubman 1989; Hanushek 1992; Black, Devereux, and Salvanes 2005). However, this relationship offers only analysis compared across families. In more recent studies, researchers have focused their interest in looking at differences within the family such as, for example, birth order, child spacing, and sibling sex compositions. The research among those who believe such an effect exists consists of two popular hypotheses: the confluence model and the resource dilution model.

2.1 Confluence Theory

The confluence theory is most popular in social psychology. This theory, introduced by Zajonc and Markus (1975), explains the relationship between IQ and family size, birth order, and age spacing. According to this theory, the intellectual environment a child is born into affects their development of intellect. Under this theory, an only child is exposed to the most intellectually mature environment and therefore possesses an advantage over children with siblings. Under the same reasoning, the confluence theory implies that firstborns will preform better than later born children. In addition, if indeed the intellectual environment influences a child's intellectual development, then sibling socialization at home may have an impact on each other's development.

2.2 Resource Dilution Theory

The confluence model is open to much criticism due to the lack of fit between the model's predictions and actual data. Due to the confluence model's limited scope, scholars are more favorable towards a second explanation of the impact of family structure, the resource dilution theory. According to this theory, the inputs provided by parents (environments, attention, financial, opportunities, *etcetera*) dilutes as the number of children increases (Blake 1981). In other words, the larger the family, the greater the dilution of resources, which in turn may impact educational progress of the child. Because family resources are limited, a child may affect the opportunity cost of investing in the education of his/her siblings. Furthermore if the costs of raising children differ by gender or ability, then having sons and daughters may have different effects on the family budget, suggesting that the sex of a child's sibling may influence his/her parental education investment (Butcher and Case 1994).

2.3 Literature Review

The role of siblings in child development has been largely studied in the fields of sociology and psychology. Siblings spend a significant amount of time together; the high degree of interactions suggests that sibling influences may have meaningful spillover effect on activity choices and behaviors. Stoneman, Brody, and MacKinnon (1986) examined same-sex and cross-sex sibling pairs in their activity selections. They find that activities selected by same-sex siblings were the most stereotypically sex typed, while cross-sex sibling activities were dominated by choices of an older sibling. Research in

psychology has shown that girls with older brothers tend to have more "masculine" traits (Koch 1955). In addition, Booth and Nolen (2012) studied gender differences in risk behavior in a controlled experiment. They find that girls in all girl groups were more likely to choose real-stakes gamble and engage in more risky behaviors. Their study implies that single sexed environment mitigates gender stereotype choices.

Existing studies in the effects of birth order have yielded mixed results, implying that findings are sensitive to the degree of controlled variables and specific instruments used in within each researcher's methodology. Kessler (1991) used data from the National Longitudinal Survey of Labor Market Experience of Youth (NLSY) to estimate the impact of family size and birth order on future wages and employment status. He found that neither birth order nor family size significantly influenced wage determination. In contrast to Kessler (1991), a more recent study by Black, Devereux and Salvanes (2005) found very large and robust effects of birth order on education.[3] They also found that family size effect become negligible once they included dummy variable indicators for birth order and twin births. Similarly, Booth and Kee (2005) utilized data from the 2003 British Household Panel Survey to analyze the degree to which family size and birth order affects a child's educational attainment. Their main findings conclude that higher birth order children receive on average a lower share of family resources. In addition, unlike Black, Devereux and Salvanes (2005), family size effect does not vanish once controlling for birth order.

[3] Their result showed that the difference in educational attainment between the first child and the fifth child in a five-child family is estimated to be equivalent to the difference between the educational attainment of Black and White students calculated from the U.S. 2000 census.

The sex composition of a household may influence a child's educational attainment in several ways. Butcher and Case (1994) studied the effect of sibling sex composition on the educational attainment of men and women born in the United States between 1920 and 1961. Their results indicated that among women, those who grew up in households with brothers obtained on average more education than women raised with any sisters. One explanation focuses on the intrafamily resource allocations. Parents may have different human capital investments in their children depending on their gender. According to Becker's (1991) model, family that faces borrowing constraints "will stop short of investing until the rate of return to each child's education is equal to the market rate of interest". In this case, if boys receive the highest marginal return to education, they will receive the most education.

Findings from Butcher and Case (1994) are held up to many criticisms. Many researchers that replicate similar studies find different results. Kaestner (1997) found no effect on attainment among whites, but among black adults, those who have sisters received greater level of educational attainment than no or fewer sisters. On the other hand, Hauser and Kuo (1998) are unable to find any significant results from the effects of sibling sex composition using three large U.S. datasets.

3. Data

The dataset used in this study are collected from the Wisconsin Longitudinal Study (WLS). This dataset is specifically chosen because no other related studies have utilized it before. In addition, respondents here are growing up in a post World War II era, therefore if there are any sibling effects, it should be at a higher magnitude since families are very financially constrained. The WLS is a longitudinal data that have been accumulated over the years on a random sample of 10,317 men and women who graduated from Wisconsin high schools in 1957. The survey was conducted to study the life course, relationships, family functioning, mental health and well – being from late adolescence through 2011. Survey data were collected from the original respondents in 1957 when they were seniors in high school. The second and third waves are collected in 1964 and 1975. All of the variables used in this study come from these three waves. This dataset serves the purpose of this study well because it provides detailed information on the respondent including parent and children's individual characteristics in addition to household level characteristics.

Respondents were on average 35 years old[4] at the time of the 1975 wave, so most will have completed their formal schooling by this time, and therefore is used as dependent variable in later regressions.[5] Control for family socioeconomic status uses parental income in year 1957 reported in $100s meaning a value of 1 is equivalent to a yearly family income of $100. Measure of respondent's IQ is mapped from the Henmon-Nelson test score, a common proxy to an individual's cognitive ability. The set of

[4] Age of respondent was not reported in year 1964 and age of respondent in year 1957 was not publicly available.

[5] Education in year 1964 is also considered to see if siblings' effects are different over the course of an individual's life.

explanatory variables include household characteristics – parental income, mother's education, father's education and occupation; respondent characteristics – IQ, plans for college, and marital status; family structure – sibship size, sibling sex composition, and birth order; and other characteristics – teacher's attitude, and friend's plan for college. Table 1 summarizes empirical means of control variables mentioned above.

Table 2 displays summary statistics for family structure. These variables will be used in later regressions to examine the effects of siblings on educational attainment. Respondents have on average 3.25 siblings, 1.58 sisters and 1.67 brothers. Majority (69.53%) of the respondents have one to four siblings. Figure 1 and figure 2 shows the average years of men and women's education in 1964 and 1974 categorized by sibling sex composition. For both men and women there is an overall inverse relationship between sibship size and educational attainment, most likely attributed to the resource dilution theory. The mean education has almost no change from one-child families to two-child families but decreases thereafter. For men, having sisters seems to hurt education more than having brothers while women are affected more from sisters in the beginning but the relationship reverses for three or more child families. However, for large families, the average years of education of both men and women appears to converge to the same amount.

The WLS sample mostly consists of a Caucasian population; therefore, minorities are underrepresented here.[6] This data is not representative of all groups in the United States. Additionally, here I assume that siblings reported on the survey either lives with

[6] Demographics of Wisconsin have been predominately white with 92.2% white in 1990, 88.9% white in 2000 and 86.2% white in 2010.

respondents or have a high daily social interaction with respondents. It is also not known if siblings are full siblings, half siblings, or adopted siblings.

Table 1: Summary Statistics: WLS

Variables	Average	Standard Deviation
Household Characteristics		
Parental Income 1957	63.31	60.28
Father graduated only high school	0.174	0.379
Father graduated college	0.063	0.243
Father graduated graduate school	0.021	0.144
Mother graduated only high school	0.266	0.442
Mother graduated college	0.082	0.274
Mother graduated graduate school	0.007	0.084
Father has a white collar job	0.207	0.405
Father has a professional/executive job	0.109	0.311
Individual Characteristics		
IQ	100.5	14.92
Planned to attend College	0.434	0.496
Married (1964)	0.639	0.480
Single (1964)	0.220	0.414
Married (1975)	0.778	0.416
Single (1975)	0.053	0.224
Other Characteristics		
Teacher encouraged college	0.366	0.482
Friends planned to attend college	0.289	0.453

Data consists of 4,991 males and 5,326 females

Table 2: Summary Statistics: Family Structure

Variables	Average	Standard Deviation
Only child	0.063	0.242
Birth Order 1	0.298	0.457
Birth Order 2	0.247	0.432
Birth Order 3	0.132	0.339
Birth Order 4	0.068	0.252
Birth Order 5+	0.192	0.394
Number of Siblings	3.247	2.572
Number of Sisters	1.582	1.533
Number of Brothers	1.665	1.614
Respondent with no sisters	0.233	0.423
Respondent with 1 sister	0.309	0.462
Respondent with 2 sister	0.185	0.388
Respondent with 3 sister	0.101	0.301
Respondent with 4+ sister	0.172	0.377
Respondent with no brothers	0.227	0.419
Respondent with 1 brother	0.292	0.455
Respondent with 2 brothers	0.196	0.397
Respondent with 3 brothers	0.101	0.302
Respondent with 4+ brothers	0.184	0.388

Data consists of 4,991 males and 5,326 females

Figure 1: Mean Education by Number of Siblings (1964)

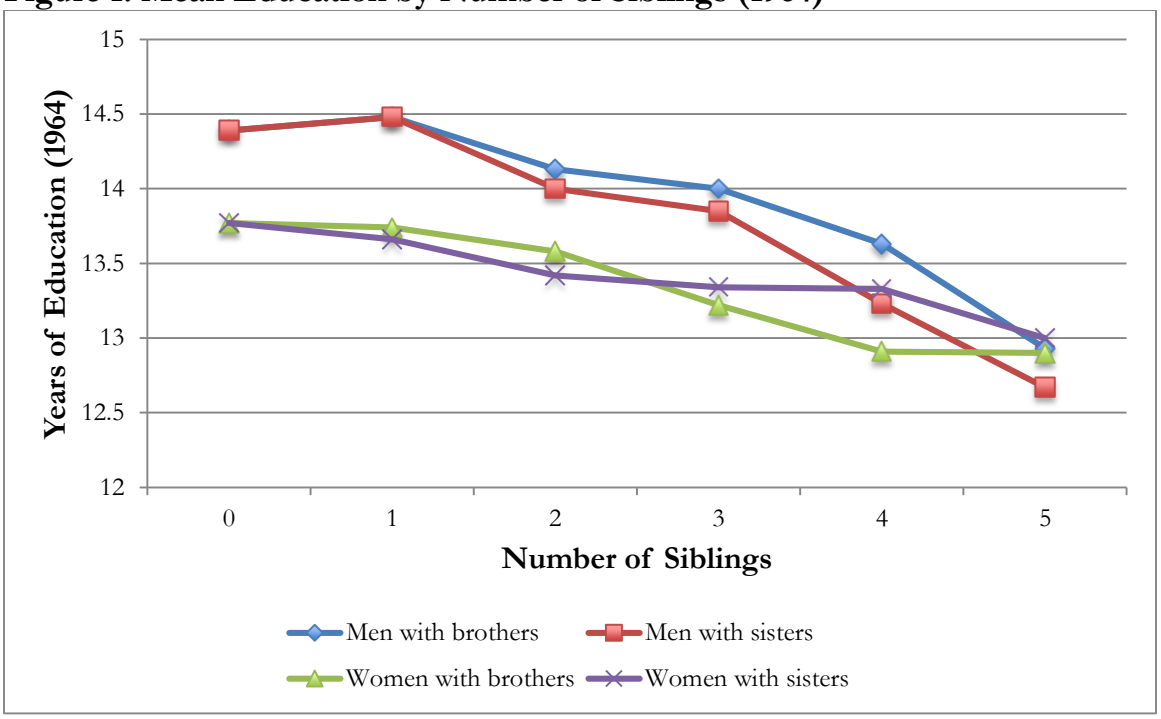
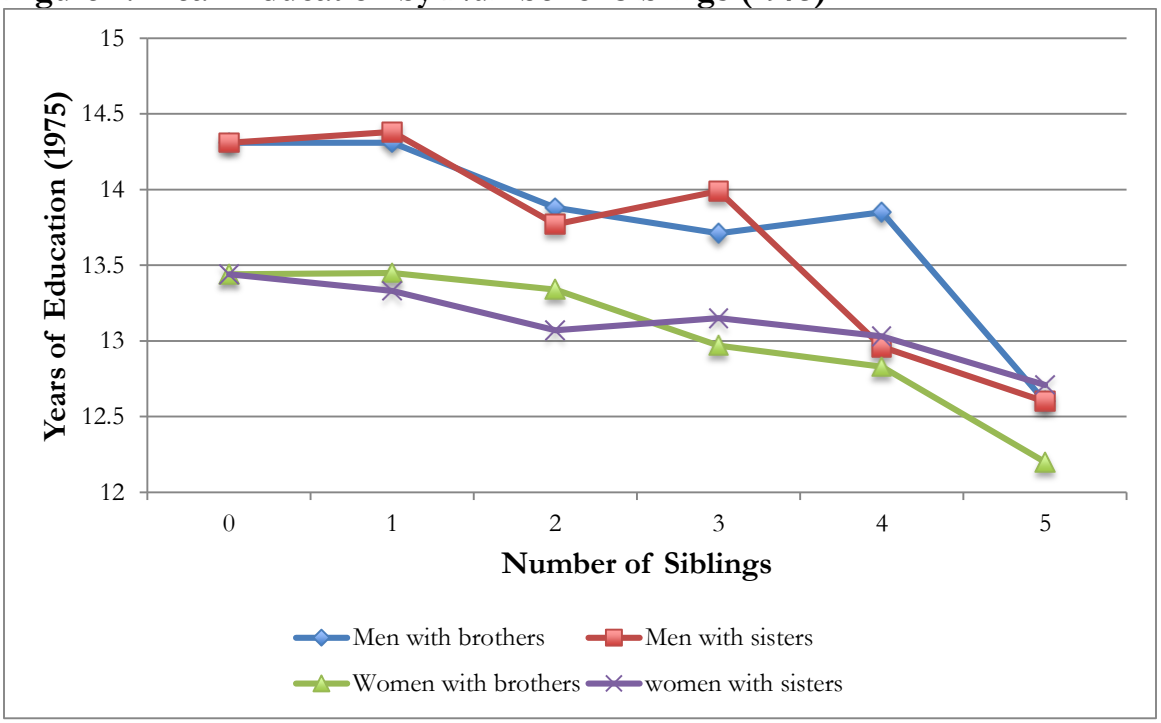


Figure 2: Mean Education by Number of Siblings (1975)



4. Methodology

4.1 Effects of Sibling on Years of Education

The question driving the first part of my research is to examine the effects of number and sibling sex composition on years of education. In order to test this relationship, an ordinary least squares regression (OSL) will be utilized. The OSL regression is as follows:

$$(1)\ Y_i = \alpha + \beta_0 Sibs_i + \beta_1 Sibs^2{}_i + \beta_2 X_i + \varepsilon_i$$

$$(2)\ Y_i = \alpha + \beta_0 Male_i + \beta_1 Sibs_i + \beta_2 Sis_i + \beta_3 Male * Sis_i + \beta_4 Male * Sibs_i + \beta_5 X_i + \varepsilon_i$$

The first regression analysis examines the effects of numbers of siblings on years of education. I run regression of completed education in year 1964 and 1975 on number of siblings while controlling for household and individual characteristics displayed in Table 1. The effects of siblings on education are allowed to have a non-linear relationship here. This specification is chosen to follow what Butcher and Case (1994) did. This regression will be run separately for male and female.

The second regression analysis examines the effects of sibling sex composition on years of education. The dependent variable is measured in self-reported years of education and the key explanatory variables are number of siblings, sisters, male*sisters, and male*siblings. Male is a binary variable with 1 indicating that the respondent is a male, and 0 if respondent is a female. Variables siblings and sisters are continuous variables indicating the numbers of siblings and sisters ever born in respondent's household. The interaction variables are created to test the differential effects of having additional sisters and brothers between male versus female. A joint model with

interactions is used here since it provides a simple and direct statistical test of the difference between the coefficients for men and women.

4.2 Effects of Sibling on College Major

The second part of my research is to examine whether sibling sex composition has an effect on an individual's choice of college major. In order to test this, I will use a linear probability OLS regression.

$$\Pr(Y_i = 1) = \alpha + \beta_0 Male_i + \beta_1 Sibs_i + \beta_2 Sis_i + \beta_3 Male * Sis_i + \beta_4 Male * Sibs_i + \beta_5 X_i + \varepsilon_i$$

The regression is run on condition that the respondents are planning to attend college.[7] Here, Y_i is a binary dependent variable with 1 indicating an individual choosing a male-dominated[8] major, and 0 otherwise. The main explanatory variables and control variables are same as previous regressions. Interpretation of the regression here is the probability that the dependent variable equals one (Y_i =1).[9]

Although there are shortcomings to the linear probability model, the probit model yields similar results and therefore those results will not be reported here.

[7] In 1957 respondents were asked to document their plan after graduation.
[8] Male-dominated majors are mapped from the National Center for Education Statistics (NCES) using statistics from 1991 field of major by gender, and is characterized as male-dominated if the major consists of over 70% proportion male. Additionally,
[9] There are several shortcomings to the linear probability model. First, the probabilities predicted by this regression may lie outside the range [0,1]. Second, this model is always heteroskedastic by construction.

5. Years of Education Results

This section discusses the effects of number and sibling sex composition on years of education. Table 3 presents the consequences of sibship sizes on completed years of education in the year 1964 and 1975.

Table 3: Effect of Number of Sibling on Years of Education[10]

	1964		1975	
	Men	Women	Men	Women
No. of siblings	-0.084	-0.021	-0.044	-0.018
	(0.025)***	(0.019)	(0.025)*	(0.020)
No. of siblings^2	0.004	-0.001	0.002	-0.001
	(0.002)**	(0.001)	(0.002)	(0.002)
Birth order	-0.002	0.009	0.007	0.019
	(0.017)	(0.012)	(0.017)	(0.012)
IQ	0.031	0.018	0.040	0.022
	(0.002)***	(0.001)***	(0.002)***	(0.002)***
Plans for college	1.742	1.553	1.880	1.209
	(0.071)***	(0.048)***	(0.078)***	(0.049)***
Teacher Attitude	0.287	0.209	0.297	0.171
	(0.058)***	(0.044)***	(0.062)***	(0.048)***
Friend's plan	0.570	0.396	0.611	0.402
	(0.066)***	(0.053)***	(0.073)***	(0.058)***
Married (1964)	0.147	0.035	-	-
	(0.271)	(0.268)	-	-
Single (1964)	0.506	0.743	-	-
	(0.273)*	(0.275)***	-	-
Married (1975)	-	-	-0.178	-0.355
	-	-	(0.095)*	(0.071)***
Single (1975)	-	-	0.006	0.679
	-	-	(0.145)	(0.143)***
HS father	0.006	0.056	0.094	0.038
	(0.072)	(0.054)	(0.077)	(0.059)
College father	0.322	0.504	0.212	0.589
	(0.129)**	(0.105)***	(0.141)	(0.118)***

[10] Research suggests that the number of older siblings may have an impact on educational outcomes. I ran an additional regression using the variable older siblings to test this hypothesis but no significance results were found.

Grad father	0.711	0.592	1.083	0.647
	(0.228)***	(0.163)***	(0.245)***	(0.206)***
HS mother	0.061	0.092	0.013	0.004
	(0.061)	(0.047)**	(0.065)	(0.050)
College mother	0.323	0.457	0.402	0.575
	(0.110)***	(0.083)***	(0.116)***	(0.102)***
Grad mother	0.035	0.380	0.353	0.554
	(0.276)	(0.286)	(0.322)	(0.305)*
White Collar father	0.254	0.133	0.290	0.139
	(0.070)***	(0.052)**	(0.075)***	(0.056)**
Professional father	0.402	0.210	0.458	0.351
	(0.120)***	(0.086)**	(0.123)***	(0.097)***
Parental Income	0.001	0.002	0.000	0.002
	(0.001)*	(0.000)***	(0.001)	(0.000)***
Constant	9.426	10.202	8.703	10.040
	(0.327)***	(0.302)***	(0.216)***	(0.177)***
R^2	0.48	0.54	0.47	0.43
N	3,939	4,212	4,372	4,679

Robust standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Looking at the first column of Table 3, there is a negative effect of siblings and a positive effect of siblings squared. This means that as the number of siblings increases, the negative effect of siblings on years of education is lessoned. More specifically, the coefficient suggests that for men with 10.5 or more siblings, the negative effect on education becomes positive. Respondents have on average three siblings in my dataset. Therefore the result of my squared term is small and can be neglected. To interpret the effect of additional siblings on education, an additional sibling is associated with a reduction in education in roughly one thirteenth (-0.076) of a year for men in 1964 at a 1% significant level. This reduction decreases in magnitude and significance for education in year 1975 but remains at a significant level. The effect for women follows similar pattern but no coefficients are found to be significant for both year 1964 and

1975. Men's education seems to be more volatile to increasing numbers of siblings while women's education is unaffected by increasing numbers of siblings. Possible reason for this could be that as the family size increases, some children has to sacrifice years of schooling and get a job instead to help support the family. Parent's educational attainment has a positive and significant effect in levels of education for both men and women. The results above also show that family background variables are important determinants of levels of education. I will continue to control for these characteristics in regressions that follow.

To extend beyond the effects of numbers of siblings on years of education, I will now test the importance of sibling sex composition on education. Model 1, 2, and 3 of Table 4 are results of completed years of education reported in 1964 while Model 4, 5, 6 are results of completed years of education reported in 1975.

From Model 1, we see that the effects of number of siblings remain at a negative and significant level. To interpret this, an additional sibling reduces on average 0.035 years of schooling. Males receive more formal education than their female counterparts. Moving to Model 2, I added a term representing the number of sisters of the respondent (controlling for total number of siblings). This term is not statistically significant, suggesting that my results do not support that parents have differential human capital investment for boys vs. girls (at least this is not the case for my dataset). If that were the case, we would expect that number of sisters would be positive and significant. This would imply that having additional sisters reduces education less than having additional brothers. Boys on average receive higher returns to schooling; therefore under the

human capital model we would expect parents to be more likely to invest in their education, draining the resources of the respondents' regardless of his/her sex.

In Model 3, I allow the effects of sibling sex composition to be differed across gender of the respondent. The interaction term was formed by multiplying dummy variable male to continuous variable indicating numbers of sisters and continuous variable indicating numbers of siblings. Although the significance and magnitude of the term siblings decreased in significance and magnitude after adding the interaction terms, a few coefficients remained at a 10% significance level. For women, each additional brother reduces education by 0.025 years at a 10% significance level while each additional sister reduces education by 0.011 years but not significant. This implies that the effects of having either sisters or brothers are not statistically different for women. For men, each additional brother reduces education by 0.032 years while each additional sister reduces education by 0.078 years, significantly more. The interaction terms β_3 and β_4 explains the differential effects of brothers and sisters for men versus women. My results suggest that additional sisters hurt men's education more compared to women with sisters at a significant level. In contrast, the differential effects of additional brothers for men are not significant compared to women with brothers.

These results contradict that of Butcher and Case (1994) who found that women benefited more from having brothers than additional sisters. However, these findings are consistent with other studies, namely Conley (2000). Conley (2000) finds that it is the increase in number of opposite sex siblings that hurt educational attainment the most. Possible reason to this may be explained by the fact that there exist benefits from gender-specific goods. Alternatively, it may be that parents choose to specialize in raising

certain gender given that the proportion of the gender of the child in the household out numbers the other. For it would be easier to raise boys than girls given that you have three sons and a daughter. This does not imply that parents give preferences to boys but rather they are more experienced in raising boys. Results from education in year 1975 are found to be insignificant. This is reasonable since effects of siblings should matter less for levels of education of respondents in their 30s compared to their 20s.

Table 4: Effect of Sibling Sex Composition on Years of Education

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Male	0.557	0.557	0.670	0.809	0.809	0.957
	(0.033)***	(0.033)***	(0.052)***	(0.034)***	(0.034)***	(0.055)***
No. of siblings	-0.035	-0.029	-0.025	-0.025	-0.020	-0.009
	(0.007)***	(0.011)***	(0.013)*	(0.008)***	(0.011)*	(0.014)
No. of sisters	-	-0.012	0.014	-	-0.012	0.011
	-	(0.017)	(0.020)	-	(0.018)	(0.022)
Male x Sisters	-	-	-0.060	-	-	-0.053
	-	-	(0.034)*	-	-	(0.036)
Male x Siblings	-	-	-0.007	-	-	-0.020
	-	-	(0.019)	-	-	(0.020)
Birth Order	0.004	0.004	0.005	0.014	0.014	0.015
	(0.010)	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)
IQ	0.025	0.025	0.025	0.032	0.032	0.032
	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
Plans for college	1.658	1.658	1.658	1.540	1.540	1.540
	(0.042)***	(0.042)***	(0.042)***	(0.045)***	(0.045)***	(0.045)***
Teacher attitude	0.242	0.243	0.242	0.222	0.222	0.223
	(0.036)***	(0.036)***	(0.036)***	(0.039)***	(0.039)***	(0.039)***
Friend's plan	0.473	0.473	0.475	0.488	0.488	0.492
	(0.042)***	(0.042)***	(0.042)***	(0.047)***	(0.047)***	(0.047)***
Married (1964)	0.084	0.085	0.077	-	-	-
	(0.191)	(0.191)	(0.192)	-	-	-
Single (1964)	0.582	0.582	0.574	-	-	-
	(0.194)***	(0.194)***	(0.195)***	-	-	-
Married (1975)	-	-	-	-0.263	-0.263	-0.265
	-	-	-	(0.058)***	(0.058)***	(0.058)***
Single (1975)	-	-	-	0.335	0.334	0.333
	-	-	-	(0.102)***	(0.102)***	(0.102)***

HS father	0.033	0.033	0.035	0.070	0.070	0.072
	(0.045)	(0.045)	(0.045)	(0.049)	(0.049)	(0.049)
College father	0.426	0.426	0.429	0.419	0.420	0.422
	(0.084)***	(0.084)***	(0.084)***	(0.092)***	(0.092)***	(0.092)***
Grad father	0.670	0.671	0.673	0.893	0.894	0.895
	(0.143)***	(0.143)***	(0.143)***	(0.166)***	(0.166)***	(0.166)***
HS mother	0.070	0.070	0.070	0.007	0.006	0.006
	(0.039)*	(0.039)*	(0.039)*	(0.042)	(0.042)	(0.042)
College mother	0.379	0.379	0.381	0.463	0.463	0.466
	(0.068)***	(0.068)***	(0.068)***	(0.077)***	(0.077)***	(0.077)***
Grad mother	0.204	0.202	0.199	0.489	0.488	0.487
	(0.198)	(0.198)	(0.198)	(0.231)**	(0.231)**	(0.230)**
White collar father	0.184	0.184	0.186	0.213	0.213	0.215
	(0.044)***	(0.044)***	(0.044)***	(0.047)***	(0.047)***	(0.047)***
Professional father	0.297	0.297	0.298	0.394	0.393	0.394
	(0.073)***	(0.073)***	(0.073)***	(0.079)***	(0.079)***	(0.079)***
Parental income	0.001	0.001	0.001	0.001	0.001	0.001
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Constant	9.468	9.465	9.418	8.871	8.870	8.797
	(0.224)***	(0.224)***	(0.224)***	(0.140)***	(0.140)***	(0.141)***
R^2	0.51	0.51	0.51	0.45	0.45	0.45
N	8,151	8,151	8,151	9,051	9,051	9,051

Robust standard errors in parentheses

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

6. College Major Results

This section discusses the effects of number and sibling sex composition on choices of college major. Table 5 presents the results.

Table 5: Effect of Sibling Sex Composition on College Major

	Model 1	Model 2	Model 3	Model 4
Male	0.366	0.389	0.189	0.218
	(0.012)***	(0.019)***	(0.009)***	(0.016)***
No. of siblings	-0.005	0.000	-0.008	-0.001
	(0.005)	(0.003)	(0.003)**	(0.002)
No. of sisters	0.003	-0.001	0.007	0.002
	(0.007)	(0.005)	(0.005)	(0.002)
Male x Sisters	-	0.009	-	0.010
	-	(0.014)	-	(0.011)
Male x Siblings	-	-0.013	-	-0.016
	-	(0.009)	-	(0.007)**
Birth order	-0.008	-0.007	0.006	0.006
	(0.004)*	(0.004)*	(0.003)*	(0.003)*
IQ	0.002	0.002	0.003	0.003
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
HS father	-0.001	-0.001	-0.018	-0.017
	(0.015)	(0.015)	(0.011)	(0.011)
College father	-0.030	-0.029	-0.002	-0.001
	(0.021)	(0.021)	(0.018)	(0.018)
Grad father	-0.075	-0.075	-0.032	-0.031
	(0.031)**	(0.031)**	(0.030)	(0.030)
HS mother	0.006	0.006	0.013	0.013
	(0.014)	(0.014)	(0.011)	(0.011)
College mother	-0.017	-0.017	-0.002	-0.001
	(0.017)	(0.017)	(0.014)	(0.014)
Grad mother	-0.078	-0.078	0.010	0.010
	(0.051)	(0.051)	(0.049)	(0.049)
White collar fa	-0.019	-0.018	0.011	0.012
	(0.014)	(0.014)	(0.011)	(0.011)
Professional fa	-0.011	-0.011	0.054	0.054
	(0.019)	(0.019)	(0.017)***	(0.017)***
Parental income	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.140	-0.152	-0.302	-0.316
	(0.044)***	(0.044)***	(0.034)***	(0.034)***

R^2	0.22	0.23	0.14	0.14
N	4,000	4,000	4,000	4,000

Robust standard errors in parentheses
* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Model 1 and 2 of Table 5 represents the choices of college major respondents reported in year 1957 while they were high school seniors, and Model 3 and 4 represents the actual college major attained reported in the year 1975. I will focus on interpreting models 3 and 4 because it is more representative of the effects of siblings on choices of college major. From Model 3, we see that an additional brother reduces the chance of choosing a male-dominated major by approximately .8% at a 5% significant level while an additional sister will only reduce this chance by approximately .1%. The coefficient for number of sisters is insignificant indicating that the effects of having additional sisters or brothers on college major choices are not significantly different.

In Model 4, I allowed the effect of siblings to differ across gender of the respondent. All key variables became insignificant in this model suggesting that there are no significant differences to the effects of siblings on college major choices for men versus women. It is important to note here that in section 5, results from 1964 yielded significantly stronger results compared to year 1975. Therefore, results may be stronger if dependent variable here uses data from 1964.[11] To interpret my findings, an additional brother for women reduces the chance of choosing a male-dominated major by approximately .1% while an additional sister increases the chance of choosing a male-dominated major by approximately .1%. For men, an additional brother reduces the chance of choosing a male-dominated major by approximately 1.7% while an additional

[11] Information on major field was not collected in wave 1964 in WLS.

sister reduces the chance of choosing a male-dominated major by approximately .5%. The interaction term is not significant meaning that men and women do not have a significant differential effect from having additional sisters and brothers.

Although no coefficients are found to be significant, the interpretation of my results above suggest that for women, mixed gender siblings tend to follow a stronger gender stereotypical specialization. In contrast, same gender siblings yield a higher probability of making less gender stereotypical choices. This result is consistent with experimental findings from Booth and Nolen (2012), where mixed-gender environment tends to reinforce gender stereotype.[12]

One possible explanation to this may be that individuals like to differentiate themselves within a household. For a female, having brothers will more likely to push her towards majoring in a non male-dominated major since the probability of her brother choosing a male-dominated major is already high. On the other hand, a female having sisters will more likely choose to specialize in male-dominated majors to differentiate herself from her sisters.

[12] They find that girls from single-sex schools behave more like boys, which suggests that gender differences might reflect social learning rather than innate characteristics.

7. Conclusion

The finding from this research is different than those of Butcher and Case (1994); however, are consistent to other studies. My results suggest that the effect of sibling sex composition on educational attainment is small and may be negligible. However, evidence points to that opposite sexed siblings reduces levels of education at a greater magnitude. This may be explained by the fact that there exist returns to scale from gender-specific goods. Alternatively, it may explain that parents may choose to specialize in raising certain gender given that the proportion of the gender of the child in the household out numbers the other.

I also find that additional brothers reduce chances of choosing a male-dominated major more than additional sisters. However, the effects of sibling sex composition on choices of major of men versus women are found to be insignificant. It would be interesting to extend the analysis to not only major fields, but also type of degree an individual attains. Additionally, it would be interesting to do this study using datasets from developing countries such as India or China where gender preferences are more prevalent compared to developed countries. In summary, my paper adds to the literature because it utilizes different datasets at a time where families are more financially constrained. Moreover, I broadened the analysis by examining the effects of siblings on major choices, which suggests that choices are not largely affected by different social environments, as many believed it would.

8. Appendices

The following lists of majors are considered to be male-dominated in my data[13]

001 Accounting - Finance
179 Aeronautics
006 Agricultural economics
007 Agricultural engineering
010 Agronomy
011 Air Force aerospace studies
018 Architecture
177 Architectural engineering
031 Chemical engineering
034 Civil and environmental engineering
039 Computer sciences
045 Dairy science
047 Dentistry
049 Economics
054 Electrical and computer engineering
175 Engineering-aeronautical
177 Engineering-architectural
056 Engineering
059 Entomology
062 Forestry
065 Geography
066 Geology and geophysics
080 Industrial education, industrial arts
081 Industrial engineering, industrial design
086 Landscape architecture
095 Mechanical engineering
103 Metallurgical and mineral engineering
104 Meteorology
132 Physics
141 Pre-dentistry
157 Soil science
164 Theology, ministers, priests
165 Urban and regional planning

Vocational, Apprenticeship Training and
Military Formal Schools
(A) = Army ; (F) = Air Force ; (M) = Marines ; (N) = Navy

310 Aircraft maintenance, aircraft mechanics

[13] The list of major field of study is obtained direction from WLS Appendix COR555. (000-194 = College majors; 300-733 = Non-college majors).

323 Architectural technology
329 Auto body repair
331 Auto mechanics
332 Automotive technology
710 Aviation
342 Aviation structural mechanics (N)
347 Avionics radar technology (F)
372 Carpentry
373 Carpentry - industrial
394 Communications technology, communications
414 Diesel and heavy equipment mechanics
419 Drafting - architectural, blue print reading
423 Drafting - engineering
424 Drafting - mechanical
425 Drafting - topographical
430 Electrical production
431 Electrician
437 Electric motor repair
442 Electronics
445 Electronics technology, electrical engineering
725 Engineering (non-military)
502 Industrial technology
525 Machinery repair (N)
535 Meat cutting, butcher
536 Mechanical design technology, mechanical engineering
537 Mechanical maintenance
719 Mechanics
540 Medical laboratory technology, medical technician
545 Metal fabricating
548 Metalworking technology (F)
549 Meteorological equipment (F)
697 Pilot training
596 Plumber
597 Police science technology
599 Power mechanics - small engines
615 Radio and television repair
616 Radio communications technology (F)
620 Real estate
636 Sheet metal worker
676 Transportation
684 Welding
688 Wood techniques, woodworking
691 X-ray technology

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