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Albert Cheng
University of Arkansas, Fayetteville

Katherine Kopotic
University of Arkansas, Fayetteville

Gema Zamarro
University of Arkansas, Fayetteville

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Parental Occupational Choice and Children's Entry into a STEM Field

Albert Cheng, Katherine Kopotic, and Gema Zamarro

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Parental Occupational Choice and Children's Entry into a STEM Field

Albert Cheng
Katherine Kopotic
Gema Zamarro

University of Arkansas

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Correspondence concerning this article should be addressed to Albert Cheng at axc070@uark.edu.

Abstract

We explore the intergenerational occupational transmission between parents and their children as it pertains to entry into the STEM field. Using the Education Longitudinal Study of 2002, we study student's aspirations to work in a STEM field and eventual STEM education and employment. We show how these patterns change depending on whether the student's parents work in a STEM field. We find strong effects of parental occupation type on student's STEM outcomes that are heterogeneous by student gender. High school boys are more likely to aspire to work in STEM if one of their parents do so. By adulthood, both boys and girls have a higher probability of majoring and working in a STEM field if their parents also do, and in this case, estimated effects are stronger for girls despite a lack of effects on high school girls' aspirations. For girls but not for boys, having a parent working in STEM increases the probability of entering the STEM field in adulthood above and beyond aspirations to enter the STEM field during adolescence.

Keywords: *occupational choice, intergenerational occupational transmission; STEM gender gaps*

Introduction

Policymakers and educators have increasingly prioritized better-preparing students to enter the science, technology, engineering, and mathematics (STEM) fields (Beede et al., 2011; Demming & Noray, 2019). They often point out that proficiency in math and science are conducive for a growing number of jobs, and advancements in the STEM field are required for the economic viability of nations in an age of globalization (Members of the 2005 “Rising above the Gathering Storm” Committee, 2010).

In this paper, we focus on the influence that parental occupation type (i.e., whether the parent has a job in the STEM field or not) might have on student’s attitudes towards STEM and eventual STEM college education and employment. There are several ways through which parental occupation type could affect their children STEM outcomes. Sociologists and psychologists have long recognized the social and cultural influences of occupational choice, providing a broad theoretical basis for the contributions of parents in shaping the vocational values, aspirations, and imagination of their children (Bryant et al, 2006; Levine, 1976). More recently, empirical studies to address the influence of parents on their children’s occupational choice has increased in concert (Oren et al. 2013; Tizner et al., 2012). However, this literature has not focused specifically on entry into the STEM field, which appears to be needed given current policy goals regarding STEM.

Using the Educational Longitudinal Study of 2002 (ELS:02), a longitudinal data set that consists of a nationally-representative sample of about 15,000 high school students, we describe the bearing that parental occupational choices have on their children’s career aspirations and employment outcomes in adulthood, paying particular attention to heterogeneous patterns by gender. We find that during high school and shortly thereafter, boys are more likely to aspire to a

STEM job if a parent also works in the field. The same, however, cannot be said for girls. Eventually, by adulthood, boys follow their parents who are in the STEM field into similar careers and are more likely to earn a postsecondary degree in a STEM field. The effect among girls is even stronger, despite the absence of any effects on aspirations in the high school years. By adulthood, girls are much more likely to earn a STEM degree and be employed in mathematically-intensive (e.g., engineering, mathematics, physics, and computer science) but not a communication-intensive STEM job if their parents work in the STEM field.

Literature Review

Scholars have long recognized that parents play a key role in shaping their children's occupational choices and trajectories. Parents convey understandings of vocation and values about work, make human capital investments, socialize children towards particular identities and life goals, and model what is occupationally possible. They expose their children to a variety of opportunities while also restricting from others (Bryant et al., 2006; Honeycut & Benson, 1997; Hodkinson & Sparkes, 1997; Laband & Lentz, 1983; Lent, Brown, & Hackett, 1994; Levine, 1976). Given these interactions within the parent-child relationship, it is unsurprising that some research has documented that parents are the strongest influence on children when it comes to occupational choice (Otto, 2000; Tynkkynen et al., 2010; Mortimer et al., 2002).

A large strand of literature both in economics and sociology has highlighted the significant intergenerational transmission of income and occupational choices from parents to their offspring (Becker & Tomes, 1979; 1986; Mulligan 1999; Grawe & Mulligan 2002; Di Pietro & Urwin, 2003; Carmichael, 2000). The more recent economics literature on this topic has focused on how the intergenerational transmission of occupational type has changed over time as women increased their participation in the labor market. In this respect, Hellerstein and Morrill

(2011) found significant intergenerational transmission for both sons and daughters, about 30 percent of sons and 20 percent of daughters end up working in the same occupation of their fathers. Li and Stafford (2017) found similar results and that the share of women in a broad definition of STEM occupations has risen, arguing that higher wages in these fields have helped women improve their occupational ranking.

Despite numerous papers highlighting the significant occupational transmission from parents to their offspring, there is a lack of literature focusing on the role of parental occupation on their offspring's STEM outcomes. However, a few exceptions exist. Oguzoglu and Ozbeklik (2016) studied the role of parental occupation on women's STEM major choices and its interaction with sibling composition. The authors found that parents working in STEM had a positive effect on the probability of their daughters majoring in STEM but the effect was bigger in the absence of a son. Similarly, Anaya et al. (2017) found that the likelihood of majoring in a STEM field increased for girls with parents who worked in a science-related occupation. These patterns are consistent with the documented strong correlations between children's desired job characteristics and their parents' job characteristics (Tizner et al., 2012).

Our work builds on this literature, in a variety of ways. First and on a more rudimentary level, we add to the literature on the intergenerational occupational transmission between parents and their children by considering STEM fields specifically. Second, rather than only focusing cross-sectionally on the influence of parental occupation on earning a postsecondary degree in STEM, we take a longitudinal perspective to study the influence of parental occupation type on STEM aspirations in high school, college major choice, and eventually labor participation in a STEM job. Indeed, studies have found that high school college aspirations and expectations are strong predictors of educational attainment, even if a majority of students (60 percent) appear to update their college expectations at least once between 8th grade and eight years after high school (Jacob & Wilder, 2010). Concerning STEM outcomes, in particular, Wang (2013) studied the role of student's high school aspirations, outcomes, and post-secondary context on their decisions to major in STEM. She finds that choosing a STEM major in college is directly influenced by the intent to major in STEM during high school years, high school math achievement, and initial postsecondary experiences.

We also augment the commonplace STEM research that has primarily investigated psychological factors that affect educational and career choices. For instance, self-perceptions and academic mindsets such as self-concept, growth mindset, and self-efficacy influence interest in and motivation to enter the STEM fields (Dweck 2008, 2007; Nix et al., 2015; Simpkins et al., 2006). Other scholars have focused on the psychological effects of gender stereotyping, which may hinder girls, in particular, from pursuing further study in STEM (Beilock et al. 2010; Dasgupta & Stout, 2014; Jacobs and Bleeker, 2004; Stout et al., 2010).

However, some scholars have responded to calls for moving beyond an individualistic, psychological approach to focusing more broadly on the ways social forces affect occupational choice (Bluestein, 2006). For instance, Vilhjálmsdóttir and Arnkelsson (2013) have shown that the way in which individuals imagine their selves in their social surroundings has a bearing on their occupational choices. They demonstrated that career aspirations among adolescents are influenced by the interests and hobbies that they share with members of their social circles. We aim to contribute to this literature by similarly moving beyond investigating psychological determinants of entry into STEM by examining the potential social role that parental occupation plays in their children's occupational choice. In other words, we take a developmental contextualist approach by considering how familial relationships and interactions within an individual's life might condition their career choices (Lerner, 1991).

Given the large literature demonstrating congruence between parent and children's occupational choices that we have discussed, we expect to find that children are more likely to aspire to enter the STEM fields, and eventually do as adults if they also have parents who work in the STEM fields. We describe the methods to empirically test this hypothesis in the next section.

Methods

Data

Data for our analysis come from ELS:02, which was gathered in four waves by the US Department of Education. During the initial wave of data collection in 2002 (*Wave 0*), a nationally-representative sample of 10th graders in the country was surveyed.[1] At the time, students completed standardized tests in math and English and responded to questionnaires in a predetermined session during a school day. These questionnaires queried students on a variety of topics such as their future plans, opinions about their school, extracurricular activities, and family background. The initial sample consisted of over 15,000 students.

The U.S. Department of Education also surveyed each student's parent during the initial wave. Parents were asked to provide information about the student, their family background, and family life. In our analysis, we rely on parent surveys for a variety of demographic control variables and their reported occupation.

Three subsequent waves of data collection occurred to follow up with these students, with the final wave occurring in early adulthood. The first follow-up (*Wave 1*) occurred two years

[1] See Ingels et al. (2014) for more details on the ELS.

after the baseline year in 2004 when most of the students were in the 12th grade. Students completed a questionnaire similar to the questionnaire administered in the initial year of data collection and again took standardized tests in Math and English. The second follow-up (*Wave 2*) occurred in 2006 when most of the students were second-year college undergraduates. In this wave, students reported information such as their college experience along with future educational and employment goals. The final follow-up (*Wave 3*) took place in 2012, which asked students about their employment histories, current families, and other topics. Parents and school personnel did not participate in these final two waves of data collection.

Measures of Student STEM Outcomes

The longitudinal nature of our data allows us to focus on a variety of student outcomes over time. Students self-reported future career plans in *Wave 1* and again in *Wave 2*. Following Nix et al. (2015) and using the U.S. Department of Labor's Occupational Information Network classification system, we use this information to create a dichotomous variable indicating whether a student plans to have a job in the mathematically-intensive STEM fields (i.e., engineering, information technology, math, or physical/life sciences) or communication-intensive STEM fields (i.e., social/behavioral and health sciences). Finally, we use employment and educational background information from the *Wave 3* survey to create a series of dichotomous variables indicating whether the student majored in either a math-intensive or communication-intensive STEM field, conditional on ever being enrolled in a postsecondary program, or whether has ever held a job in the mathematically- or communication-intensive STEM fields, conditional on ever being employed.

Empirical Strategy

Student perceptions and STEM outcomes. We examine how the occupational choices of students' parents are related to a variety of student STEM outcomes described above. We estimate models based on the following specification:

$$Y_i = \beta_0 + \beta_1 Parent\_MathIn_i + \beta_2 Parent\_MathIn_i \times Female_i + \beta_1 Parent\_CommIn_i + \beta_2 Parent\_CommIn_i \times Female_i + \beta_2 X_i + u_i. \quad (1)$$

In equation (1) Y_i represents a STEM outcome, including STEM job aspirations in 12th grade and in college, postsecondary degree completion in a STEM field, and employment in a STEM field at age 25-26. We include two separate dummy variables that indicate whether any of student *i*'s parent had an occupation in a STEM-related job in the mathematically-intensive or communication-intensive sciences. We also interact these dummy variables with student *i*'s gender to assess whether associations between parental occupation and outcomes differ between boys and girls, given the prior literature on gender differences in STEM (Nix et al., 2015).

X_i is a vector of sociodemographic control variables including student's gender, race, baseline math test scores, mother's educational background, household income, each parent's employment status, and the urbanicity and US census region of the student's school. As in Wang (2013), we additionally control for the student's aspirations to enter the STEM field in models where we predict ultimate educational attainment and education outcomes to examine if parental occupation has any bearing on these outcomes net of student aspirations.

Given the inclusion of control variables such as household income, parent employment status, and parent educational attainment, we interpret the parental occupational variables as capturing any remaining effects that parents might have on student career aspirations, degree completion, or employment in a STEM field net of the direct economic and educational effects.

We have suggested that potential effects might be channeled through mechanisms such as role modeling or specific human capital investments.

To ensure that our results remain nationally representative, we employ the use of sampling weights in our analysis. Also, standard errors are clustered at the school level to take into account the fact that we have multiple students in the sample interviewed from the same schools.

Results

Descriptive statistics

Table 1 presents descriptive statistics for the students in our sample. Our sample is equally divided by gender with exactly 50 percent of the students being female. Reflecting other census data on the racial composition of the U.S. in 2002, 60 percent of the students in our sample are White, 14 percent are Black, 16 percent are Hispanic, 4 percent are Asian and another 5 percent are coded as another race (Aud et al., 2010). We also note that 11 and 15 percent of students have parents employed in the math-intensive and communication-intensive fields, respectively.

≪Table 1≫

Table 2 shows summary statistics for student outcome variables both for the entire sample and also by gender. Consistent with prior research, there are significant differences between boys and girls in their job aspirations and employment outcomes (Kahn & Ginther, 2017). In 12th grade, for example, 17 percent of boys report having plans to have a STEM job in the mathematically-intensive sciences while only 5 percent of girls do so. These differences in aspirations and eventual entry into a mathematically-intensive science field persist into adulthood. However, girls are more likely to aspire to a job in the communication-intensive sciences during secondary and postsecondary school. Even by adulthood, 10 percent of girls have a job in the communication-intensive sciences field compared to just 4 percent of boys. All patterns are consistent with prior literature (Li & Stafford, 2017).

≪Table 2≫

Determinants of STEM outcomes

We now turn to our results concerning parental occupation type. Regression estimates of our empirical model are shown in Table 3. In Panel A of the table, we present results for *Wave 1* when students were in twelfth grade. We observe that girls who do not have parents working in the STEM field are about 12 percentage points less likely than boys to aspire to a math-intensive STEM job. However, these girls are 24 percentage points more likely to aspire to a communication-intensive job. Among boys, having a parent in a math-intensive and communication-intensive field increases the likelihood of aspiring to work in the same field by 4 and 13 percentage points, respectively. On the other hand, parental occupation does not appear to shift aspirations among girls. The negative interaction terms and the main effect estimates for boys net out to zero.

<<Table 3>>

Aspirational patterns among boys and girls, as well as their association with parental occupational choice, persist into the students' college years. Boys with a parent in the math- or communication-intensive STEM field are more likely to aspire to enter the same respective fields. Meanwhile, girls' aspirations for entering communication-intensive STEM jobs do not vary with their parent's occupational choices. We only find some evidence that girls are about two percentage points more likely to desire a math-intensive STEM job if they have parents in such a field. These results are presented in panel B of Table 3. This total effect estimate of 2 percentage points is statistically significant at the 0.05 level and substantively meaningful given that only 5 percent of girls in the sample share these aspirations.

In the last panel of Table 3, we report results for degree completion in a STEM field and employment outcomes. As shown in the first column of that panel, girls without parents in a STEM field are 16 percentage less likely to earn a postsecondary degree in a STEM field, relative to boys without parents in a STEM field. In fact, boys without parents in a STEM field are not any more or less likely to earn a degree in a STEM field compared to boys with parents in the STEM field. The pattern, however, is different among girls. Girls who have parents with an Math-intensive STEM job are 7 percentage points more likely to earn a STEM degree. At 11 percentage points, the difference in STEM degree attainment is even larger for girls who have parents with a Communication-intensive STEM job compared to girls without such parents. Both results are significant at the 0.01 level. Moreover, we observe these differences among girls net of the aspirations to enter the STEM field that they reported in high school. Although students who aspired to enter the STEM field are 20 percentage points more likely to earn a STEM degree, parent occupation type is predictive of STEM degree attainment for girls but not boys. In other words, it appears that any effect that parental occupation type has on STEM degree attainment for boys is channeled through altering their aspirations, which were higher than girls' aspirations since high school. Among girls, parental occupation type is both channeled through aspirations and has some independent influence on STEM degree attainment.

As show in the second column of Panel C, parental occupation has a similar relationship with job entry into the STEM field. Girls are 9 percentage points less likely than boys to have a Math-intensive STEM job among students without a parent working in the STEM field. However, girls who have a parent with either a Math-itensive or Communication-intensive

STEM job are about 4 to 5 percentage points more likely to also have a Math-intensive STEM job — a result that is statistically significant at the 0.05 level. In contrast, we observe no such association between parental occupation and having a STEM job among boys. Once again, any effect that parental occupation type has on entry into a Math-intensive STEM job seems mostly channeled through aspirations among boys but has some independent influence on girls.

In the final column of Panel C, we observe no independent influence of parent occupation type on entry into a Communication-intensive STEM job. Girls are about 8 percentage points more likely to have a Communication-intensive STEM job than boys, and all students who had highschool aspirations to have a career in STEM are 14 percentage points more likely to have a Communication-intensive STEM job relative to students who did not have such aspirations.

Discussion and Conclusion

We set out to test whether parental occupational choices are transmitted inter-generationally to their children, specifically focusing on aspirations and entry into the STEM fields. We began by presenting summary statistics, replicating gender differences in student STEM outcomes demonstrated by other research (Nix et al., 2015). Boys plan to enter a mathematically-intensive STEM profession and actually earn a STEM degree at higher rates than girls, but girls plan on having a job in the communication-intensive sciences and end up working in that field in higher proportions than boys do. Given this result, we urge caution when using broad strokes to describe the gender gap in STEM. For instance, rather than stating that women are underrepresented in all STEM jobs, recognizing that women are underrepresented in the mathematically-intensive sciences but not in the communication-intensive sciences may be more accurate and useful if the goal is to address the STEM gender gap (Kahn & Ginter, 2017).

We then demonstrated that students with aspirations during adolescence to have a career in STEM field are more likely to earn a STEM degree and have a STEM job. However, we also found that parental occupational type has an independent influence on STEM degree attainment and entry into a Math-intensive STEM job among girls but not for boys. These results suggest that parental occupation type has bearing on encouraging girls to enter the STEM fields, even if they have lower aspirations than boys to do so during adolescence. More study into the dynamics behind this relationship will be valuable to better understand gender differences in occupational choices as they pertain to STEM.

More generally, our work is consistent with the literature on intergenerational occupational transmission between parents and their children (Bryant et al., 2006; Tziner et al., 2012; Oren et al., 2013; Vilhjálmsdóttir & Arnkelsson, 2013). Nonetheless, we reiterate that we cannot claim causal links between parental occupation type and student outcomes. Nor can we identify the specific mechanisms within the parent-child relationship that affects children's occupational choices. In line with the existing intergenerational occupational transmission literature, we have suggested that these patterns might be due to role-modeling effects, establishing social norms, or specific human capital investments that parents make to encourage entry into the STEM fields (Dasgupta & Stout, 2014; Levine, 1976; Kahn & Ginther, 2017; Oren et al., 2013). However, more research testing these hypotheses would be worthwhile. What, exactly, about the parent-child relationship explains these patterns? Moving beyond individualistic psychological factors, what and how do social practices that occur within the familial context shape the career aspirations and choices of children? Such inquiry is welcome if one wishes to pursue the policy goals not only of closing the gender gap in STEM but encouraging students – boys and girls, alike – to enter the STEM fields.

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Table 1. Summary Statistics

	Mean	Standard Deviation	Minimum	Maximum
Parent Occupation Type				
MI STEM Job	0.11	0.31	0	1
CI STEM Job	0.15	0.36	0	1
Female	0.50	0.50	0	1
Student Race				
White	0.60	0.49	0	1
Black	0.14	0.35	0	1
Hispanic	0.16	0.37	0	1
Asian	0.04	0.20	0	1
Other Race	0.05	0.22	0	1
Mother's Educational Background				
Less than High School	0.13	0.34	0	1
High School	0.28	0.45	0	1
Some College	0.35	0.48	0	1
Bachelor's Degree	0.17	0.37	0	1
Post Baccalaureate Degree	0.08	0.27	0	1
Annual Household Income				
Less than $20,000	0.15	0.36	0	1
$20,000 to 34,999	0.19	0.39	0	1
$35,000 to $49,999	0.2	0.40	0	1
$50,000 to $74,999	0.21	0.41	0	1
$75,000 to $99,000	0.13	0.34	0	1
More than $100,000	0.13	0.33	0	1
School Locale				
Urban	0.3	0.46	0	1
Suburban	0.49	0.50	0	1
Rural	0.21	0.41	0	1
U.S. Region				
Northeast	0.19	0.39	0	1
South	0.24	0.43	0	1
Midwest	0.34	0.47	0	1
West	0.23	0.42	0	1

Notes: Sampling weights included. MI = Mathematically-intensive; CI = Communication-intensive. Source: Education Longitudinal Study of 2002.

Table 2. Summary Statistics of Student Outcomes Overall and by Gender

	Overall		Boys		Girls	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Wave 1 (12th Grade)						
Plans to have a STEM Job in the MI Sciences	0.10	0.31	0.17	0.38	0.05	0.21
Plans to have a STEM job in the CI Sciences	0.27	0.44	0.15	0.36	0.38	0.49
Wave 2 (2 Years after 12th Grade)						
Plans to have a STEM Job in the MI Sciences	0.09	0.29	0.14	0.35	0.04	0.20
Plans to have a STEM job in the CI Sciences	0.23	0.42	0.12	0.33	0.34	0.47
Wave 3 (Age 25-26)						
Earned a Degree in a STEM Field	0.16	0.37	0.25	0.43	0.09	0.29
Employed in a STEM Job in the MI Sciences	0.06	0.24	0.09	0.29	0.03	0.17
Employed in a STEM Job in the CI Sciences	0.07	0.26	0.04	0.19	0.10	0.30

Note. Independent t-tests indicate that all differences in means are statistically significant at the 0.01 level. Sampling weights included. MI = Mathematically-intensive; CI = Communication-intensive. Source: Education Longitudinal Study of 2002.

Table 3. Parent Influences on Student STEM Outcomes

Panel A: Twelfth Grade Outcomes	Aspire to MI STEM Job	Aspire to CI STEM Job
Female	-0.116**	0.240**
	(0.011)	(0.014)
Parental Occupational Effects		
Parent has MI STEM Job	0.039**	-0.014
	(0.013)	(0.037)
Parent has MI STEM Job * Female	-0.021	-0.032
	(0.031)	(0.048)
Parent has CI STEM Job	0.008	0.125**
	(0.014)	(0.028)
Parent has CI STEM Job * Female	-0.006	-0.092**
	(0.028)	(0.034)
Observations (approx.)	6,870	6,870

Panel B: Outcomes Two Years After High School	Aspire to MI STEM Job	Aspire to CI STEM Job
Female	-0.106***	0.222***
	(0.011)	(0.013)
Parental Occupational Effects		
Parent has MI STEM Job	0.031**	-0.002
	(0.014)	(0.033)
Parent has MI STEM Job * Female	-0.016[a]	0.017
	(0.024)	(0.041)
Parent has CI STEM Job	0.004	0.101***
	(0.013)	(0.026)
Parent has CI STEM Job * Female	0.035	-0.081***
	(0.023)	(0.030)
Observations (approx..)	7,390	7,390

Panel C: Outcomes at Age 25-26	STEM Degree Attainment	Has MI STEM Job	Has CI STEM Job
Female	-0.178**	-0.094**	0.084**
	(0.019)	(0.011)	(0.011)
Parental Occupational Effects			
Parent has MI STEM Job	0.001	-0.001	-0.029
	(0.026)	(0.012)	(0.027)
Parent has MI STEM Job * Female	0.066*[, b]	0.049*[, a]	-0.023
	(0.031)	(0.020)	(0.025)
Parent has CI STEM Job	0.042	-0.007	0.024
	(0.022)	(0.011)	(0.021)
Parent has CI STEM Job * Female	0.087*[, b]	0.041[a]	0.039
	(0.039)	(0.022)	(0.029)
Aspirations at Wave 1	0.193**	0.063**	0.140**
	(0.014)	(0.008)	(0.010)
Observations (approx.)	3,360	5,760	5,760

Notes: Models control for student's gender, race, baseline math test scores, mother's education, parent's employment status, household income, and the urbanicity and census region of student's school. Standard errors clustered at the school level. Coefficients are marginal effects computed after estimating logistic regression models. MI = Mathematically-intensive; CI = Communication-intensive. *p<0.05; **p<0.01; [a]total effect for females significant at p<0.05; [b]total effect for females significant at p<0.01. Source: Education Longitudinal Study of 2002.