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Trends in gender segregation in the choice of science and engineering majors

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ABSTRACT

Numerous theories have been put forward for the high and continuing levels of gender segregation in science, technology, engineering, and mathematics (STEM) fields, but research has not systematically examined the extent to which these theories for the gender gap are consistent with actual trends. Using both administrative data and four separate longitudinal studies sponsored by the U.S. Department of Education's National Center for Education Statistics (NCES), we evaluate several prominent explanations for the persisting gender gap in STEM fields related to mathematics performance and background and general life goals, and find that none of them are empirically satisfactory. Instead, we suggest that the structure of majors and their linkages to professional training and careers may combine with gender differences in educational goals to influence the persisting gender gap in STEM fields. An analysis of gendered career aspirations, course-taking patterns, and pathways to medical and law school supports this explanation.

1. Introduction

Women now surpass men in college completion (Buchmann and DiPrete, 2006; DiPrete and Buchmann, 2013) and attain bachelors, masters and doctoral degrees at rates that exceed those of men (Snyder and Dillow, 2010). Yet horizontal gender segregation in fields of study, which had decreased somewhat in the 1970s and 1980s, has been stagnant for the past 20 years (Alon and Gelbgiser, 2011; Charles and Bradley, 2002). In particular, the literature has emphasized the slow gender integration in the pursuit of science, technology, engineering, and mathematics (STEM) majors (Turner and Bowen, 1999; Xie and Shauman, 2003). Given concerns about an undersupply of STEM graduates and a continuing gap in wages between male and female college graduates, the female shortfall in the pursuit of STEM majors is an important social policy issue (U.S. Department of Commerce, 2012; Xie and Killewald, 2012).

Recent evidence could support an impression that the gender gap in the attainment of STEM bachelor's degrees is narrowing. Although only 25% of STEM bachelor's degrees were awarded to women in 1977, women received 40% of STEM bachelor's degrees as of 2000 and, as Fig. 1 shows, they continue to receive STEM bachelor's degrees in increasing numbers.

Aggregate data about the share of STEM degrees by gender, however, conceal several related trends. First, more women than men enroll in higher education and receive bachelor's degrees, and the female lead has increased since women achieved parity in the number of bachelor's degrees in 1982. Yet, women continue to prefer non-STEM degrees to STEM degrees; the increased share of STEM degrees awarded to women coexists with a continuing disproportionate female preference for non-

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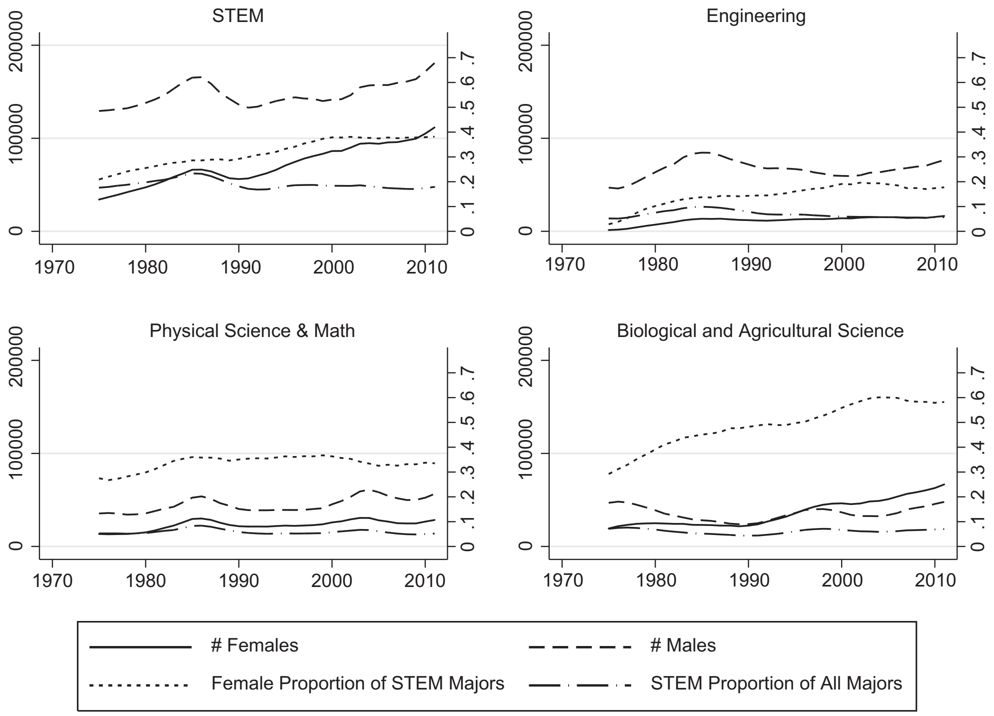

Fig. 1. Bachelor's degrees awarded to men and women in STEM fields of study, 1977–2011. *Note:* The first graphic displays the number of male and female STEM bachelor's degree recipients from 4-year colleges over the period 1975–2011, along with a dotted line showing the female proportion of STEM degree recipients in each year. The second-fourth graphics display the same information broken down for the subfields of engineering, physical science, and biological and agricultural science. *Source:* National Science Foundation WebCASPAR Database.

STEM majors.[1] Second, the number of male students receiving STEM degrees has oscillated since 1980; the number of male STEM degrees decreased noticeably in the late 1980s before rising again in the 2000s.[2] The male trend suggests that there are external factors bearing on the attractiveness of STEM majors. Third, the biological sciences became more popular in the early 1990s for both males and females.[3] During the past two decades, women who choose STEM majors disproportionately pursue biological science degrees. The combined consequence of these trends is that the share of biological science degrees awarded to women has increased from 40% to 60% over the last 30 years. At the same time, however, the shares of physical science and engineering degrees awarded to women have fallen in the last decade. The gender disparity is sharpest in engineering, where the share of degrees awarded to women has never reached 25%. In other words, any female advantage in STEM degrees is confined to the biological sciences; the male advantage persists in the physical sciences and engineering (at least in aggregate) (Fig. 1).[4]

Numerous theories have been proposed for the high and continuing levels of gender segregation, but research has not systematically examined the extent to which these theories for the gender gap are consistent with actual trends. The question that motivates our study is how the gender gap in STEM fields of study has remained relatively stable in the face of both the changing gender distribution in higher education enrollment and trends in gender-specific factors that bear directly on the attractiveness of STEM fields of study, including especially test scores, life goals, expectations about work–family compatibility, and desires for extrinsic or intrinsic satisfaction. To address this question, we revisit arguments from prior research to see how they hold up to different analytical strategies with better and more recent data. Turner and Bowen (1999) analyzed the College and Beyond data (which are drawn from 12 elite colleges and universities), and attributed between one-third and one-half of the gender gap in STEM majors in 1989 to a gender discrepancy in SAT test scores, with even

[1] In this paper, we use the term "preference" to refer to the tendency for one gender or another to choose to major in STEM fields. It is a preference "all things considered." It is quite possible that a young woman would like ("prefer") under other circumstances to be a mechanical engineer but chooses to major in ("prefers", all things considered) the biological sciences because she perceives mechanical engineering to be unsupportive of women.

[2] Fig. 1 demonstrates that STEM majors are in relative decline compared to other majors after mid-1980.

[3] In 2009, the biological sciences subfield represented 37% of STEM majors; females have comprised more than half of biological science majors since the mid 1990s.

[4] The slow convergence implied by Fig. 1 obscures a complex pattern within the many distinct STEM subfields. Thus, our analysis of trends within subfields suggests, for example, that women made gains in the computer sciences during the 1970s and 1980s but that those gains largely have been erased. At the same time, female representation in the subfields of chemistry and mathematics has risen steadily to about 50% (a data point which itself masks the increasing female–male odds of majoring in chemistry and the decreasing female–male odds of majoring in math). Conversely, the trends within most engineering subfields and physics suggest slight gains in female representation from the 1970s to the 1990s, which have leveled off.