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The gender gap in college major: Revisiting the role of pre-college factors☆

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ABSTRACT

This paper considers the importance of pre-college test scores in accounting for gender gaps in college major. Large gaps in major content exist: men are more likely to study math-, science-, and business-intensive fields, while women are more likely to study humanities-, social science-, and education-intensive fields. Previous research has found that gender differences in college preparation, typically measured by SAT scores, can account for only a small portion of these differences. Using a broader array of pre-college test scores (the ASVAB), I show that differences in college preparation can actually account for a large portion of most gender gaps in college major content, including 62% of the gap in science, 66% of the gap in humanities, and 47% of the gap in engineering. SAT scores explain less than half as much as the ASVAB scores, while noncognitive skill measures appear to explain none of the gaps in major. The gender gaps in test scores, particularly in science and mechanical fields, exist by the mid-teenage years and grow with age.

1. Introduction

Gender differences in college major choice are well known and have been studied by researchers across many disciplines. Men are more likely to study science, engineering, and business, while women are more likely to study humanities, education, and some social sciences. Given that male-dominated majors are often associated with higher-earning career paths, the difference in major choice is an important component of the gender wage gap (Charles and Corcoran, 1997).

In this paper, I study the relationship between pre-college factors, as measured by a battery of test scores, and college major content. Previous research has generally found that differences in college preparation between males and females – typically measured by SAT scores – can only account for a small portion of the gender gap in major choice. I improve on this prior work by using a richer set of pre-college skill measures in a wide variety of subjects, including math, verbal, science, and mechanical test scores. I also characterize college majors as bundles of course content, which allows for more detailed analysis than a traditional categorization of majors. I show that while SAT scores can account for a small portion of gender gaps in major content, a broader set of pre-college skill measures (the ASVAB) can account for more than twice as much. These measures account for 62% of the gap in science content, 66% of the gap in humanities content, and 47% of the gap in the probability of majoring in engineering. On the other hand, business and education fields have large gender gaps that are unexplained by test scores.

I then investigate the timing and origins of the gender gaps in test scores. I show that gender gaps in test scores, particularly in science and mechanical subjects (which are highly predictive of going into STEM majors), are present by age 15, the earliest age I can observe. The gaps then grow with age, so that boys widen their advantage in these fields as they get older. One possible reason for this pattern is gender differences in course-taking. I show that, while boys do take more middle and high school courses in shop and some science fields, this cannot explain the age patterns of the gaps in scores.

I will typically refer to test scores as measuring "pre-college factors", and it is important to be clear about what I mean. In using this term, I follow Neal and William (1996) who refer to test scores taken before labor market entry as "pre-market factors". By factors, I mean the sum of all forces that have shaped one up until the time the test score is measured. This includes innate ability but also parental, school, peer, and environmental influences. Test scores may also include information about past discrimination and the students' preferences. I sometimes also refer to these factors as "skills" or "capabilities", but these should not be confused with innate ability. To be clear, I cannot separate biological ability from preferences and other influences. The test scores contain information on all of these factors.

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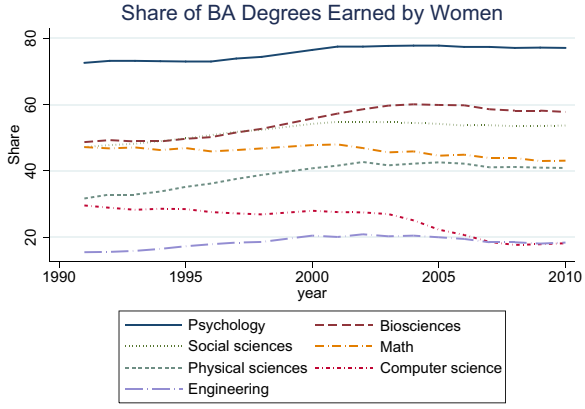

Fig. 1. Share of bachelor's degrees earned by women, by Field.

Gender gaps in college major are hardly a new topic for research. Among many others, Turner and Bowen (1999), Daymont and Andrisani (1984), Arcidiacono (2004), and Zafar (2013) have studied this issue, and the existence of large gender gaps, particularly in science, engineering, and humanities, is well known. Dickson (2010) has shown that gender gaps in major choice are much larger than racial gaps.

What is somewhat remarkable about the gender gaps in major choice is their persistence over time, even in the face of dramatic changes in the gender makeup of college students and graduates. As Goldin et al. (2006) report, female college enrollments have increased relative to those of males steadily over the last 70 years. In 1947, there were 2.3 undergraduate males per undergraduate female; by 1960, the ratio was down to 1.55, and by 2003, females outnumbered males by a ratio of 1.3 to 1. They propose several explanations for this reversal, one of which is girls' improved preparation for college relative to boys', including taking more math and science courses. Despite this, the share of undergraduate degrees earned by women in some science-related fields, including engineering and computer science, has stayed largely flat or even declined (see Fig. 1). Turner and Bowen (1999) note that the gender gaps in education and business majors have narrowed some over time, but remain large.

Researchers have explored a number of explanations for gender gaps in college major using both qualitative and quantitative methods. Turner and Bowen (1999) use SAT math and verbal scores as measures of college preparation and find that this can account for only a minority of the gender gap in majors; they point to other factors, including differences in preferences and labor market expectations, as the main determinants of the gaps.[1] Similarly, Dickson (2010) finds that aggregate SAT and ACT scores explain little of the gender gaps in majors or in differential switching out of engineering majors by gender. Paglin and Rufolo (1990), looking primarily at occupational choices and earnings, find that pre-college quantitative skills (such as the SAT math score) explain some of the male-female major gap and earnings gap. Ware and Lee (1985) look at the determinants of majoring in science and find that high SAT math scores and highly educated parents are positive predictors. As in the other papers, this does not seem to account for much of the gender gap.

Taking a more structural approach, Arcidiacono (2004) concludes that, "Virtually all ability sorting [across majors] is because of preferences for particular majors in college and the workplace." Similarly, Zafar (2013) studies the major choices of a set of Northwestern University students and concludes that, "The gender gap is mainly due to gender differences in preferences and tastes" and not discrimination or differences in academic preparation. The consensus in this literature seems to be that skills, as typically measured by SAT or ACT scores, are not the driving factor in the gender major gap.[2]

With pre-college preparation seemingly not the main culprit, much of the literature has focused on other possible drivers of the gender gap in college majors, and particularly in STEM majors. I discuss these alternate hypotheses in Section 2.1 after showing some stylized facts about these gender gaps.

This paper revisits the importance of pre-college skills in college major choice. Instead of relying on SAT and ACT scores, I make use of the Armed Services Vocational Aptitude Battery (ASVAB) tests in the National Longitudinal Survey of Youth data sets. These tests provide me with a detailed pre-college skill vector for each student, including measures of math, reading, science, and auto/mechanical skills. I show that having this wide array of skill measures – particularly the mechanical scores – dramatically improves our ability to understand college major choice. This is the first paper to use the full set of ASVAB scores to study college major choice in detail. Because my results differ substantially from previous work using SAT or ACT scores, the use of these data is a major contribution.

My key finding is that pre-college ASVAB scores account for a large portion of many gender gaps in college major content, including 62% of the gap in science, 47% of the gap in engineering, 66% of the gap in humanities, and 22% of the gap in mathematics. By contrast, business- and education-intensive majors retain large gender gaps even when controlling for test scores. Using SAT scores only explains about half as much.

Thus, when talking about gender gaps in college major, it is important to answer the question, "Which gap?" Some gender gaps are explained by academic preparation, while others are not. On the whole, these results suggest that the prior literature has been too quick to dismiss college preparation as an explanation for gender gaps in college major. Meanwhile, including "noncognitive" skill measures does nothing to explain the gender gaps, as these measures do not significantly predict major choice.

Finally, I ask at what ages the large test score gaps between men and women appear. Taking advantage of the age structure of the NLSY, I observe gender test score gaps among test takers of different ages. Test score gender gaps, particularly in science and mechanical subjects, are present in the mid-teenage years – well before college begins – and then widen substantially with age.

The remainder of the paper is organized as follows. In Section 2, I display some summary data on gender gaps in college majors and discuss some popular explanations for these gaps. Section 3 discusses the data and empirical strategy, Section 4 presents the results, and Section 5 concludes with a discussion of the results and their importance.

2. Gender gaps in college majors

In Section 4, I will use the NLSY data to document the gender gaps in college major content in my sample. Here, I provide some summary measures using data from the National Science Foundation's *Women, Minorities, and Persons with Disabilities in Science and Engineering* report (NSF 2014). Fig. 1 (BA degrees) and 2 (PhDs) summarize these data from 1991 to 2010. Women's shares of bachelor's degrees awarded vary widely across fields, from 77% in psychology to 18% in engineering in 2010. Female shares are generally highest in social sciences and biosciences and lowest in some STEM fields, including physical sciences, computer science, and engineering. Some of these shares have changed considerably over time, with women growing as a share of psychology, bioscience, social science, and physical science

[1] According to College Board data, men currently score about 30 points higher than women on the SAT math component, while women score higher on the writing section. Verbal scores are similar for men and women.

[2] As I discuss later in the paper, preferences of students can themselves influence test scores, so "skills" and "preferences" cannot be neatly separated.

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