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Math-oriented fields of study and the race gap in graduation likelihoods at elite colleges

Dafna Gelbgiser ^{a,*}, Sigal Alon ^b^a Department of Sociology, 362 Uris Hall, Cornell University, Ithaca NY 14853-7601, USA^b Department of Sociology and Anthropology, Tel-Aviv University, Ramat Aviv, Tel-Aviv 69978, Israel

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ABSTRACT

This study examines the relationship between chosen field of study and the race gap in college completion among students at elite colleges. Fields of study are characterized by varying institutional arrangements, which impact the academic performance of students in higher education. If the effect of fields on graduation likelihoods is unequal across racial groups, then this may account for part of the overall race gap in college completion. Results from a large sample of students attending elite colleges confirm that fields of study influence the graduation likelihoods of all students, above and beyond factors such as students' academic and social backgrounds. This effect, however, is asymmetrical: relative to white students, the negative effect of the institutional arrangements of math-oriented fields on graduation likelihood is greater for black students. Therefore, the race gap is larger within math-oriented fields than in other fields, which contributes to the overall race gap in graduation likelihoods at these selective colleges. These results indicate that a nontrivial share of the race gap in college completion is generated after matriculation, by the environments that students encounter in college. Consequently, policy interventions that target field of study environments can substantially mitigate racial disparities in college graduation rates.

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1. Introduction

Despite significant improvement in the representation of black students at elite colleges over the past few decades, black students at these colleges are still significantly less likely than their white peers to earn a bachelor's degree (Alon and Tienda, 2005; Bowen and Bok, 1998). Since many of the advantages of an elite college education hinge upon degree completion, this disparity is an important contributor to racial inequality. Uncovering the roots of the race gap in degree attainment among this very select group of students can help universities narrow this gap and, subsequently, improve the representation of blacks in business, government and other positions of social and economic leadership (Bowen and Bok, 1998; Small and Winship, 2007).

A race gap in college graduation rates is to be expected given individual-level differences in social and academic background, academic preparation, and cultural differences in attitudes about education (Alon and Tienda, 2005; Alon, 2007; Bowen and Bok, 1998; Downey, 2008; Roksa et al., 2008). For example, black students at elite colleges are more likely

* Corresponding author.

E-mail addresses: dg432@cornell.edu (D. Gelbgiser), salon1@post.tau.ac.il (S. Alon).

than their white counterparts to suffer multiple social and academic disadvantages (Alon, 2007), which hinders degree completion. Yet the evidence suggests that the race gap in graduation likelihoods is exacerbated, or mitigated, by factors *within* colleges, such as campus racial composition and institutional selectivity (Alon and Tienda, 2005; Bowen and Bok, 1998; Small and Winship, 2007). For example, the evidence suggests that college selectivity level is positively associated with degree completion. In fact, Small and Winship (2007) show that variation in college selectivity accounts for roughly 40 percent of the between-institution differences in the race gap in college completion, above and beyond the impact of individual-level differences in social and academic background. This effect, however, is not identical across racial groups: although all students benefit from attending selective colleges, black students benefit more than white students do (Alon and Tienda, 2005). These studies suggest that a non-trivial share of the race gap in college graduation rates is generated after matriculation, by the academic and social environments that students encounter at selective institutions.

Indeed, most of the literature on the relationship between academic environments and racial disparities in bachelor's degree attainment has focused on the characteristics of colleges. It seems, however, that field of study (college major) environments are another important source driving this race gap, one that has been largely overlooked. Fields of study are characterized by diverse institutional arrangements (Kerckhoff, 1995), including grading policies, curriculum structure, academic intensity and social context, which shape the immediate environment in each field and, as a result, impact academic performance.¹ For example, studies show that the institutional arrangements of math-oriented fields (such as math, engineering, physical sciences and economics) are associated with lower grades and graduation rates compared to other fields (Alon and Gelbgiser, 2011; Freeman, 1999; Hearn and Olzak, 1981; Leppel, 2001; Sabot and Wakeman-Linn, 1991; Suresh, 2006; Xie and Shauman, 2003). The evidence suggests that black students may be especially disadvantaged in these fields, with their competitive academic and hostile social environments, and more exposed to stereotypes about their intellectual abilities. This type of climate can impact the academic performance of black students both directly, by exposure to a hostile academic environment, and indirectly, by increasing the cognitive pressure on black students to perform via a process known as "stereotype threat" (e.g., Steele and Aronson, 1995; Aronson et al., 2002; Price, 2010). Thus, given the strong link between fields of study and graduation likelihood, fields of study may be an important focal point for understanding the race gap in college graduation, especially in cases where a field's institutional arrangements affect the graduation likelihoods of black and white students differently.

This study, then, sets out to assess the role of field of study environment in shaping the racial disparities in graduation likelihoods at elite colleges. The empirical investigation uses a large census-like study of roughly 24,000 students who attended elite four-year colleges and universities in the 1990s (College and Beyond), providing a comprehensive and systematic assessment of this issue. However, whereas most previous investigations on fields of study categorize fields into broad disciplines (i.e., social sciences, humanities, engineering fields, etc.), or into STEM versus non-STEM groups, the current investigation takes it a step further, and classifies fields by math intensity instead. While the former approach highlights differences in the intellectual content of fields, but not their structures the latter relies on what is often considered the primary attribute in determining a field's academic rigor and competitiveness (e.g., Correll, 2001; Daempfle, 2003; Seymour and Hewitt, 1997; Turner and Bowen, 1999; Xie and Shauman, 2003). We use the average math SAT scores in fields in order to characterize the full range of math intensity across majors. This classification system enables us to carefully examine how a theoretically important, but often ignored, attribute of fields of study—math intensity—correlates with student outcomes. In doing so, this study not only contributes to the existing scholarship on the race gap in higher education, but also expands the growing literature on fields of study.

The results of this study demonstrate that fields of study are an important source of the race gap in college graduation rates at elite colleges. The institutional arrangements of math-oriented fields are particularly detrimental to black students, which, in turn, promotes the overall race gap in college graduation. These results not only highlight an additional source of racial disparities in college graduation, but also shed light on one possible mechanism for the underrepresentation of blacks in math, science and technology occupations.

2. Race and field of study choices

Among the many choices that students face throughout their educational career, selection of a college major is key in that it will determine many aspects of the college experience and beyond: the number and content of required courses, the professors they encounter, the academic norms and culture within a major, the social environment of the classroom, and, not least, their labor market opportunities after graduation (Arcidiacono, 2003; Shauman, 2006; Thomas and Zhang, 2005). That is, when students choose a college major, they are not just choosing an area of academic study, but also the immediate social and academic environment that will shape their experience in higher education (Hearn and Olzak, 1981; Leppel, 2001; Sabot and Wakeman-Linn, 1991). Furthermore, with the expansion of the higher education system during the second half of the 20th century, field of study distribution became more consequential not only for students' academic outcomes, but also for

¹ According to Kerckhoff (1995:342), "institutional arrangements serve to channel the flow of individuals from origins to destinations in the stratification system. Those institutional arrangements constitute the sorting machines whose structures provide pathways to the levels in industrial societies' stratification systems." We use this term here to refer to the sorting mechanisms that channel college students from the beginning of their educational career to graduation, including curricular structure, grading policies and academic demands.

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