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

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A B S T R A C T

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.

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

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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.

labor market placement (Lucas, 2001; Ma and Savas, 2014; Wolniak et al., 2008). As college attainment became more widespread, much of the sorting into labor market positions, previously correlated to *levels* of educational attainment, became more highly correlated to *types* of educational attainment, and, especially, to fields of study (Arcidiacono, 2003; Davies and Guppy, 1997; Karen, 2002; Lucas, 2001; Ma and Savas, 2014; Rumberger and Thomas, 1993; Thomas, 1985, 2000; Thomas and Zhang, 2005; Wolniak et al., 2008).

The existing research indicates that there are some differences between the distributions of black and white students across math-oriented and non-math oriented fields of study (Davies and Guppy, 1997; Montmarquette et al., 2002; Riegle-Crumb and King, 2010; Simpson, 2001; Thomas, 1985). In analyzing nationally representative samples of high school students who matriculated at four-year colleges, Ma (2009) and Riegle-Crumb and King (2010) found that black students were slightly more likely to enter math and science fields than their white counterparts, net of select social and academic factors.[2] In contrast, Porter and Umbach (2006) found that black students at one selective liberal arts college in the 1990s were less likely than white students to enroll in math, science and technology fields, compared to social science fields. Arcidiacono et al. (2012) found that at one selective university, first-year black students were more likely than their white peers to indicate that they intend to major in math and science fields, but also more likely to leave their chosen math-oriented fields and enroll in social science majors later on (see also Dickson, 2010 for similar patterns).

The implication, from the majority of studies on the topic, that black students are somewhat more inclined toward math-oriented fields, relative to their white peers, may be related to racial differences in attitudes towards academia and labor market opportunities. Goyette and Mullen (2006) suggest that due to the long history of exclusion from higher education and discrimination in the labor market, black students are prone to fields that are more closely related to specific occupations (e.g., engineering), and that lead to higher rewards in the labor market, over humanities fields, such as philosophy and literature, which were historically preferred by the white elite. This preference, however, may be offset by race differences in academic preparation. Even at elite colleges, black students arrive with lower test scores, and are less likely to come from high schools that offer advanced placement courses in math and science, relative to whites (Alon, 2007; Margolis et al., 2008). As a result, they may lack sufficient preparation and self-confidence to enroll and persist in engineering and other math-intensive fields, and may consequently opt out in favor of other vocational/professional fields that require less rigorous math preparation. Thus, even if black students prefer math-oriented fields, systematic social and academic disadvantages may offset these preferences.

In sum, because variations in academic environments shape students' experiences and outcomes in different ways, the disparities between the distributions of black and white students across fields of study, even if small, may contribute to the race gap in college graduation. The next section expands on the link between chosen field of study and the graduation likelihoods of black and white students.

3. Math-oriented fields and the race gap in degree attainment

Because of major-specific variations in grading norms, curricular structure, and social and academic climates, field of study is an important predictor of student achievement and graduation likelihood (Alon and Gelbgiser, 2011; DesJardins et al., 2002; Hearn and Olzak, 1981; Leppel, 2001; Sabot and Wakeman-Linn, 1991; Xie and Shauman, 2003). Fields characterized by high math intensity (e.g., engineering, computer science, economics) tend to have stricter curricula and many barrier courses intended to “weed out” less capable students (Mann and DiPrete, 2013; Xie and Shauman, 2003). These fields usually employ curve-based grading, which grades students on their relative performance and encourages a more competitive social atmosphere (Suresh, 2006; Xie and Shauman, 2003). In contrast, fields characterized by low math intensity (e.g., sociology, literature, education) offer more open curricula and employ more lenient grading practices (Hearn and Olzak, 1981; Mann and DiPrete, 2013).[3]

Fields of study also differ in their social and cultural environments (Margolis and Fisher, 2003; Price, 2010; Seymour and Hewitt, 1997). Classrooms in math-oriented fields are filled with mostly male students and male professors, who are predominantly white (Price, 2010; Margolis and Fisher, 2003). Students in non-math-oriented fields, in contrast, are exposed to a more diverse student body and faculty (Price, 2010; Hearn and Olzak, 1981). This diversity influences departmental culture and, in turn, the academic experience of students (Cole and Yip, 2008; Daempfle, 2003; Margolis and Fisher, 2003).

While it is true that the systematic differences across fields promote gaps in college achievement and graduation likelihood among all students, the effect can be especially strong on black students. Price (2010), for example, shows that having white male professors has a negative impact on the persistence of black students in science and technology fields. Similarly, Chavous et al. (2004) find that black students experience greater exposure to stereotypes in traditionally male-dominated fields, such as engineering and computer science, than in more diverse fields. Indeed, the more competitive environments

[2] Riegle-Crumb and King (2010) find both adjusted and unadjusted differences in the likelihoods of enrolling in math-oriented STEM fields for black and white students (Fig. 1 vs. Figs. 2 and 3). Arcidiacono et al. (2012) report the unadjusted difference between black and white students at one elite university (Table 7).

[3] Moreover, although many fields of study in higher education have experienced significant grade inflation over the past two decades, math-oriented fields were generally unaffected by these trends (Achen and Courant, 2009; Freeman, 1999). As a result, students in math-oriented fields have lower grades, on average, than their peers in other fields (Alon and Gelbgiser, 2011; Arcidiacono et al., 2012).

of math-oriented fields are particularly detrimental for black students due to a process known as "stereotype threat," in which black students "face the threat of confirming or being judged by a negative societal stereotype—a suspicion—about their group's intellectual ability and competence" (Steele and Aronson, 1995:797; see also Beasley and Fischer, 2012; Cabrera et al., 1999; Chavous et al., 2004; Owens and Lynch, 2012; Steele, 1997; Steele and Aronson, 1998; Solorzano et al., 2001). The exposure to stereotype threat increases anxiety and puts cognitive pressure on black students, consequently lowering their achievements and engagement in the domain, and increasing their chances of dropping out (Beasley and Fischer, 2012; Chavous et al., 2004; Pinel et al., 2005; Steele, 1997). Consequently, the race gap in academic performance among students at elite colleges may be larger in math-oriented fields than in other fields.

The discussion above implicates fields of study as an undeniably important axis of racial inequality in degree attainment in cases where there are differences in the distribution of black and white students across fields, or where the environments of math-oriented fields are more detrimental to the persistence of black students, or both. And yet, most research on the race gap in college graduation rates has dealt with institutional stratification, while ignoring stratification by fields of study. The current investigation fills this gap by empirically examining three research questions: (1) To what extent do black and white students at elite institutions differ in their likelihoods of enrolling in math-oriented fields of study?; (2) To what extent are the graduation likelihoods of black and white students influenced by the institutional arrangements within math-oriented and non-math-oriented fields of study?; and (3) What share of the race gap in degree attainment among students at elite colleges can be attributed to variations in field of study arrangements?

4. Data, variables and method

4.1. Data and sample

The empirical investigation in this study is based on the College and Beyond (C&B) database, whose exceptionally large sample size of around 24,000 students is especially useful for examining the influence of fields of study on racial disparities in degree attainment. The C&B, a restricted-access census-like database built by the Andrew W. Mellon Foundation, includes the individual records of all undergraduate students who enrolled in one of 28 academically selective four-year colleges and universities in the fall of 1989 (Bowen and Bok, 1998).[4] The two dependent variables in the current study—field of study and 6-year graduation status—are drawn from these institutional records.

Using the C&B database has several notable advantages, the first and foremost of which is its large sample of black students at selective four-year colleges compared to other commonly used datasets, such as the ELS or BPS. Because this examination requires dividing the sample into race by field categories, a large enough sample of black students is critical for ensuring valid and stable results. Against the backdrop of studies that use one institution (e.g., Arcidiacono et al., 2012) or smaller sample sizes (e.g., Riegle-Crumb and King, 2010), the C&B is alone in its ability to produce reliable and robust estimates of field of study stratification by race among students at elite colleges. Furthermore, the institutions in the sample are of comparable selectivity, which mitigates the variation between institutions and allows for a closer investigation of intra-institutional stratification. These characteristics, along with the wealth of information on students' social and academic backgrounds, render the C&B uniquely suitable for the current investigation, despite the fact that it reflects students who attended college in the 1990s.[5]

Our analyses focus on the sample of 2,012 black students and 21,625 white students for whom graduation status and college major information is available. We account for non-random attrition from our analytic sample by constructing sample weights that allow projections for the entire population of black and white students at the C&B colleges. These weights are based on the sample weight developed by the data distributors (see Bowen and Bok, 1998), multiplied sequentially by the estimated inverse probabilities that account for non-response on the two main dependent variables (i.e., field of study and graduation status).[6] The standard errors are clustered by institutions to fit the data structure.

[4] The data for the only two public institutions in the sample were derived from probabilistic samples. For these two institutions only, the data distributers provided sample weights to account for students' probability of being included in the sample. For all other institutions, records were collected for all enrolled students.

[5] It is important to note that the patterns today may differ than those in the C&B data. Nonetheless, the evidence suggests that stratification between fields of study has only increased in the years since (e.g., Achen and Courant, 2009; Freeman, 1999). Thus, we expect the underlying relationship between race, fields of study and college graduation rates to be similar today.

[6] These estimated probabilities are drawn from a logit model predicting inclusion in the analytic sample by a comprehensive set of social, academic and institutional factors. In essence, these weights give more weight to cases in the analytic sample that are similar in characteristics to cases that were omitted from the sample due to missing information on the outcome variables.

4.2. Variables

4.2.1. Classifications and characteristics of college majors

We use 26 distinct categories of college majors, including math and physics, engineering, psychology, foreign languages, music and theater, art and art history, and sociology (see Appendix A for a full list).[7] We characterize the academic and social environments of majors by collapsing individual-based information drawn from the entire C&B cohort by fields of study. Our key distinction is the math intensity of college majors. We use the average math SAT score of all students in a major to classify the math intensity of fields. As expected, average math SAT scores vary substantially across majors, ranging from a low of 562 in education fields to a high of 702 in computer and information sciences (see Appendix A). This classification of fields goes beyond the popular STEM versus non-STEM dichotomous approach; by placing fields on a continuous spectrum, we highlight the main barrier to enrollment and success in fields: math intensity. In addition to using this continuous measurement (math intensity) of fields, we also collapse fields into two main groups: fields in the top 25 percent of the math-intensity distribution are classified as *math-oriented fields*, while fields in the bottom 75 percent are classified as *non-math-oriented fields*. Math-oriented fields include the biological sciences, mathematical and physical sciences, economics, chemistry, engineering, and computer sciences/information fields, and their average math SAT scores range from 659 to 702. We constructed several additional major-based variables to capture the social and academic environments within majors: size (total number of students enrolled in a major), grading norms (average GPA in a major), and gender composition (the share of women enrolled in a major).

4.2.2. College graduation

College graduation, our main outcome variable, is coded 1 for students who obtained a bachelor's degree within 6 years of matriculation (including students who transferred institutions), and 0 for students who did not obtain a degree.

4.2.3. Student race

Race is coded 1 for students who are non-Latino black, and 0 for non-Latino white.[8]

4.2.4. Adjustment variables

To estimate the selection into college majors and the net effect of college majors on graduation likelihood, all models adjust for a comprehensive set of social, academic and institutional factors that are known to influence both college selection and graduation.[9] *Social background factors* include gender, family income, parental education, high school type, eligibility for financial aid status, and home region. *Academic preparation factors* include high school class rank, and math and verbal SAT scores. *Institutional factors* include institutional selectivity level and the share of women in an institution.[10] Descriptive statistics for all variables are provided in Appendix B.

4.3. Analytical strategy

Our analytical strategy consists of three stages: First, we examine the selection regime that channels students to fields of study by estimating a series of logit and OLS models, which predict a student's major from the comprehensive set of background and institutional factors described above. We fit these models to the entire sample, and then by racial groups in the sample. Second, we examine how graduation likelihood is influenced by the institutional arrangements within fields of study by fitting several multilevel models that predict six-year graduation likelihood, while taking into account the variability associated with the math orientation of majors, and with individual and institutional characteristics. We fit these models to the entire sample and allow the slope of race (denoting the race gap) to vary by the math orientation of majors. Additionally, we explore the possibility of unobserved negative selection into fields of study by estimating a weighted regression (Morgan and Todd, 2008; Morgan and Winship, 2015) that assesses heterogeneity in the effect of field of study on graduation likelihood.[11]

Building on these results, we assess what share of the race gap in college graduation can be attributed to stratification by fields of study. First, we estimate the raw gap by fitting a model that predicts student graduation rates as a function of race

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[7] College major categories are based on students' last reported college major prior to departing the institution (either by graduating or dropping out). The data distributers coded the major information into 66 distinct majors. To ensure valid and stable results, majors with less than 65 students and/or less than 20 black students were collapsed into larger categories of majors based on field similarity and size. One major in the sample, "Arts and Science, general" (N = 236), was omitted from the sample due to outlier graduation likelihoods relative to all other fields in the C&B data (23 vs. 92 percent). It is likely that some schools used this major category for students who left the institution prior to declaring a major. Our sample weights account for this omission and allow projections for the entire population of black and white students at the C&B schools.

[8] Although field of study can be relevant for all racial/ethnic groups, we focus here on the black-white race gap exclusively because the processes that contribute to the black-white race gap likely differ from those that shape other race/ethnic disparities. Including Asians and Hispanics in the analyses could downplay processes that are unique to each group. We plan to expand this approach to examine other racial and ethnic groups in future research.

[9] See Alon (2007), Alon and DiPrete (2015), Bowen and Bok (1998), Bradley (2000), Correll (2001), Davies and Guppy (1997), Goyette and Mullen (2006), Ma (2009), Mann and DiPrete (2013), Margolis et al. (2008), Morgan et al. (2013), Turner and Bowen (1999), Wilson and Boldizer (1990), Wolniak et al. (2008).

[10] This adjustment also helps distinguish between all-women and co-ed institutions.

[11] Results from the weighted regression are presented in the Supplementary Appendix.

Table 1
Graduation rates and percentage distributions of black and white students across fields of study at elite colleges.

	White students	Black students
	%	%
Panel A: Graduation rates		
Six-year graduation rate	93.2%	83.6%
Panel B: Distribution across fields of study		
Math-oriented fields	29%	26%
Non math-oriented fields	71%	74%
Total	100%	100%

Notes: Data are weighted (see main text). N = 21,625 for white students; N = 2,012 for black students. The differences between black and white students in both panels are statistically significant (Pearson Chi Square = 269.73, $p < 0.01$ in Panel A; Pearson Chi Square = 13.66, df = 1, $p < 0.01$ in Panel B).
Source: C&B 1989.

alone. Next, we estimate the "net race gap" by adjusting for the set of social, academic and institutional factors. To account for the effect of field of study, we add to the model fixed-effects for all majors that disaggregate the field of study-associated variance in college graduation from the variance associated with other factors. We also include race by field of study fixed-effects interactions to account for the variation in the effect of fields on graduation likelihoods, by race. Based on this model, we calculate two predictive scenarios that gauge the influence of field of study on the race gap in graduation, above and beyond the influence of social, academic and institutional factors.

5. Results

5.1. Race and choice of field of study

Among students at the most selective colleges in the nation, there is a substantial race gap in college graduation. The graduation rates of white students in the C&B data are almost 10 percentage points higher than those of black students: 93.2 percent among white students versus 83.6 percent among black students (see Panel A in Table 1). Yet we find only small differences in the distribution of students across fields of study. For instance, black students are slightly underrepresented in math-oriented fields relative to white students: 29 percent of white students enroll in math-oriented fields versus 26 percent of black students, a difference of only 3 percentage points (see Panel B in Table 1). The underrepresentation of black students in math-oriented fields may stem from racial differences in background characteristics. Table 2 presents descriptive statistics of the social background, academic preparation and institutional factors associated with black and white students at elite colleges, revealing substantial disparities between the two sample groups. For example, relative to black students, white students have more financial resources (family income of $65K for white students vs. $41K for black students), are more likely to have at least one college-educated parent (86 percent vs. 62 percent), and are less likely to be eligible for financial aid (19 percent vs. 40 percent). Differences in the academic preparation of black and white students are also large: white students are more likely to be ranked in the top 10 percent of their high school class (56 vs. 37 percent), and the average math and verbal SAT scores of white students are much higher than those of blacks (641 vs. 540 for math, and 584 vs. 511 for verbal). The gaps in selectivity levels of the institutions that black and white students attend are less pronounced.

We fit several OLS models that predict the math intensity of students' last reported majors, adjusting for race and the full set of aforementioned social, academic and institutional factors (Table 3, Models 1–3). Net of these factors, black students, relative to whites, enroll in more math intensive fields, with average math SAT scores that are 5.49 points higher (Model 1). Thus, the observed underrepresentation of black students in math-oriented fields, reported in Table 1, is driven by differences in the characteristics of black and white students, reported in Table 2. These results are consistent with prior studies that show black students' inclination for math-oriented fields (Arcidiacono et al., 2012; Ma, 2009; Riegle-Crumb and King, 2010). To account for the non-linearity in fields of study, we replicated these analyses using logit models (Models 4–6, Table 3), where fields of study were divided into math-oriented versus non-math-oriented fields. The results tell a similar story: net of everything else, black students are 1.52 times more likely to enroll in math-oriented fields than are white students ($\exp(0.419) = 1.52$, Model 4).

Although black students exhibit a higher preference for math-oriented fields net of other factors, the results of the race-specific models (Models 2, 3, 5 and 6, Table 3) reveal similarities in the magnitude and direction of the coefficients, indicating that, by and large, the impact of social, academic and institutional factors on field of study choices is similar for both black and white students.[12]

[12] Some differences in the magnitude of the effects of gender, parental education and geographic area are found. As a sensitivity analysis, we estimated models for both black and white students that include an interaction term between gender and race (results are available from authors upon request). The interaction term was not statistically significant, and the model fit statistics suggest that the inclusion of the interaction term did not significantly improve the model fit.

Table 2
Social background, academic preparation, and institutional characteristics factors of black and white students at elite colleges.

	White students	Black students
Social background		
Female	0.50	0.58
Income (in $K)	65.02	41.33
Parental education (BA)	0.86	0.62
Parental education: missing	0.08	0.05
Geographic area: South	0.25	0.38
Geographic area: Midwest	0.24	0.24
Geographic area: West	0.07	0.06
Geographic area: Northeast	0.44	0.32
Need financial aid	0.19	0.40
Academic preparation		
HS class rank: top 10%	0.56	0.37
HS class rank: missing	0.19	0.18
HS type: public	0.42	0.43
SAT Math	640.57	539.67
SAT verbal	583.83	511.20
Institutional factors		
Institutional selectivity: most competitive	0.19	0.21
Institutional selectivity: highly competitive	0.42	0.39
Institutional selectivity: very competitive	0.40	0.40
% female in institution	0.50	0.51

Notes: Data are weighted. Based on chi square test and t-tests, the differences are statistically significant for all factors except “HS class rank: missing” and “HS type: public.”
Source: C&B 1989.

Put differently, we find no evidence that the selection regime channeling students to math-oriented fields is different for black students. For example, in both groups, students with stronger academic preparation are more likely to enroll in math-oriented fields.

Taken together, these results suggest that the disparities in field of study distribution between black and white students are not the main culprit behind the race gap in college graduation: black and white students are almost equally distributed across math-oriented and non-math oriented fields in the C&B schools. Moreover, even though black students exhibit higher preference for math-oriented fields relative to whites, net of other factors, the associations between their social and academic factors and their field of study selections do not vary by race. Next, we explore whether the institutional arrangements within fields of study may influence the graduation rates of black and white students differently, and, as a result, contribute to the race gap in college graduation.

5.2. *The math intensity of fields of study and graduation likelihood*

We estimate a series of multilevel models predicting students' six-year graduation likelihoods while accounting for the variability associated with field math intensity (measured by the average math SAT score in a major) and a set of social, academic and institutional factors. Following Alon and Gelbgiser (2011), we also include the square term for math intensity in the models in case the relationship between the math intensity of fields and 6-year graduation likelihood is not linear.[13] We assess race differences in the effect of field of study institutional arrangements on graduation likelihood by allowing the race slope to vary by the math intensity of majors. The point estimates from these models are available in the Supplementary Appendix (Table SA1). To ease the interpretation of the results, we present the predicted graduation probabilities of black and white students obtained from these models. Fig. 1a and b plot the predicted 6-year graduation likelihoods and their confidence intervals for black and white students by major math intensity, obtained from the full model.[14] In Fig. 1a, we standardized the predicted 6-year graduation probabilities to reflect the social, academic and institutional factors that characterize the sample of *white* students. In Fig. 1b, we standardized the predictions to reflect the social, academic and institutional factors that characterize the sample of *black* students.[15]

Fig. 1a and b shows that when it comes to graduation likelihood, *all* students are negatively affected by the math intensity of fields, even when we adjust for social background, academic preparation and institutional characteristics. Yet, compared to whites, black students suffer a greater reduction in graduation likelihood as a major's math intensity increases. That is, the graduation likelihoods of black students in math-oriented fields (i.e., majors with average math SAT scores of 659 or higher) are substantially lower than the graduation likelihoods of observationally similar black students in non-math-oriented fields (i.e.,

[13] Alon and Gelbgiser (2011) found a significant curvilinear relationship between the share of women in fields and students' 6-year graduation likelihoods. Since the math intensity of fields is correlated with the representation of women in fields, this relationship of interest may be curvilinear as well.

[14] Because the square term for math intensity is significant across all models, the predicted probabilities in Fig. 1a and b are based on the full specification of the model.

[15] Given that logit coefficients vary across values of the predictors, we standardize the predictions to both populations' characteristics to ensure that the results are robust. This is especially important given the differences in the composition of black and white student samples observed in Table 2.

Table 3
Logit and OLS models that predict field of study selection, for students at elite colleges.

	Field math intensity (average math SAT score)			Math-oriented vs. non-math-oriented fields		
Model#:	(1)	(2)	(3)	(4)	(5)	(6)
Population:	All	White students	Black students	All	White students	Black students
Race: black	5.491**			0.419**		
	(1.057)			(0.100)		
Social background:						
Female	−10.986**	−11.168**	−8.507**	−0.632**	−0.639**	−0.507**
	(1.329)	(1.470)	(1.417)	(0.069)	(0.077)	(0.101)
Family income (in $K)	−0.012	−0.010	−0.049*	−0.004**	−0.004**	−0.010**
	(0.010)	(0.011)	(0.023)	(0.001)	(0.001)	(0.003)
Parental Education: BA	0.242	0.664	−0.965	−0.016	−0.024	0.186*
	(0.691)	(0.861)	(1.182)	(0.070)	(0.076)	(0.093)
Parental Education: missing	−0.077	0.028	−2.983	0.176+	0.194*	−0.201
	(0.593)	(0.699)	(3.779)	(0.099)	(0.095)	(0.348)
Region: South	−1.598	−1.844	0.927	−0.025	−0.061	0.436+
	(1.917)	(2.074)	(1.805)	(0.129)	(0.134)	(0.227)
Region: Midwest	4.819**	4.692**	6.967**	0.382**	0.361**	0.760**
	(1.361)	(1.399)	(2.131)	(0.123)	(0.126)	(0.255)
Region: West	−0.566	−0.525	−0.639	0.083	0.068	0.391
	(1.155)	(1.097)	(3.307)	(0.115)	(0.108)	(0.298)
Financial aid status: eligible	1.082	1.129	0.884	0.048	0.060	−0.009
	(0.670)	(0.788)	(2.665)	(0.059)	(0.059)	(0.291)
Financial aid status: missing	−0.361	−0.251	−1.381	−0.066	−0.060	−0.101
	(2.005)	(2.085)	(3.125)	(0.188)	(0.205)	(0.278)
HS type: public	3.883+	3.733	5.659*	0.253+	0.249	0.314+
	(2.172)	(2.194)	(2.166)	(0.153)	(0.153)	(0.180)
Academic background:						
SAT math	0.088**	0.090**	0.079**	0.008**	0.008**	0.007**
	(0.008)	(0.008)	(0.013)	(0.001)	(0.001)	(0.001)
SAT verbal	−0.002	−0.001	−0.013	−0.003**	−0.003**	−0.002**
	(0.006)	(0.006)	(0.013)	(0.000)	(0.000)	(0.001)
HS class rank (top 10% = 1)	2.491*	2.531*	1.873	0.406**	0.422**	0.244*
	(1.197)	(1.192)	(1.680)	(0.067)	(0.066)	(0.123)
HS class rank: missing	1.620	1.605	1.371	0.160*	0.162*	0.152
	(0.990)	(1.041)	(1.556)	(0.077)	(0.082)	(0.150)
Institutional characteristics:						
Institutional selectivity: very selective	2.670	2.643	2.577	0.379**	0.381*	0.359
	(2.124)	(2.203)	(2.150)	(0.144)	(0.152)	(0.266)
Institutional selectivity: highly selective	−0.000	0.158	−1.027	0.598**	0.597**	0.598**
	(1.957)	(2.004)	(2.204)	(0.179)	(0.195)	(0.143)
% female in institution	6.119	6.266	5.666	0.642*	0.685*	0.222
	(5.493)	(5.662)	(8.257)	(0.278)	(0.304)	(0.571)
Constant	581.905**	579.622**	598.125**	−4.990**	−5.127**	−3.994**
	(5.318)	(5.383)	(6.937)	(0.408)	(0.434)	(0.600)
Observations	23,637	21,625	2,012	23,637	21,625	2012
R-squared/Pseudo R-squared	0.151	0.153	0.124	0.101	0.102	0.0918
Chi square				1906	2066	437.3
DF				18	17	17
Log Likelihood				−15961	−14737	−1204

Notes: Data are weighted. Standard errors are clustered. Robust standard errors are in parentheses.
**p < 0.01, *p < 0.05.
Source: C&B 1989.

majors with average math SAT scores lower than 659). While math-oriented fields also have a negative impact on the graduation likelihoods of white students, the penalty is much smaller. In contrast, in fields characterized by low math intensity (e.g., education, health sciences and communications), the race gap is not significant. Thus, the race gap in graduation rates is substantially larger in math-oriented fields than in non-math-oriented fields, even after accounting for differences in student characteristics.

The main conclusion from this analysis is that the size of the race gap varies by field math intensity, regardless of student characteristics. To illustrate, if the distribution of social, academic and institutional characteristics of black students were matched to those of white students, the predicted race gap in graduation likelihood in fields with an average math SAT score of 603, such as sociology, would be about 3 percentage points (94.1 percent for white students vs. 91.1 percent for black students, Fig. 1a). Yet the predicted race gap for students with the *same characteristics* who enroll in fields with an average math SAT score of 687, such as engineering, is more than double: 91.6 versus 84.7 percent, a gap of about 7 percentage points. Put differently, if we take black and white students with similar social backgrounds and academic preparation and move them

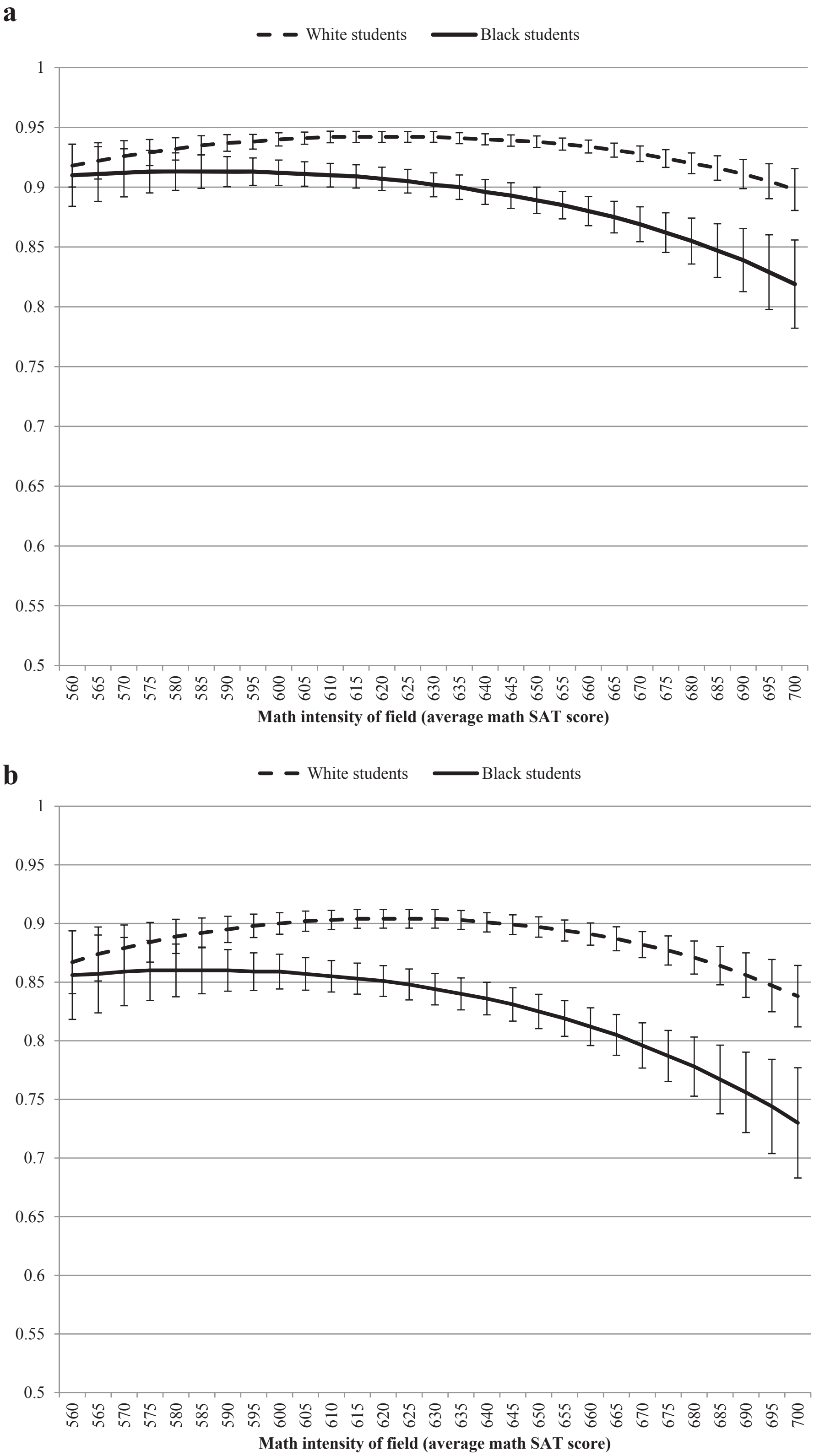

Fig. 1. 1a). Predicted six-year graduation probabilities for black and white students at four-year elite colleges, by math intensity of field (standarized to white students' distribution of social, academic and institutional factors). 1b). Predicted six-year graduation probabilities for black and white students at four-year elite colleges, by math intensity of field (standarized to black students' distribution of social, academic and institutional factors).

Table 4
Bivariate correlations and means of different characteristics of fields of study in elite colleges.

	Bivariate correlations	Means		
	Math intensity (average math SAT score in field)	Math-oriented fields	Non-math-oriented fields	t-test
Grading norms (average cumulative GPA of students in major)	0.0398*	3.12	3.17	16.14*
Grading norms (only math-oriented fields)	−0.1179*			
Grading norms (only non-math-oriented fields)	0.2957*			
Class size (number of students enrolled in a program)	0.0968*	149.36	122.78	−8.71*
Race composition (% black students in major)	−0.2197*	0.07	0.09	18.00*
Gender composition (% female students in major)	−0.5924*	0.35	0.57	79.42*

Notes: Data are weighted, *p < 0.05.
Source: C&B 1989

from a non-math-oriented to a math-oriented field, the race gap in graduation likelihood increases substantially, *just* from this transition. This is due to the greater, and unique, disadvantage that black students experience in math-oriented fields.[16]

It is possible that some of the negative effect of math-oriented fields on graduation likelihood stems from the negative selection of students, especially black students, into these fields. Although we cannot fully account for selection in observational data, we explore the possibility of negative selection by estimating a weighted regression that predicts black and white students' graduation likelihoods as a function of the math orientation of their chosen field of study. This technique, developed from the counterfactual literature on causal inference, helps detect heterogeneity in the effect of the treatment that is related to selection into the treatment. The results from the weighted regressions (discussed and presented in the Supplementary Appendix) support the conclusion drawn from the multilevel models, and suggest that these results are not driven by negative selection. Specifically, we find that the negative effect of math-oriented fields on graduation likelihood does not vary by a student's (observed) propensity to enter a math-oriented field.

The negative effect of math-oriented fields on graduation likelihood may capture systematic differences in the institutional arrangements of math-oriented vs. non-math-oriented fields, which, in turn, shape the graduation likelihoods of student groups in distinct ways. Table 4 shows bivariate correlations between math intensity and other characteristics of fields, including size, grading norms and gender composition. We find that grading norms have a curvilinear relationship with math orientation: in math-oriented fields, the average GPA decreases as math intensity increases. The opposite is true in non-math-oriented fields: the average GPA is higher in fields with medium math intensity than in those with low math intensity. Field math intensity is also correlated with the size and gender composition of fields: math-oriented fields tend to be larger, and are characterized by lower representations of female students. These disparities are well captured in the mean differences between math-oriented and non-math-oriented fields: the academic environment in math-oriented fields is characterized by lower average GPAs (3.12 vs. 3.17), larger classes (149 vs. 123 students), and lower representations of women (35 vs. 57 percent female). Although these characteristics certainly do not capture all the factors that shape students' experiences and achievements, they nonetheless provide a snapshot of some of the systematic differences across fields.

The results so far demonstrate that the social and academic environments of math-oriented fields differ systematically from those of non-math-oriented fields. These differences, we demonstrate, influence the graduation likelihood of all students, above and beyond factors such as social background, academic preparation, propensity to enroll in math-oriented fields, and characteristics of institution attended. Black students, however, are especially disadvantaged by the institutional arrangements of math-oriented fields, relative to white students. As a result, the race gap in math-oriented fields is substantially larger than in other fields. Next, we gauge the relative share of the race gap in graduation likelihood that can be attributed to the institutional arrangements of math-oriented fields.

5.3. Fields of study and the overall race gap in graduation likelihoods

We estimate a series of logit models predicting students' 6-year graduation likelihoods and use the predicted probabilities from these models to evaluate changes in the gap.[17] Column 1 in Table 5 shows the raw graduation rates for students in the C&B sample. Although the graduation rates of both black and white students are high in these selective schools—93.2 percent for white students and 83.6 percent for black students—there is a sizeable race gap of 9.6 percentage points. About half of this gap is explained by race differences in social background, academic preparation and institutional characteristics (Column 2). Nonetheless, even after differences in the composition of the samples are netted out, a net race gap of about 5.1 percentage points remains.

[16] As a sensitivity analysis, we estimated a comparable HLM model using a STEM vs. non-STEM classification system for majors, instead of math intensity (based on the NSF definition of STEM fields). The results, discussed in the Supplementary Appendix, are similar to those presented here.

[17] Coefficients from these models are presented in Appendix C.

Table 5
Predicted six-year graduation likelihoods from logit models and predictive scenarios, for students at elite colleges.

	Observed and adjusted gap		Predictive scenarios: Race-specific relationship between field and graduation likelihood	
	Raw gap	Net gap	Black students' effects	White students' effects
	1	2	3	4
White	0.932	0.929	0.885	0.932
Black	0.836	0.878	0.836	0.900
Race gap	0.096	0.051	0.049	0.031
% of raw gap explained		46.9%	2.1%	20.2%
% of net gap explained			4.0%	38.0%

Notes: The "% of raw gap explained" denotes the share of the raw gap that is explained by the predictive scenario, above and beyond the effect of social, academic and institutional factors accounted for in the net gap. The "% net gap explained" denotes the share of the predicted net gap explained by the scenario specification.
Source: C&B 1989

To examine how much of this remaining gap can be explained by the stratification of fields of study, we estimate a model predicting 6-year graduation likelihoods that includes student race, the full set of background and institutional factors, and fixed-effects for fields of study. We account for the race variation in the effect of fields of study reported in Fig. 1a and b by including interactions of race with the field of study fixed-effects. Based on this model, we outline two predictive scenarios that help us gauge the influence of fields on the race gap: In the first scenario, we assign the field of study effects of black students to the white student sample (so that the white student group assumes the effect of academic environment on graduation likelihood as actually experienced by black students), but leave everything else as is (including social background, academic preparation, institutional factors, and distribution across fields). In the second scenario, we assign the field of study effects of white students to the black student sample, but leave everything else as is. Because both scenarios require that the field effect be equal for black and white students, any decrease in the overall race gap in graduation likelihood stems from the asymmetrical effect of fields on graduation likelihood by race.

The predicted probabilities estimated from these scenarios demonstrate the importance of field of study stratification for the overall race gap in general, and to the graduation rates of black students in particular. In the first scenario, in which all students in the sample are assigned black students' field effects on graduation likelihood, the net race gap decreases only marginally—from 5.1 to 4.9 percentage points (Column 3, Table 5). But in the second scenario, in which all students are assigned white students' field effects (Column 4, Table 5), the net race gap decreases from 5.1 to 3.1 percentage points, which accounts for about 20 percent of the raw gap. This relatively sharp decrease in the race gap is driven by black students' greater sensitivity to the environments of math-intensive fields of study: When black students are assigned white students' field effects on graduation, they no longer suffer from their specific disadvantage in these fields, and the race gap decreases substantially. The graduation likelihoods of white students, on the other hand, are far more resilient to the variation in field environments. In sum, the results from the predictive scenarios are consistent with the argument that field of study environment plays an important role in shaping overall racial disparities in graduation likelihoods, especially with regard to the unique disadvantage of black students in math-oriented fields.

It is possible that some of the effect of field math intensity on the graduation likelihoods of black students, which we have attributed to variation in learning environments, is driven by selection to math-oriented fields based on unobserved characteristics, such as motivation and attitudes. In order for unobserved selection to conflict with our results, the unobserved characteristics need to be uncorrelated with the observed characteristics included in our selection models (i.e., Table 3). This would be the case, for example, if (1) black students who are unmotivated were more likely to enter math-oriented fields, and (2) their lack of motivation was not correlated with their academic achievements in high school, SAT scores, and family socio-economic status. While it is possible, we find it unlikely that students' motivation and attitudes has no bearing on prior academic achievements, especially among students at the most selective colleges. Although we cannot fully assess the possibility of selection on unobserved characteristics in observational data in order to establish causality, we think that the evidence presented here (as well as in the weighted regression) strongly suggests that the environment of fields is responsible for the variation in the size of the race gap across fields, rather than selection into fields.

6. Conclusions

Individual-level factors, such as academic preparation and social background, explain a large share of the race gap in college graduation among students at elite colleges. Yet significant disparities in the graduation likelihoods of black and white students remain even after adjusting for these factors. This study contributes to the growing literature on the race gap by identifying an important and highly consequential additional source of the race gap in college graduation: students' chosen field of study. We demonstrate that enrolling in math-oriented fields, like STEM fields, is detrimental to the graduation likelihoods of all students, but especially to those of black students, net of personal attributes, academic preparation, propensity to enroll in these fields, and institutional characteristics. Consequently, the race gap in graduation rate in math-oriented fields is larger than in other fields, which contributes to the overall race gap in graduation likelihoods at these selective schools. These results imply that a nontrivial share of the race gap is generated after matriculation, by the social and academic environments that students encounter in college. This is especially discouraging given the fact that black students who enter math-oriented majors likely overcame many hurdles prior to entering these fields. Nonetheless, even these select few experience lower graduation likelihoods in these fields relative to their white counterparts.

These findings indicate that field of study environment is a promising avenue for future research on the race gap in graduation likelihood and the policy interventions aimed at reducing racial disparities in degree attainment. Fields of study environments are shaped largely by organizational processes and through diffusion of practices across universities (e.g., Kraatz and Zajac, 1996). Curve-based grading policies and weed-out courses, for example, are common place in most departments of math-intensive fields. Similarly, grade inflation is common in most social science and humanities departments at four-year colleges (e.g., Freeman, 1999). These organizational processes, we show, are consequential for student outcomes in higher education, and should be an integral part of the research that focus on racial and ethnic patterns of inequality in higher education. Future research should identify key organizational actors, practices, and patterns of diffusion in the field of higher education that can be targeted in policy interventions. Given the focus of most existing research on differences in individual-level characteristics, which are harder to address via policy interventions, focusing on the academic and social environment that students encounter in colleges can be especially rewarding.

The main goal of this new line of research is to identify the causal mechanism that generate the asymmetrical effect of math-oriented fields on the graduation likelihoods of black and white students at elite colleges. Although we are unable to identify what exactly is depressing the achievements of black students who enrolled in math-oriented fields with the C&B data, we offer several possible hypotheses based on our findings and previous research. First, the more competitive and sometime hostile social environments of math-oriented fields may be especially detrimental for black students. For example, enhanced exposure to stereotype threat may be responsible for some of the negative impact of math-oriented fields on the academic achievements of black students (Owens and Lynch, 2012; Steele, 1997; Beasley and Fischer, 2012; Beasley, 2012). In addition, in most math-oriented fields, black students face an environment that is primarily dominated by white males (Seymour and Hewitt, 1997). The lack of black professors and role models may foster an environment in which black students, even at the most elite universities, find it harder to flourish. Indeed, previous findings show that having a more racially- and gender-diverse faculty is associated with higher rates of persistence among black students (e.g., Price, 2010).

The negative effects of the social circumstances on black students persistence are likely heightened by the academic arrangements within these majors. “Weed-out” courses and curve-based grading norms in math-oriented fields, for example, can exacerbate the pressure on black students to perform well and increase fears of confirming racial stereotypes. Moreover, the rigid curriculum structure of most math-oriented fields may be especially detrimental for low performing students and limits their ability to advance in the program. Teasing out the influence of these and other factors can help institutions design environments that are conducive for the academic performance of both black and white students in math-oriented fields.

Taken together, our findings also suggest a new insight into the underrepresentation of blacks in math, science and technology occupations in the labor market. Although black students consistently exhibit higher preference for math-oriented fields and occupations than white students (Arcidiacono et al., 2012; Riegle-Crumb and King, 2010), they are less likely to work in these occupations in the labor market (e.g., Margolis et al., 2008; Burke and Mattis, 2007). To be sure, there are many factors that contribute to this disparity, yet our study suggests that part of the leak in the science and technology occupational pipeline, at least among students at elite universities, occurs *within* colleges, as black students encounter environments that they find especially hard to navigate. From this vantage point, policy interventions aimed at promoting environments in math-oriented fields that nurture the academic achievements of black students will not only reduce the overall race gap in college graduation, but can also improve the representation of blacks in science and technology professions. Given the economic benefits associated with these occupations (e.g., Melguizo and Wolniak, 2012), such policy interventions can have far-reaching implications for race inequality.

Appendix D. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.ssresearch.2016.03.005.

Appendix A. Fields of study in the C&B sample and their math intensity

	Average math SAT score in field	N
Math-oriented fields:		
Computer and information sciences	702	294
Math and physics	698	834
Engineering	687	2217
Chemistry and geology	671	554
Economics	664	1357
Biological sciences and agriculture	659	1641
Other fields:		
Philosophy	651	294
History	645	1724
Pre-med	644	110
Humanities, other	643	605
American studies	637	253
Political science	633	2627
Business and management	632	1798
Other fields	632	302
Area studies	631	422
English literature	630	2121
Psychology	629	1612
Foreign languages	626	597
Music and theater	623	559
Art and art history	621	550
Other professional/vocational fields	615	559
Social sciences, other	612	560
Sociology	603	361
Communication	592	868
Health sciences	565	348
Education	562	470
Total	641	23637

Notes: Data are weighted. Average math SAT scores are based on the entire C&B 1989 cohort, not just black and white students.
Source: C&B 1989.

Appendix B. Definitions of variables and descriptive statistics

Variable name	Definitions	Mean	Std. Dev.
Six-year graduation rate	A dummy variable, where 1 indicates that a student graduated within six years of matriculation	0.924	0.26
Race	1 = non-Hispanic black; 0 = non-Hispanic white	0.079	
Gender	Women = 1, men = 0	0.502	
Family income	Average yearly family income in $K	63.154	28.79
Parental education: BA	At least one parent has BA	0.838	
Parental education: Missing	No information on parental education	0.073	
Region: South		0.261	
Region: Midwest		0.237	
Region: West		0.074	
Financial aid eligibility status: eligible	If student eligible for financial aid	0.205	
Financial aid eligibility status: missing	No aid information	0.507	
HS class rank: top 10%	In top 10% of class	0.545	
HS class rank: missing	Missing information on HS class rank	0.191	
SAT math	Math SAT scores	632.609	86.41
SAT verbal	Verbal SAT scores	578.101	87.55
HS type: public	Public high school	0.421	
Institutional selectivity: most competitive	Barron's classification of institutional competitiveness: most competitive	0.190	
Institutional selectivity: very competitive	Barron's classification of institutional competitiveness: very competitive	0.396	
Institution's gender composition	% female in institution	0.502	0.12

Appendix C. Coefficients from logit models predicting six-year college graduation likelihood

Model#:	(1)	(2)	(3)
Race: black = 1	−0.983***	−0.625***	−0.610
	(0.133)	(0.0985)	(0.349)
Social background	No	Yes	Yes
Academic preparation	No	Yes	Yes
Institutional factors	No	Yes	Yes
Field of study (fixed effects)	No	No	Yes
Field of study*race	No	No	Yes
Constant	2.612***	2.731***	2.869***
	(0.169)	(0.680)	(0.638)
Observations	23,637	23,637	23,637
DF	1	18	26
Log likelihood	−7799	−7307	−7135
Pseudo R-squared	0.0139	0.0761	0.0978

Note: Data are weighted (see main text). For parsimony's sake, we only show the point estimates for the race coefficient. Full results are available from the authors. Note that for the interactive model (Model 3), the main effect for race can be interpreted as the effect of race in the reference category for major (political science).
Robust standard errors are in parentheses.
**p < 0.01, **p < 0.05.
Source: C&B 1989.

References

Achen, Alexandra C., Courant, Paul N., 2009. What are grades made of?". J. Econ. Perspect. 23 (3), 77.

Alon, Sigal, Gelbgiser, Dafna, 2011. The female advantage in college academic achievements and horizontal sex segregation. Soc. Sci. Res. 40 (1), 107–109.

Alon, Sigal, Tienda, Marta, 2005. Assessing the “mismatch” hypothesis: differentials in college graduation rates by institutional selectivity. Sociol. Educ. 78 (4), 294–315.

Alon, Sigal, DiPrete, Thomas A., 2015. Gender differences in the formation of a field of study choice set. Sociol. Sci. 2, 50–81.

Alon, Sigal, 2007. The effect of overlapping disadvantages on the racial/ethnic graduation gap among students attending selective institutions. Soc. Sci. Res. 36 (4), 1475–1499.

Arcidiacono, Peter, Aucejo, Esteban M., Spenner, Ken, 2012. What happens after enrollment? an analysis of the time path of racial differences in GPA and major choice. IZA J. Labor Econ. 1 (1), 1–24.

Arcidiacono, Peter, 2003. Ability sorting and the returns to college major. J. Econ. 121 (1–2), 343–375.

Aronson, Joshua, Fried, Carrie B., Good, Catherine, 2002. Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. J. Exp. Soc. Psychol. 38 (2), 113–125.

Beasley, Maya A., 2012. Opting Out: Losing the Potential of America's Young Black Elite. University of Chicago Press.

Beasley, Maya A., Fischer, Mary J., 2012. Why they leave: the impact of stereotype threat on the attrition of women and minorities from science, math and engineering majors. Soc. Psychol. Educ. 15 (4), 427–448.

Bowen, William G., Bok, Derek, 1998. The Shape of the River: Long-term Consequences of Considering Race in College and University Admissions. Princeton University Press, Princeton, NJ.

Bradley, Karen, 2000. “The incorporation of women into higher education: Paradoxical outcomes?.” Sociol. Educ. 1–18.

Burke, Ronald J., Mattis, Mary C. (Eds.), 2007. Women and Minorities in Science, Technology, Engineering, and Mathematics: Upping the Numbers. Edward Elgar Publishing.

Cabrera, Alberto F., Nora, Amaury, Terenzini, Patrick T., Pascarella, Ernest, Hagedorn, Linda Serra, 1999. Campus racial climate and the adjustment of students to college: a comparison between White students and African American students. J. High. Educ. 70 (2), 134–160.

Chavous, Tabbye M., Harris, Angel, Rivas, Deborah, Helaire, Lumas, Green, Laurette, 2004. Racial stereotypes and gender in context: African Americans at predominantly black and predominantly white colleges. Sex. Roles 51 (1–2), 1–16.

Cole, Elizabeth R., Yip, Tiffany, 2008. Using outgroup comfort to predict Black students' college experiences. Cult. Divers. Ethn. Minority Psychol. 14 (1), 57.

Correll, Shelley J., 2001. Gender and the career choice process: the role of biased self-assessments. Am. J. Sociol. 106 (6), 1691–1730.

Daempfle, Peter A., 2003. An analysis of the high attrition rates among first year college science, math, and engineering majors. J. Coll. Student Retent. Res. Theory Pract. 5 (1), 37–52.

Davies, Scott, Guppy, Neil, 1997. Fields of study, college selectivity, and students inequalities in higher education. Soc. Forces 74 (4), 1417–1438.

DesJardins, Stephen L., Dennis, A. Ahlburg, McCall, Brian P., 2002. A temporal investigation of factors related to timely degree completion. J. High. Educ. 73 (5), 555–581.

Dickson, Lisa, 2010. Race and gender differences in college major choice. Ann. Am. Acad. Political Soc. Sci. 627 (1), 108–124.

Downey, Douglas B., 2008. Black/white differences in school performance: the oppositional culture explanation. Annu. Rev. Sociol. 34, 107–126.

Freeman, Donald G., 1999. Grade divergence as a market outcome". J. Econ. Educ. 30 (4), 344–351.

Goyette, Kimberly A., Mullen, Ann L., 2006. Who studies the arts and sciences? social background and the choice and consequences of undergraduate field of study. J. High. Educ. 77 (3), 497–538.

Hearn, James C., Olzak, Susan, 1981. The role of college major departments in the reproduction of sexual inequality. Sociol. Educ. 195–205.

Karen, David, 2002. Changes in access to higher education in the United States: 1980–1992amprdquosemicolon. Sociol. Educ. 75 (3), 191–210.

Kerckhoff, Alan C., 1995. Institutional arrangements and stratification processes in industrial societies. Annu. Rev. Sociol. 323–347.

Kraatz, M.S., Zajac, E.J., 1996. Exploring the limits of the new institutionalism: the causes and consequences of illegitimate organizational change. Am. Sociol. Rev. 812–836.

Leppel, Karen, 2001. The impact of major on college persistence among freshmen. High. Educ. 41, 327–342.

Lucas, Samuel R., 2001. Effectively maintained inequality: education transition track mobility and social background effects. Am. J. Sociol. 106 (6), 1642–1690.
Ma, Yingyi, Savas, Gokhan, 2014. Which is more consequential: fields of study or institutional selectivity? Rev. High. Educ. 37 (2), 221–247.
Ma, Yingyi, 2009. Family socioeconomic status, parental involvement, and college major choices—Gender, race/ethnic, and nativity patterns. Sociol. Perspect. 52 (2), 211–234.
Mann, Allison Leigh, DiPrete, Thomas A., 2013. Trends in Gender Segregation in the Choice of Science and Engineering Majors. Social Science Research 42 (6), 1519–1541.
Margolis, Jand, Estrella, R., Goode, J., Holme, J., Nao, K., 2008. Stuck in the Shallow End: Education, Race, and Computing. The MIT Press, Cambridge, MA.
Margolis, Jane, Fisher, Allan, 2003. Unlocking the Clubhouse: Women in Computing. MIT press.
Melguizo, Tatiana, Wolniak, Gregory C., 2012. The earnings benefits of majoring in STEM fields among high achieving minority students. Res. High. Educ. 53 (4), 383–405.
Montmarquette, Claude, Cannings, Kathy, Mahseredjian, Sophie, 2002. How do young people choose college majors? Econ. Educ. Rev. 21, 543–556.
Morgan, Stephen L., Todd, Jennifer J., 2008. A diagnostic routine for the detection of consequential heterogeneity of causal effects. Sociol. Methodol. 38, 231–281.
Morgan, Stephen L., Winship, Christopher, 2015. Counterfactuals and Causal Inference: methods and Principles for Social Research, second ed. Cambridge University Press.
Morgan, Stephen L., Gelbgiser, Dafna, Weeden, Kim A., 2013. Feeding the pipeline: gender, occupational plans, and college major selection. Soc. Sci. Res. 42 (4), 989–1005.
Owens, Jayanti, Lynch, Scott M., 2012. Black and hispanic immigrants' resilience against negative-ability stereotypes at selective colleges and universities in the United States. Sociol. Educ. 85 (4), 303–328.
Pinel, Elizabeth C., Leah, R. Warner, Chua, Poh-Pheng, 2005. Getting there is only half the battle: stigma consciousness and maintaining diversity in higher education. J. Soc. Issues 61 (3), 481–506.
Porter, Stephen R., Umbach, Paul D., 2006. College major choice: an analysis of person-environment fit. Res. High. Educ. 47 (4).
Price, Joshua, 2010. The effect of instructor race and gender on student persistence in STEM fields. Econ. Educ. Rev. 29 (6), 901–910.
Riegle-Crumb, Catherine, King, Barbara, 2010. Questioning a White male advantage in stem examining disparities in college major by gender and race/ethnicity. Educ. Res. 39 (9), 656–664.
Roksa, Josipa, Grodsky, Eric, Arum, Richard, Gamoran, Adam, 2008. Changes in higher education and social stratification in the United States. In: Shavit,Yossi, Adam Gamoran, Arum, Richard (Eds.), Stratification in Higher Education: a Comparative Study. Stanford University Press.
Rumberger, Russell W., Thomas, Scott L., 1993. The economic returns to college major, quality and performance: a multilevel analysis of recent graduates. Econ. Educ. Rev. 12, 1–19.
Sabot, Richard, Wakeman-Linn, John, 1991. Grade inflation and course choice. J. Econ. Perspect. 5 (1), 159–170 (Winter, 1991).
Seymour, Elaine, Hewitt, Nancy M., 1997. Talking about Leaving: Why Undergraduates Leave the Sciences. Westview Press, Boulder, CO.
Shauman, Kimberlee, 2006. Occupational sex segregation and the earnings of occupations: what causes the link among college-educated workers? Soc. Sci. Res. 35, 577–619.
Simpson, Jacqueline C., 2001. Segregation by subject: racial differences in the factor influencing academic major between European American, Asian American and African, hispanic and native American. J. High. Educ. 72, 63–100.
Small, Mario L., Winship, Christopher, 2007. Black students' graduation from elite colleges: institutional characteristics and between-institution differences". Soc. Sci. Res. 36 (3), 1257–1275.
Solorzano, Daniel, Miguel, Ceja, Tara, Yosso, 2001. Critical race theory, racial microaggressions, and campus racial climate: the experiences of African American college students". J. Negro Educ. 69 (1/2), 60–73.
Steele, Claude M., Aronson, Joshua, 1995. Stereotype threat and the intellectual test performance of African Americans. J. Personality Soc. Psychol. 69 (5), 797–811. Nov 1995.
Steele, Claude M., Aronson, Joshua, 1998. Stereotype threat and the test performance of academically successful African Americans. In: Jencks, Christopher, Phillips, Meredith (Eds.), The Black-White Test Score Gap. Brookings Institution Press, Washington, DC, pp. 401–427.
Steele, Claude, 1997. A threat in the air: how stereotypes shape intellectual identity and performance. Am. Psychol. 52 (6), 613–629. Jun 1997.
Suresh, Radhika, 2006. The relationship between barrier courses and persistence in engineering. J. Coll. Student Retent. 8 (2), 215–239.
Thomas, Gail E., 1985. College major and career inequality: implications for Black students. J. Negro Educ. 54 (4), 537–547.
Thomas, Scott L., 2000. Deferred costs and economic returns to college major, quality, and performance. Res. High. Educ. 41 (3), 281–313.
Thomas, Scott L., Zhang, Liang, 2005. Post-baccalaureate wage growth within 4 Years of graduation: the effects of college quality and college major. Res. High. Educ. 46 (4), 437–459.
Turner, Sarah E., Bowen, William G., 1999. Choice of college major: the changing (unchanging) gender Gap. Indus. Labor Relat. Rev. 52 (2), 289–313.
Wilson, Kenneth L., Boldizar, Janet P., 1990. Gender segregation in higher education: effects of aspirations, mathematics achievement, and income. Sociol. Educ. 63 (1), 62–74.
Wolniak, G., Seifert, T., Reed, E., Pascarella, E., 2008. College majors and social mobility. Res. Soc. Stratif. Mobil. 26, 123–139.
Xie, Yue, Shauman, Kimberlee A., 2003. Women in Science: Career Processes and Outcomes. Harvard University Press, Cambridge, MA.