Questioning a White Male Advantage in STEM: Examining Disparities in College Major by Gender and Race/Ethnicity

Catherine Riegle-Crumb and Barbara King

EDUCATIONAL RESEARCHER 2010 39: 656
DOI: 10.3102/0013189X10391657

The online version of this article can be found at:
http://edr.sagepub.com/content/39/9/656

Published on behalf of

American Educational Research Association

and

SAGE

http://www.sagepublications.com

Additional services and information for Educational Researcher can be found at:

Email Alerts: http://er.aera.net/alerts

Subscriptions: http://er.aera.net/subscriptions

Reprints: http://www.aera.net/reprints

Permissions: http://www.aera.net/permissions
The authors analyze national data on recent college matriculants to investigate gender and racial/ethnic disparities in STEM fields, with an eye toward the role of academic preparation and attitudes in shaping such disparities. Results indicate that physical science/engineering (PS/E) majors are dominated by men, but not, however, disproportionately by White men. After accounting for high school preparation, the odds of declaring a PS/E major are two times greater for Black males than for White males, and Black females are closer than White females to closing the gap with White males. The authors find virtually no evidence that math attitudes contribute to disparities in choice of a PS/E major. Finally, in contrast to PS/E fields, biological sciences draw relatively equitably from all groups.

Keywords: equity; postsecondary education; sociology

The fields of science, technology, engineering, and math (STEM) are inextricably linked to national economic prosperity and innovation, occupying an esteemed status in the public eye. Participation in STEM has traditionally been the domain of White males, and correspondingly, researchers have long been interested in the topic of equity in STEM, examining how and why certain groups have more or less access, opportunity, and success in the educational trajectories leading to STEM occupations (Bystydzienski & Bird, 2006; Leslie, McClure, & Oaxaca, 1998; Oakes, 1990). From a social justice perspective, gender and racial/ethnic disparities in STEM fields represent a troubling instance of stratification. Seen through the lens of national interest, the importance of diversity was recently underscored by reports from the National Academy of Sciences (2007a, 2007b), suggesting that, without the participation of individuals of all racial/ethnic backgrounds and genders, the increasing demand for workers in these fields will not be met, potentially compromising the position of the United States as a global leader.

This article contributes to previous research on equity in STEM through a systematic analysis of a nationally representative panel of recent college matriculants, with the goal of evaluating the degree to which different racial/ethnic and gender subgroups have caught up to the traditionally advantaged position of White males in STEM postsecondary fields. Although there is a body of rich extant literature on equity in STEM, there is a lack of research examining trends among cohorts entering college after the millennium. Given the heightened and substantial efforts at both national and local levels in recent years aimed at promoting and diversifying these fields, an examination of contemporary trends is clearly warranted (National Academies, 2007a).

Our article contributes to the literature on equity by considering the intersection of gender and race/ethnicity so that the experiences and choices of subgroups, such as Black males, which are often overlooked in large-scale research, are instead highlighted. We assess two commonly discussed explanations for the underrepresentation of certain groups in STEM fields that are rarely addressed empirically using national data, particularly when racial/ethnic disparities are examined. Research on inequality at the postsecondary level often suggests that differences in academic preparation during the secondary years, as well as differences in attitudes toward STEM fields, are the likely links to subsequent stratification; but the research less often assesses the validity of such arguments with extensive quantitative data (Blickenstaff, 2005; Hilton & Lee, 1998; Smyth & Mc Ardle, 2004). Using data from students’ high school transcripts and from surveys, we examine how differences in academic preparation and attitudes play a role in shaping disparities in choice of major, with a critical eye toward how such arguments do or do not apply to the experiences of each gender and racial/ethnic subgroup. Finally, consistent with our intent to go beyond the majority of the literature that examines broad patterns of equity in STEM, we distinguish between entry into physical science and engineering majors and entry into biological science majors, as these fields represent two distinct paths. In sum, our article provides a much-needed update to the literature on equity in STEM postsecondary fields at the national level by providing a more comprehensive picture of the complexity and diversity of experiences and trajectories of a recent college cohort.
Background

Considering Gender and Race/Ethnicity

The literature on gender equity in STEM fields dates back many decades. It chronicles the existence of disparities throughout the stages of the life course, beginning with studies of visual-spatial skills during the first years of life and culminating with studies of adult careers (Chipman, Brush, & Wilson, 1985; Rosser, 1997; Zeldin, Britner, & Pajares, 2008). Although there is no shortage of literature on the gender gap in STEM fields, a careful review of the literature over the past 25 years indicates that there is in fact little research that considers the simultaneous intersection of gender and race/ethnicity, particularly among studies at the national level (American Association of University Women Educational Foundation [AAUW], 2008). For example, Xie and Shauman’s (2003) recent seminal book on gender differences in individuals’ pathways through postsecondary STEM majors and into the labor force considers race/ethnicity as a background variable. Similarly, Blickenstaff’s (2005) review of the literature on the factors behind women’s relative absence from STEM majors and careers does not mention the possibility of racial/ethnic differences. On the flip side, there is another body of research focusing exclusively on racial/ethnic differences in STEM, often examining national-level inequalities in math and science during the high school years, with comparatively less attention to the gaps in STEM outcomes during college (see, e.g., Jencks & Philips, 1998; Tate, 1997). Among recent studies that do focus on the latter, Anderson and Kim (2006) compare the paths of minority students with those of White students in STEM but do not discuss gender.

Although we have learned much about patterns of equity from such previous research, important stories can be missed by treating either gender or racial/ethnic differences in the aggregate. When examining gender differences through a broad lens, we are in effect assuming that one set of patterns, obstacles, and experiences applies generally to all females and another to all males. Recent studies indicate that this is indeed a problematic assumption (Muller, Stage, & Kinzie, 2001). For example, Hanson (2006) argues that although many would expect that African American women in science would be doubly disadvantaged as members of two underrepresented and stereotyped groups, in fact African American female youth generally hold more favorable attitudes toward science than do White female youth, including feeling that it is more useful for their futures. Similarly, an exclusive focus on race/ethnicity ignores the possibility that gender is a key factor with regard to individuals’ pathways through STEM education. Two recent studies offer evidence of racial/ethnic equality in student intent to declare a STEM major, such that Black and Hispanic youth are as likely as Whites to report such a plan (Anderson & Kim, 2006; Higher Education Research Institute at UCLA, 2010). Yet without knowing whether and how such patterns differ by gender, conclusions about potential progress toward equity are severely limited.

In this article, we build upon and extend previous national research that examines only one axis of stratification—either race/ethnicity or gender—by analyzing how the intersection of these two dimensions may shape students’ entry into STEM college majors. As White males historically have dominated STEM fields, both in number and in perception as the normative picture of a scientist, they are the relevant reference group (Buck, Clark, Leslie-Pelecky, Lu, & Cerda-Lizarraga, 2008; Seymour & Hewitt, 1997). Therefore, we investigate how different racial/ethnic and gender subgroups compare with White males in terms of entrance into postsecondary STEM fields.

Paving the Path to College: Academic Preparation and Attitudes

The factors that shape students’ choices of college major occur well before they set foot on a college campus. Previous literature has shown that students’ prior academic preparation and attitudes toward math and science in high school are the strongest predictors of entrance into a STEM major in college (Tai, Liu, Maltese, & Fan, 2006). Therefore, the underrepresentation of certain groups in STEM fields is often discussed as a consequence of lower levels of academic qualifications or lower levels of interest and inclination toward such fields (Hilton & Lee, 1998; Oakes, 1990; Smyth & Mc Ardle, 2004). Yet although such accounts seem quite logical on the surface, there is in fact a shortage of empirical research that has systematically considered whether and how these factors affect gender and racial/ethnic disparities in postsecondary STEM fields at the national level.

It is important to note that although aggregate gender differences in academic preparation such as high school course-taking and test scores were once quite pronounced, this is no longer the case. Beginning in the mid-to-late 1990s, gender differences in advanced-level math and science course-taking have virtually disappeared (Riegle-Crumb, Farkas, & Muller, 2006; Xie & Shauman, 2003). In recent years, girls have also greatly diminished the once-strong male advantage in standardized math and science tests (Hyde, Lindberg, Linn, Ellis, & Williams, 2008). In addition, girls typically have higher grades than boys do in all subjects, including math and science (AAUW, 2008; Riegle-Crumb, 2006). Indeed, several studies using data from students in the 1990s have shown that aggregate gender disparities on high school academic indicators are very small in magnitude and do virtually nothing to explain differences in the choice of a STEM major (Simon & Farkas, 2008; Xie & Shauman, 2003).

Yet as mentioned previously, there is little prior research at the national level on how racial/ethnic differences in preparation contribute to inequity in STEM fields and even less on how gender and racial/ethnic patterns overlap (AAUW, 2004). We do know that Black and Hispanic students have made significant progress toward closing the majority–minority gap in both course-taking and test scores over the past few decades; yet disparities remain substantial in size and scope. For example, Berends, Lucas, and Penaloza (2008) found that although the Black–White test gap decreased approximately 20% from 1972 to 2004, the remaining disparity was still almost one standard deviation. However, some studies have shown that African American females have higher levels of academic preparation in math and science than their male peers, including higher test scores and levels of course-taking (Hyde & Linn, 2006; Riegle-Crumb, 2006). Therefore, although it seems likely that minority students’ comparatively low levels of academic preparation in high school could be a key obstacle to equity in STEM majors in...
college, this may be particularly the case for minority male students. Our study provides the opportunity to explore this issue.

With regard to students’ attitudes as a key precursor for entry into STEM college majors, in general, high school girls perceive themselves as less proficient than boys in math, despite comparable performance levels (Correll, 2001). Indeed, gender differences in math and science attitudes appear as early as elementary school and are often suggested as a more likely culprit than skills and ability for explaining women’s lower aggregate rates of entry into STEM fields (Correll, 2001; Eccles, 1994). However, not all girls may share such negative opinions of math and science. For example, there is evidence that African American females report higher levels of interest in science in high school than White females (Hanson, 2006). And although minority youth in general trail behind White youth on academic indicators, this is not the case for attitudes. For example, Muller, Stage, and Kinzie (2001) found that Black and Hispanic students scored higher than White students on a scale asking them how much they liked math.

Taken together, such patterns indicate a potentially complex intersection of race/ethnicity and gender and suggest that although White males as a group have historically and disproportionately dominated STEM fields, this may no longer be the case. We argue that a consideration of separate racial/ethnic and gender subgroups is warranted to address the question of whether White males remain the most likely to enter STEM postsecondary fields among a recent national sample of college matriculants and to ascertain how prior differences in both attitudes and academic preparation contribute to patterns of inequality.

Data and Results

We used data from the Educational Longitudinal Study (ELS) of 2002, designed by the National Center for Education Statistics, to follow a nationally representative cohort of approximately 15,000 students beginning in their sophomore year of high school. Follow-up surveys were administered in 2004 and 2006. Students’ high school transcripts were also collected, enabling analysts to construct complete course-taking histories for students’ high school years.

We restrict our analyses to Black, Hispanic, and non-Hispanic White students who were enrolled in a 4-year degree-granting institution in 2006, which was the sophomore year of college for “on-time” students, and those who reported having declared a college major. We note that in the ELS sample, as has been documented with other national data sets (Buchmann & DiPrete, 2006), females of all racial/ethnic groups exhibit higher rates of college attendance at 4-year degree-granting institutions than their male peers (52.8% of White females vs. 46.1% of White males; 38% of Black females vs. 34.1% of Black males; and 29.6% of Hispanic females vs. 20.1% of Hispanic males). Regardless of gender, the majority–minority gap in 4-year college attendance is notably large, as Black and Hispanic youth have lower rates of matriculation than their White peers.

We distinguish among physical science and engineering majors (which includes math and computer science), biological science majors, and non-STEM majors. Previous national studies typically collapse a broad array of STEM majors into one category, thereby ignoring potential differences in pathways and predictors of what leads students to select a particular field (Eisenhart & Finkel, 1998). With regard to issues of gender equity in particular, women’s historically lower rates of representation in the physical sciences and engineering than in the biological sciences, it is important to consider these as distinct and separate fields (National Science Board, 2004). A complete list of the specific majors included in each of these three categories is included in the online supplemental document (available on the journal website).

Figure 1 displays the percentages of students of each racial/ethnic and gender group in our sample who declared a physical science or engineering major, a biological science major, or a non-STEM major. When we consider STEM fields in the aggregate (physical sciences or engineering and the biological sciences), females of all racial/ethnic groups have lower representation than males. Less than 20% of White, Black, and Hispanic female college students declare either type of STEM major, whereas STEM fields are the choice of approximately 35% of males from all groups considered. But these differences are driven almost entirely by the distributions in physical science and engineering, where gender gaps are large, such that men outnumber their female peers of the same race/ethnicity by approximately a factor of 4. In contrast, gender equity is more the norm for the biological sciences, with similar percentages of male and female students from each racial/ethnic group declaring a major in that field.

We observe no evidence in Figure 1 to suggest that minority college students are underrepresented in STEM college majors. Comparing female students from different racial/ethnic groups, we find no significant differences between the percentages of Black, Hispanic, and White women in STEM fields. Among male students, chi-square tests also reveal no statistically significant differences in the distribution of college majors by race/ethnicity. The data do indicate that the physical science and engineering fields are clearly dominated by men, but not, as might be expected, disproportionately by White men.

We next turn to consider how accounting for differences in academic preparation in high school and students’ attitudes contributes to the patterns observed in Figure 1. We define academic preparation with three measures: test scores, grades, and course-taking (see the online supplemental document for a full description of all variables included in the analyses). ELS administered a standardized math exam to students during their senior year of high school, and grades are obtained from students’ high school transcripts and averaged across all math courses taken from Grades 9 through 12. Course-taking in both math and science was also taken from students’ high school transcripts and coded as an ordinal variable capturing the highest level course that students reached in each subject by their senior year. As seen in Table 1, among 4-year college matriculants, minority students of both genders were less academically prepared on average than White males, with Black youth falling the farthest behind. For example, Black youth of both genders trail White males’ course-taking level in math and science by half a standard deviation and are behind on math test scores by well over one standard deviation. Differences between White males and White females are dramatically smaller, with the largest disparity found for test scores (0.4 a standard deviation) and a disparity in favor of White females for high school math grades. As expected on the basis of
prior research, the story of inequality in high school STEM preparation is clearly one of race/ethnicity more than gender.

Attitudes are measured by two separate scales. The first taps students’ confidence in math, as evidenced by their responses to questions about whether they can do well on math tests, understand difficult math texts and classes, do well on math assignments, and master math class skills. The second indicator, math affect, summarizes students’ responses to questions about whether they get totally absorbed in math, think math is fun, and think math is important. White males exhibit the highest levels of confidence in their math ability in comparison with all other groups; yet their confidence is only slightly higher than that of Black and Hispanic males (less than one fourth of a standard deviation). In contrast, Black male students report the highest affect toward math of any group, including White males. Indeed, there is evidence of a generally high affect for math among minority youth of both genders, with Black females as well as Hispanic males and females exhibiting similar levels to White males. In fact, White females are the only group reporting significantly lower degrees of math affect than White males. Stepping back, it is clear that when considering differences in attitudes, White males are not consistently the group most favorably inclined toward math.

We now turn to the results of multinomial logistic regression analyses comparing the likelihood for different racial/ethnic and gender subgroups (relative to White males) of declaring STEM major. The percentages of students selecting each major by race/ethnicity and gender are shown in Figures 1. The choice of major by race/ethnicity and gender (n = 3,946).

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>White Male</th>
<th>White Female</th>
<th>Hispanic Female</th>
<th>Black Female</th>
<th>Hispanic Male</th>
<th>Black Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>ns (weighted)</td>
<td>1,334</td>
<td>1,699</td>
<td>240</td>
<td>295</td>
<td>139</td>
<td>239</td>
</tr>
<tr>
<td>Math attitudes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math confidence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Effect size)</td>
<td>2.92 (.067)</td>
<td>2.68* (0.69)</td>
<td>2.68* (0.73)</td>
<td>2.58* (0.68)</td>
<td>2.75 (0.74)</td>
<td>2.80* (0.64)</td>
</tr>
<tr>
<td>(Effect size)</td>
<td>0.34</td>
<td>0.34</td>
<td>0.50</td>
<td>0.24</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>Math affect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Effect size)</td>
<td>2.52 (.65)</td>
<td>2.38* (0.63)</td>
<td>2.50 (0.59)</td>
<td>2.55 (0.59)</td>
<td>2.59 (0.67)</td>
<td>2.65* (0.54)</td>
</tr>
<tr>
<td>(Effect size)</td>
<td>0.22</td>
<td>0.02</td>
<td>-0.05</td>
<td>-0.12</td>
<td>-0.21</td>
<td></td>
</tr>
<tr>
<td>Academic preparation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highest math course</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Effect size)</td>
<td>7.86 (1.16)</td>
<td>7.75* (1.06)</td>
<td>7.48* (1.12)</td>
<td>7.24* (1.23)</td>
<td>7.57 (1.30)</td>
<td>7.17* (1.18)</td>
</tr>
<tr>
<td>(Effect size)</td>
<td>0.10</td>
<td>0.33</td>
<td>0.53</td>
<td>0.24</td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td>Highest science course</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Effect size)</td>
<td>5.40 (0.87)</td>
<td>5.22* (0.85)</td>
<td>5.01* (0.95)</td>
<td>4.96* (0.95)</td>
<td>5.12* (1.08)</td>
<td>4.89* (1.00)</td>
</tr>
<tr>
<td>(Effect size)</td>
<td>0.20</td>
<td>0.44</td>
<td>0.49</td>
<td>0.31</td>
<td>0.57</td>
<td></td>
</tr>
<tr>
<td>Math GPA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Effect size)</td>
<td>2.56 (.72)</td>
<td>2.73* (0.67)</td>
<td>2.48 (0.81)</td>
<td>2.04* (0.75)</td>
<td>2.17* (0.96)</td>
<td>1.94* (0.73)</td>
</tr>
<tr>
<td>(Effect size)</td>
<td>-0.24</td>
<td>0.12</td>
<td>0.72</td>
<td>0.52</td>
<td>0.86</td>
<td></td>
</tr>
<tr>
<td>Math test score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Effect size)</td>
<td>62.28 (10.73)</td>
<td>57.86* (10.33)</td>
<td>51.34* (12.45)</td>
<td>45.07* (11.27)</td>
<td>53.28* (13.19)</td>
<td>48.21* (13.40)</td>
</tr>
<tr>
<td>(Effect size)</td>
<td>0.42</td>
<td>0.99</td>
<td>1.59</td>
<td>0.82</td>
<td>1.26</td>
<td></td>
</tr>
</tbody>
</table>

Note. Means are displayed first, followed by standard deviations in parentheses. Effect sizes (relative to White males) are calculated as the difference between the means divided by the pooled standard deviation. An asterisk indicates that the given mean is significantly different from the mean for White males at the .05 level.
majors. These analyses enable us to discern the extent to which racial/ethnic and gender differences in preparation and attitudes contribute to the patterns of choice of major observed in Figure 1. First, we present the results comparing the odds of declaring a physical science or engineering major versus a non-STEM major in Figure 2, and then the odds of declaring a biological science versus a non-STEM major in Figure 3. We begin with a baseline model that includes only gender and racial/ethnic categories and then adjust for the potentially confounding effects of student social class background and delayed college entry. Next, we add indicators of students’ math attitudes, then measures of students’ academic preparation in high school. We include full results of the models in the online supplemental document; here, we focus on gender and racial/ethnic group disparities across models. Finally, we conduct propensity score analyses to more rigorously adjust for differences between groups and address the potential for selection bias. Note that these analyses confirm the robustness of the results presented here (see the online supplemental document for a complete discussion of propensity score models and results).

Declaration of a Physical Science or Engineering Major (vs. Non-STEM Major)

As seen in Figure 2, the odds of White women declaring a physical science or engineering major versus a non-STEM major remain far below the odds of White men (indicated by the bold line at the value of 1 on the y-axis) even after accounting for differences in attitudes and academic preparation. Given the relatively small magnitude of White male and White female disparities on many of the potentially explanatory indicators, this is not necessarily surprising. We see an almost identical pattern for Hispanic females, such that they remain far less likely than White males to declare a physical science or engineering major, regardless of attitudes or preparation. The results for Black females, however, represent a departure from trends for other females. Once academic preparation is taken into account, the relative odds of Black females declaring a physical science or engineering major increase to just less than half that of White males. Calculating the predicted probabilities of declaring a physical science or engineering major by group in this final model reveals that the probability for Black females is .09, compared with a probability of .18 for White males. In contrast, the probability is only .04 for White females. Thus, net of other factors, Black females are closer than White females to closing the gap with White males in the physical science and engineering fields.

Furthermore, the analyses reveal a striking pattern pertaining to Black male youth. Once differences in academic preparation are held constant, Black males are substantially more likely than White males to declare a physical science or engineering major. Specifically, at comparable levels of preparation, a Black male entering a 4-year college or university is more than two and a half times more likely to declare a physical science or engineering major than his White male peer. Although it appears that there is a modest advantage among Hispanic males compared with White males as well, this difference is not statistically significant, indicating that male Hispanic college matriculants remain as likely as White males to pursue physical science or engineering majors regardless of differences in attitudes and academic preparation.

Declaration of Biological Science Major (vs. Non-STEM Major)

Figure 3 displays parallel models predicting choice of a biological science major versus a non-STEM major. White, Black, and Hispanic females and Black and Hispanic males are all as likely as the reference group of White males to declare such a major. Furthermore, with the addition of indicators of social class, attitudes, and academic preparation, we see little change to the relative odds for each group of declaring a biological science major compared with the reference category of White males. In general, and in stark contrast to physical sciences and engineering, the biological sciences draw relatively equitably from different gender and racial/ethnic groups.

Discussion and Conclusion

Contrary to continuing stereotypes of STEM fields as a White male domain (Buck et al., 2008), we do not find evidence of a consistent White male advantage in entrance into STEM postsecondary fields. Furthermore, with regard to common arguments offered for inequality in STEM fields, we find virtually no evidence that math attitudes play a role in shaping disparities in choice of major. However, we find interesting results on the role of academic preparation. We find only one instance in which accounting for differences in preparation appears to help explain gender inequity. Specifically, once differences in high school academic background are held constant, Black females come closer to closing the gap with White males and are in fact more likely to declare such a major than their White female peers. As noted above, Black and Hispanic male college matriculants are as likely as their White male peers to enter STEM majors, despite pronounced differences in average levels of academic preparation. Once we account for these differences, Black male youth are in fact substantially more likely to declare a physical science or engineering major than White males. These results underscore the value of considering the intersection of race/ethnicity and gender in place of a broad focus on one dimension of inequality or another.

It is important to point out that, because our sample includes only students who successfully matriculate to a 4-year college, our analyses necessarily exclude more than half of minority youth of this age group because they do not make it to college. The minority students in our sample are therefore a select group. Yet pronounced majority/minority disparities in academic preparation are nevertheless evident among college matriculants. The obstacles to equity at the primary and secondary education levels are extensive and well known, including the lack of qualified teachers (particularly in math) and insufficiently rigorous curricula faced by many minority youth (Darling-Hammond, 2001). Our analyses indicate that in spite of such obstacles, minority male students who enter college subsequently pursue STEM postsecondary fields at the same rates as White males. In addition, our findings suggest that an important byproduct of increasing majority–minority equity in K–12 math and science preparation nationwide would be a much more racially diverse population of undergraduates in physical science and engineering fields. In general, our study points to the relatively high proclivity
of Black students of both genders toward physical science and engineering fields as an important topic for future research. Perhaps studies that examine the encouragement that students receive from significant others, such as parents or teachers, to major in such fields, or studies that focus on students’ objectives for college matriculation, could provide relevant information about the patterns we observe here.

In addition, further work is needed to shed light on the relative dearth of White and Hispanic female students in physical science and engineering majors. Our results clearly demonstrate

---

**FIGURE 2.** Predicted odds, in comparison with those of White males, of declaring a physical science or engineering major relative to a non–STEM (science, technology, engineering, or math) major by gender and racial/ethnic group. The odds for White males are indicated by the bold line at the value of 1 on the y-axis. The results are from nested models of multinomial logistic regression analyses. An asterisk indicates a statistically significant difference from White males, $p < .05$.

**FIGURE 3.** Predicted odds, in comparison with those of White males, of declaring a biological science major relative to a non–STEM (science, technology, engineering, or math) major by gender and racial/ethnic group. The odds for White males are indicated by the bold line at the value of 1 on the y-axis. The results are from nested models of multinomial logistic regression analyses.
that accounting for differences in academic preparation and attitudes brings these two groups nowhere closer to equity with White males. Indeed, the patterns observed for the likelihood of declaring a physical science or engineering major looked remarkably similar for White and Hispanic females, despite the relative advantages in educational opportunities and experiences typically enjoyed by the former group (Riegle-Crumb, 2006; Schneider, Martinez, & Owens, 2006). Research on gender socialization and the saliency of gender stereotypes across different racial/ethnic groups may offer further insight into such trends (Catsambis, 1995; Hanson, 2006). Others have argued for a focus on the formation of preferences, decisions, and opportunities much earlier in the life course as more likely to offer insights into the gendered patterns observed in college and beyond (Catsambis, 1995).

In contrast to the disparities observed in the physical sciences and engineering, the generally equitable gender and racial/ethnic distribution of majors in the biological sciences warrants more attention. Why is it that these fields within science show so few signs of stratification? Perhaps the biological sciences are perceived as more open, inviting, and hospitable to those from traditionally underrepresented groups. Although in this article we have chosen to focus on how measurable characteristics of individuals predict their choices of major, it is clear that social-structural and institutional factors are also in play. For example, it is possible that the biological sciences have been more effective in and/or committed to the recruitment of underrepresented groups. Although our explanations remain necessarily speculative for the time being, we agree with the need voiced by others for more research on how structural and contextual factors, such as the norms and procedures within certain departments, work to either facilitate equality or inhibit it (Bystydzienski & Bird, 2006).

Like any study, ours is limited by the availability of data. For example, because we do not yet have available data on degree completion for ELS students, it is beyond the scope of this study to examine questions regarding differential attrition and/or attainment by racial/ethnic and gender group. However, it is important to note that although the underrepresentation of women in science occupations has often been explained by the supposition that they are more likely than White men to leave the pipeline at every junction (Seymour & Hewitt, 1997), a careful review of the recent research literature reveals evidence to the contrary. Indeed several studies using national or large-scale data find no aggregate gender differences in STEM persistence to degree (Chen, 2009; Xie & Shauman, 2003). For example, using data from the Beginning Postsecondary Study, Chen found no significant differences in persistence or attrition rates between males and females in STEM.

Further, conclusions about whether STEM attrition rates are higher among minority students are complicated by the fact that few studies have taken into account the much higher attrition rates of minority students from college in general (Cole & Espinoza, 2008). Anderson and Kim (2006) found that although Black and Hispanic STEM majors had lower persistence rates than their White counterparts, such patterns were in no way unique to STEM majors. In other words, minority youth had lower rates of persistence to graduation than their majority peers across almost all majors considered. Whether in fact the obstacles to minority persistence in STEM are greater than the obstacles to minority persistence in college in general needs more examination.

In sum, disparities in who pursues STEM fields clearly remain and warrant sustained attention. Yet, too often, assumptions about differences between groups, whether the differences pertain to assumptions about their ability to succeed or their preferences to participate, are reinforced and subsequently lead to the creation of more disparities (Correll, 2001; Hyde & Linn, 2006). Therefore, it is crucial that we recognize diversity where it does exist, noting progress toward equity and offering empirical evidence that can impede the further perpetuation of stereotypes about who belongs in STEM fields.

NOTES

This research was supported in part by Grant No. 5 R24 HD042849, Population Research Center, awarded to the Population Research Center at the University of Texas at Austin by the Eunice Kennedy Shriver National Institute of Health and Child Development. It was also supported by a grant from the National Science Foundation (No. DUE-0757018), Chandra Muller, principal investigator, and Catherine Riegle-Crumb, co–principal investigator. The opinions expressed here are the authors’ and do not necessarily reflect those of the granting agencies.

The literature on equity in science, technology, engineering, and math, particularly with regard to gender, is indeed vast and addresses a range of issues such as the potential for genetic and biological factors to shape outcomes and the role of family, friends, peers, pedagogy, curriculum, teacher training, classroom social climate, and institutional policies in promoting or deterring equity. The particular focus of this article is patterns of equity in choice of college major.

Racial/ethnic classification is based on student reports. The small number of individuals identifying as multiracial Black are categorized as Black in our analyses. However, exploratory analyses that did not categorize these students as Black yielded results virtually identical to those presented here. Our analytic sample is also limited to students who have valid transcript weights in the Educational Longitudinal Study (ELS), as all analyses use such weights. Missing data on independent variables ranged from a low of 5% for test scores to a high of 19% for math affect. Missing data were imputed using Stata. (See the online supplemental document for more details on the analytic sample and all variables used in the analyses.)

Ideally, we would include measures of students’ science attitudes as well as their math attitudes. Unfortunately, ELS asked students only about the latter, not the former. In addition, although we do have measures for students’ science grade point averages (GPAs), we chose to include only math GPA in the final models, as science GPA did not have an independent effect net of other variables in the model and our main results did not change according to whether it was included or not. Finally, we note that in exploratory analyses, we included measures of student and parent educational expectations as well as students’ intended occupations. Including these measures did not alter the key results of our analyses.

As can be seen in the full regression models in Tables S2 and S3 in the online supplemental document, we find that math attitudes are statistically significant predictors of both physical science and engineering majors and biological science majors, as are math course-taking and math GPA. In addition, science course-taking significantly predicts declaration of a biological science major. However, math test score does not significantly predict either type of science major, nor does family income. Parental education significantly predicts only choice of a biological science major.
and is not significant in the final model with indicators of academic preparation included. Finally, in response to a concern raised by an anonymous reviewer, we conducted supplementary analyses using propensity score-matching techniques to confirm that the association observed between high school course-taking and choice of major remained even after accounting for individuals' differential propensities to be enrolled in advanced courses.

Changing the contrast category to White females confirms that Black females are significantly more likely than White females to declare a physical science or engineering major. In addition, subsequent analyses that did not include measures of attitudes confirmed that when academic preparation indicators are added (either with or without attitude measures included in the model), both the Black male and Black female odds ratios increase relative to the comparison group of White males.

In addition to considering odds ratios, we calculated marginal effects across models, as some have argued that this offers a more accurate comparison of differences across nested models and/or a more accurate comparison of different groups or samples (Mood, 2010). All results were consistent with the patterns observed with odds ratios. Results are available upon request.

REFERENCES


**AUTHORS**

**CATHERINE RIEGLE-CRUMB** is an assistant professor of science and math education in the Department of Curriculum and Instruction and a faculty research associate in the Population Research Center at the University of Texas, Austin. She can be contacted at University of Texas, Austin, One University Station, G1800, Austin, TX 78712, or at riegle@austin.utexas.edu. Her research focuses on gender and racial/ethnic inequality in educational experiences and achievement, particularly in STEM fields, with an emphasis on the role of social contexts.

**BARBARA KING** is a Ph.D. candidate in math education in the Department of Curriculum and Instruction at the University of Texas, Austin, One University Station, G1800, Austin, TX 78712; bking@mail.utexas.edu. Her dissertation examines persistence and attrition in STEM postsecondary fields.

Manuscript received May 19, 2010
Revisions received July 22, 2010, and October 15, 2010
Accepted October 31, 2010