High School Predictors of a Career in Medicine

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ABSTRACT

While there is no dearth of high school students who are interested in becoming physicians, racial/ethnic disparities still exist in the medical profession. This retrospective cohort study examined the influences on students' desire, at the end of high school, for a medical career, and, in particular, how these influences differed by race/ethnicity. Multiple logistic regression models were used to predict students' medical career intentions at the end of high school. Interest in a medical career at the beginning of high school strongly predicted interest in a medical career at the end of high school. Authors found almost no racial/ethnic differences in interest in medicine, after controlling for other predictors. The exception was elevated medical career interest amongst Asians. Furthermore, Black and Hispanic students who wanted to become physicians tended to have high intrinsic motivations, but low science performance. Limited proficiency in science may impede Black and Hispanic students' further progress through the medical pipeline.

Introduction

Medicine is an attractive career for many students (Mcharg, Mattick, & Knight, 2007). Whereas there is no general shortage of students vying for admission to medical school, disparities still exist in how race/ethnicity is represented in the medical profession (Komaromy et al., 1996). This has been a concern internationally as well in the United States, where relatively low numbers of underrepresented minority (URM) students apply to, enter, and graduate from medical school (Dames, 2014; Griffin & Hu, 2015). For example, while U.S. census data from 2010 show 17% and 12% of the American population identifying as Hispanic and Non-Hispanic Black (henceforth referred to as Black), respectively (United States Census Bureau, 2010), medical school graduates in 2014 are reported as 6% Hispanic and 6% Black (Association of American Medical Colleges, 2014).

Introduction

At a relatively late stage in the medical career pipeline, our estimates show that the numbers of Black (15,000) and Hispanic (22,500) freshmen interested in a career in medicine are still large enough to potentially bring the ethnic/racial composition of the medical profession more in line with that of the general population. (These estimates were made by taking the racial/ethnic percentages of students interested in a career in medicine

by the end of high school in our representative sample and multiplying them by the total number of freshmen in the U.S in 2014 (Eagan et al., 2014).) However, the URM numbers drop substantially by medical school application and enrollment (Association of American Medical Colleges, 2010). To deal with this disparity, many programs have been developed to assist students at these later stages of the medical pipeline. These include selecting for both academic and non-cognitive factors in medical admissions (Powis, Hamilton, & McManus, 2007), providing admissions materials and support before application (Keith & Hollar, 2012), and, controversially, lowering academic requirements (O'Neill, Vonsild, Wallstedt, & Dornan, 2013).

However, as Ferguson, James, Yates, and Lawrence (2012) stated, such interventions that occur late along the pipeline to choosing a medical career take place only "after ethnic, sex and socio-economic biases may already be established (p. 382)." Our study expanded on Ferguson et al. (2012) by looking at predictors of student interest in medicine earlier along the medical career pipeline: at the end of high school. It was intended to inform policy initiatives that are planned to support URM students.

Academic factors predicting interest in medicine

Most studies agree that academic competence in high school, especially in science, is vital for students' continuation through the medical pipeline (Aschbacher, Li, & Roth, 2010; El Mouzan, 1992; Oscos-Sanchez, Oscos-Flores, & Burge, 2008; Terrell, 2006). Thurmond and Cregler (1999) have suggested that early intervention directed at basic science courses is important to maintaining students' interest in, and progression through, the medical pipeline. Moreover, URM students can have negative experiences with science education due to issues with scientific identity (Carlone, Haun-Frank, & Webb, 2011; Hazari, Sadler, & Sonnert, 2013) and with their relationships with primary and secondary science teachers (Kitts, 2009; Mcharg, Mattick, & Knight, 2007). However, the majority of the studies examining the relationship between academic performance and the pursuit of a medical career have focused on the implementation of a specific program and its immediate effects; not on its longer-term impact (Terrell, 2006). In general, there is a dearth of empirical knowledge about how academic experiences and performance at the high school level influence students' medical career choices (Dames, 2014).

As such, academic variables typically reported upon in science, technology, engineering, and mathematics (STEM) pipeline studies were selected for analysis (Sadler, Sonnert, Hazari, & Tai, 2014). These variables matched the aforementioned focus on scientific competency in high school. In addition, a strong performance in STEM courses and majoring in a STEM field in college are often cited as predictors of doing well in medical school (Lambe & Bristow, 2011; Montague & Odds, 1990). However, non-science majors can also succeed in the medical profession where verbal reasoning/analytical writing skills are also highly valued (Ellaway et al., 2014; Herman & Veloski, 1981). Hence, in addition to high school STEM variables, students' final English grade in high school was included in our variable list.

Career motivation predicting interest in medicine

An extensive body of psychological and educational studies has explored human motivation; and, within this field of research, the distinction between intrinsic and extrinsic motivations has been fundamental (Ryan & Deci, 2000). The distinction has been widely used also in the study of work preferences (Amabile, Hill, Hennessey, & Tighe, 1994). In the present study of medical career interest, these two concepts of intrinsic and extrinsic motivation serve as a conceptual foundation. Doctors' intrinsic and extrinsic motivations are important for the quality of the relationship between physician and patient (Barr, 2010; Powis, 1994). In addition, these motivation variables play a role in students' medical career aspirations (Mcharg, Mattick, & Knight, 2007) especially in Black and Hispanic students (Boekeloo, Randolph, Timmons-Brown, & Wang, 2014; Boekeloo, Jones, Bhagat, Siddiqui, & Wang, 2015). Given that some high school students do not have a grasp of the nuanced differences between various medical careers (e.g., scientific researcher, clinical physician, family doctor, etc.) they may make decisions about their career choice based on previous experiences (Todaro, Washington, Boekeloo, Gilchrist, & Wang, 2013), interactions with adults (Zebrak, Le, Boekeloo, & Wang, 2013), or on general cues (Boekeloo, Jones, Bhagat, Siddiqui, & Wang, 2015). Of these influences some may relate to intrinsic motivation by highlighting aspects of the job like helping others and working with people, or to extrinsic motivation by underscoring potential fame and making money.

Suggesting the importance of influences outside academics, a study following 239 premedical undergraduates through the first and second years of their program found that students' favorite high school or college subject, as well as academic major, was unrelated to their decision to apply to medical school (Staley & Hood, 1977). In a study of 33 ethnically and economically diverse high school students, Aschbacher, Li, & Roth (2010) found that, despite doing less well in science courses, many students' medical career aspirations persisted due to family support and intrinsic motivations. Similarly, a study of 90 students participating in a "Mini-Med School" launched by the Royal College of Surgeons in Ireland found that high school students' interest in medicine was primarily due to the perceived ability to help others and not to any other surveyed motivations (Shaikh, Babar, & Cross, 2013). These motivational findings are echoed by Dames's (2014) case study in which eight URM subjects entering the medical pipeline did so "in spite of their science disengagement (p. 150)."

Alternatively, it is often assumed, with varying degrees of alarm, that students with an interest in medicine are driven by extrinsic motivations (e.g., prestige, money, power) (Green, 1989). McFarland (1987) was troubled by the existence of a so-called 'pre-med syndrome,' in which students become, "narrow grade-conscious overachievers, who are less sociable and more interested in money and prestige (p. B1)." This fear has not abated since 1987 and lingers in medical dissertations and journals, where the quality and motivation of students admitted to medical schools and the culture in which they will be immersed have been critically examined (Leblanc, 2007; Neilson, 2003).

Study Aim

Because academic success alone does not fully predict who wishes to pursue medicine as a career (Greenhalgh, Seyan, & Boynton, 2004), we also included the subject of career motivations in our study. Through examining students' background, academic, and motivation variables our study aimed to add to the evidence base about students' career interests in medicine at the end of high school. Its main research questions were:

1. What are the main predictors of students' medical career interest at the end of high school?
2. Do these predictors differ by race/ethnicity?

Methods

We employed a retrospective cohort method, which is a standard method used especially in epidemiological, public health, and medical research (MacMahon, 1965; Mantel & Haenszel, 1959). In a retrospective cohort study, members of cohorts who currently fall into different categories recall their earlier experiences. Through statistical methods, such studies are then able to simultaneously test the strength of a multitude of existing hypotheses. In this study, we compared past experiences of two different groups of college students – those who planned to pursue a medical career and those who did not – in a nationally representative sample of college entrants in the U.S. Although randomized control trials are generally considered the "gold standard" in establishing causal effects, they require much longer time periods than retrospective studies and are often fraught with practical and ethical difficulties. Alternatively, longitudinal education studies are commonly prospective in that they follow a group of similar individuals forward in time to find how certain differences in exposure result in different outcomes. Such prospective studies again typically take much longer (and are more expensive) than retrospective studies and, hence, cannot include variables generated from recent research in the field. Instead, we asked students early in their college experience to report retrospectively about their earlier experiences. They reported their career interests at several educational junctures as well as on a variety of experiences and background variables. The *Persistence Research in Science and Engineering* (PRiSE) project was a large-scale study of students from 34 two- and four-year colleges and universities selected from a stratified random sample that accounted for institution size and type.

Sample

The PRiSE project sought to recruit students at the beginning of their studies and enrolled in a mandatory introductory English class at their institution. The rationale for this particular class versus a STEM course required for premedical students was that it included the full complement of students for analysis – those who, at some time did, and those who never did, contemplate a medical career. Recruitment of institutions began with a 2005 National Center for Education Statistics (NCES) list of degree-granting postsecondary institutions in the United States (containing Fall 2004 enrolment numbers), generated from the Integrated Postsecondary Education Data System (IPEDS) database. The table comprised 4,454 institutions. Of these, 3,799 post-secondary institutions were deemed

eligible for our study due to their enrolment being greater than 100 undergraduates (1,672, 44.0%, were two-year institutions and 2,127, 56.0%, were four-year institutions). In these groups, institutions were divided into bins based on their size. The sample selected contained 1,732 small four-year colleges, 297 medium four-year colleges, 134 large four-yeas colleges, 1,277 small two-year colleges, 298 medium two-year colleges, and 91 large two-year colleges.

Within these six bins, the institutions were randomized, and any schools without science majors were excluded. We then went down each list, recruiting institutions that agreed to participate until a sufficient number of students in each category could be reached. To prevent the possibility of students being overrepresented by one institution a cap of 500 students per institution was instated, which was triggered a few times. In all, 160 institutions were contacted. Of these, only 43 institutions initially agreed to participate. Usable student questionnaires were received from 34 institutions.

To understand if the participating institutions systematically differed from the institutions that declined the invitation to participate, we compared the participating and non-participating institutions on variables that were available in the IPEDS data set. We found no statistically significant differences in terms of Carnegie classification. This was true when we compared those who initially agreed to participate with those who initially declined as well as when we compared those who actually returned completed surveys with those who initially declined or initially agreed but did not follow through.

The full dataset of returned surveys included 6,598 students of which 56.4% (3,721) attended four-year, and 43.6% (2,877) attended two-year institutions. In all, fourteen two-year schools (six small, three medium, five large) and twenty four-year schools participated (twelve small, three medium, five large). The proportion of participants from four- and two-year institutions was very similar to the corresponding proportion in the population, as described above (56.0% vs. 44.0%). Regarding our second stratification criterion, we had aimed at a sample that contained, among the four- and two-year students, a third of students who attend large, medium, and small institutions. Among the four-year students in our sample, 1,556 (41.8%) attended large, 967 (26.0%) attended medium, and 1,198 (32.2%) attended small institutions; among the two-year students in our sample, 1,139 (39.6%) attended large, 708 (24.6%) attended medium, and 1,030 (35.8%) attended small institutions. Whereas the target percentages of 33.3% for each group were not attained, the actual percentages were deemed close enough to be an adequate representation of the population.

Instrument

The 7-page, 50-item survey instrument was constructed to gather information on the full range of student experiences in high school that might impact a student's choice to pursue a STEM or STEM-related career. Many items used were drawn from another survey study of students enrolled in introductory college science courses (Factors Influencing College Science Success [FICSS]) that underwent rigorous validity and reliability checks (Sadler & Tai, 2007a; Sadler & Tai, 2007b). These items included: high school science and

math course-taking history, standardized test performance, and background characteristics, such as gender, and parental education. A pilot survey was taken by 49 undergraduate students to adjust scales for ceiling and floor effects. These students also served as a focus group to help clarify wording. In addition, a focus group on the PRiSE survey was held with about ten experts in science education, including a psychometrician, former high school science teachers, and university-level science instructors. The discussion in this group indicated that the survey questions could be considered valid for the purpose of identifying students' career aspirations and experiences during high school. Further, content validity was established through open-ended online surveys with 412 science teachers and professors to incorporate the breadth of views and hypotheses posed by the community. We also conducted a test-retest reliability study of 96 students who took the PRiSE survey and then completed it again after a two-week interval. Combining tests of both dichotomous and continuous variables (correlation coefficient and Cohen's Kappa), the reliability of the survey was 0.70. Coupled with the large sample size, the likelihood of a reversal in the direction of effect of a variable is less than 0.04% (Thorndike, 1997). In the case of identification of career interest, test-retest agreement was high, 87.2% between the two administrations.

We were greatly influenced by the methodological practices of epidemiology in which great care is employed when substituting recall for longitudinal data collection. We closely followed recommendations that improve accuracy and reliability in large-scale studies that depend on self-reported data (Bradburn, 2000; Niemi & Smith, 2003; Pace, Barahona, & Kaplan, 1985). Self-reports from college students of course-taking, grades earned, and standardized test scores tend to be highly accurate (Anaya, 1999; Baird, 1976). Kuncel, Credé, and Thomas (2005) found that self-report may be characterized as reasonably accurate in samples where the surveys address issues relevant to the respondents. In surveying college students, most in their first semester of college, reflection on their prior preparation and career aspirations would be commonplace. In addition, the students' own professors (who were individually recruited by the project) administered the surveys in class at the start of the term, raising student compliance and perceived importance of the survey.

Variables

Subjects were asked to choose from multiple categories to characterize their career aspirations at several times prior to college. Among these were middle school (MS), beginning of high school (BHS), and end of high school (EHS). Interest in a medical profession was exhibited by 1,201 (18.2%) of our sample of 6,598 students when they were in MS. The interest level decreased to 957 (14.5%) at BHS and to 726 (11.0%) at EHS. The dummy variable EHS interest in medicine was used as the dependent variable in our logistic models, while interest at the earlier stages served as control.

In addition to gender (female=0, male=1), demographic information was collected on the level of each parents' education (i.e., less than high school=1, high school=2, some college=3, four-year degree=4, graduate degree=5), the parent having a science-related career (yes=1, no=0), and race/ethnicity. The race/ethnicity variables were collected using

the U.S. Census Bureau's classification system (United States Census Bureau, 2010). Individuals were asked if they were of Hispanic origin and with which race they identified. In our study, participants who identified as being of Hispanic origin were labeled as Hispanic, and participants who did not identify as having Hispanic origins were grouped into the following (Non-Hispanic) categories: White, Black, Asian, and Other (including Native American Indian, Pacific Islander, and Other).

Of the students interested in medicine in middle school, 788 (65.6%) identified as White, 162 (13.5%) identified as Hispanic, 100 (8.3%) as Black, 70 (5.8%) as Asian, and 81 (6.8%) as Other. These numbers changed to 608 (63.5%) White, 125 (13.1%) Hispanic, 86 (9.0%) Black, 64 (6.7%) Asian, and 74 (7.7%) Other by BHS and to 458 (63.1%) White, 99 (13.6%) Hispanic, 66 (9.1%) Black, 50 (6.9%) Asian, and 53 (7.3%) Other by EHS.

Because academic variables within each discipline of mathematics, English, and science were found to correlate, composite variables were constructed. The math and English composites each contained the students' grade in the most advanced math or English course taken in high school, their SAT/ACT math or English score, and, for the math composite, information on whether they took calculus in high school (Table 1). The variables were standardized, added, and standardized again for ease of interpretation. The science composite contained the count of the total number of science courses taken in high school and the average grade for each of those science courses. Like before, these variables were standardized, added, and standardized again (Table 1).

Table 1
Variables contained in academic composites before standardization (n=6,598) (A+=4.33, A=4.0, A-=3.67, B+=3.33, B=3.0, B-=2.67 etc.)

Academic Composite	Variables Included in Composite	Mean	Standard Deviation
Math	Grade in most Advanced Math Course	3.1	0.90
Composite	SAT/ACT Math	529	126
	Took Calculus in High School	11.4%	
English	Grade in most Advanced English Course	3.5	0.72
Composite	SAT/ACT Verbal	532	103
Science	Total Number of Courses (of possible 7)	3.0	1.50
Composite	Average Grade	3.3	0.67

Note: A+=4.33, A=4.0, A-=3.67, B+=3.33, B=3.0, B-=2.67 etc.

A range of motivation variables were collected through the survey question that asked subjects to "Rate the following factors in terms of their importance for your future career satisfaction" on a scale from 0 (not at all important) to 5 (very important). These values were standardized. A factor analysis was performed with varimax rotation to reduce the overall number of variables yielding two distinct factors, which were named Intrinsic Motivation and Extrinsic Motivation. Extrinsic Motivation included the variables: importance of fame, leading, money, inventing, and an easy job. Intrinsic Motivation included the variables: importance of helping others, working with people, time for family, use of talent, career development, job security, personal time, job excitement, job

opportunities, and making own career decisions. For each group, the standardized individual motivations were summed and standardized again to produce the composites Intrinsic and Extrinsic Motivation.

Analytical Plan

To address our first research question, the most appropriate means for analyzing the issue of medical career interest at EHS (a binary variable) was to construct logistic regression models that simultaneously tested multiple independent variables for significance. To address our second research question we compared significant variables from the most parsimonious logistic regression model by race/ethnicity for students in the medically interested and non-medically interested groups and then between students interested in medicine at EHS and students not interested in medicine by EHS within race/ethnicity.

Results

Predicting medical interest through logistic regression

Table 2 presents a series of logistic regression models. Model 0 contained only students' race/ethnicity. Model 1 contained students' background and prior interest. In Model 2, the academic composite variables were added (and parental education was removed, owing to its non-significance). Model 3 further added the motivation variables. In Model 4, all non-significant values from Model 3 were removed (with exception of race/ethnicity). Finally, we tested all possible interactions, and presented the significant ones in Model 5.

We selected the most parsimonious model (Model 4) to interpret. The odds of reporting a medical career interest (rather than a career interest outside of medicine) at EHS were about eleven times higher for students who reported an interest in medicine at BHS than for students who did not report such an interest at BHS (Table 2). Additional positive effects were found for students who had medical career aspirations already in MS, who had a parent in a science-related field, and who identified as Asian. Furthermore, controlling for the other predictors, the odds of being interested in a medical career at EHS were 1.3 times greater for females than for males.

The odds of a student reporting a medical career interest at EHS increased by 1.3 times for each standard deviation increase in the Science Composite and 1.3 times for each standard deviation increase in Intrinsic Motivation. Conversely, the odds of *not* reporting a medical career interest at EHS increased 1.2 times for each standard deviation increase in Extrinsic Motivation.

Whereas we found that the Math Composite and English Composite variables were significant by themselves ($p \leq 0.05$, not shown), only the Science Composite was a significant predictor when all three composites were present in the model of wanting a medical career at EHS, owing to collinearities.

All interactions between the independent variables were tested for significance. Two were found significant (Model 5) and graphed in Figure 1. Intrinsic motivation mattered slightly less in predicting EHS interest in medicine for Hispanic students and students who identified as Other than for White students (Figure 1 top). We also found for students with an interest at BHS in medicine, there was very little gender difference in their odds of persisting in that interest to EHS. Among students who were not interested in medicine at BHS, however, females became more attracted than males by the end (Figure 1 bottom).

Table 2

Logistic models predicting end of high school interest in medicine with odds-ratios and statistical significance of variable indicated

Variable	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5
Interest BHS		11.6(0.11)***	11.1(0.10)***	10.9(0.10)***	10.9(0.10)***	9.20(0.12)***
Interest MS		1.54(0.11)***	1.55(0.11)***	1.52(0.11)***	1.53(0.11)***	1.54(0.11)***
Gender (male= 1)		0.71(0.09)***	0.70(0.09)***	0.76(0.10)**	0.75(0.10)**	0.58 (0.13)***
Parent Sci-Related Career		1.43(0.09)***	1.40(0.09)***	1.37(0.10)***	1.35(0.09)***	1.34(0.09)***
Total Parent Ed		1.01(0.02)				
Other	1.17(0.15)	1.30(0.18)	1.25(0.18)	1.29(0.18)	1.29(0.18)	1.04(0.29)
Hispanic	0.88(0.15)	1.20(0.18)	1.18(0.14)	1.18(0.14)	1.17(0.14)	1.14(0.19)
Black	1.24(0.15)	1.10(0.21)	1.20(0.17)	1.27(0.17)	1.24(0.17)	1.29(0.23)
Asian	1.64(0.16)*	1.50(0.21)*	1.35(0.19)	1.48(0.19)*	1.48(0.19)*	1.48(0.28)
Math Composite			1.01(0.05)	1.01(0.05)		
English Composite			1.07(0.05)	1.07(0.05)		
Science Composite			1.24(0.05)***	1.24(0.05)***	1.28(0.05)***	1.27(0.05)***
Intrinsic Motivation				1.31(0.06)***	1.33(0.06)***	1.47(0.06)***
Extrinsic Motivation				0.84 (0.05)***	0.83(0.05)**	0.84(0.05)***
Interest BHS * Gender						1.71(0.19)**
Intrinsic Motivation * Hispanic						0.70(0.16)*
Intrinsic Motivation * Other						0.69(0.17)*
N	6598	6598	6598	6598	6598	6598
McFadden Pseudo R^2	0.003	0.216	0.226	0.231	0.231	0.237

Note: Interactions indicated by asterisk between variables. The McFadden Pseudo R^2 varies with each model. Differences in the amount of variance associated by Models 3, 4, and 5 are not significant, however the most parsimonious model is Model 4. Statistical significance noted: p=* < 0.05, **< 0.01, ***<0.001

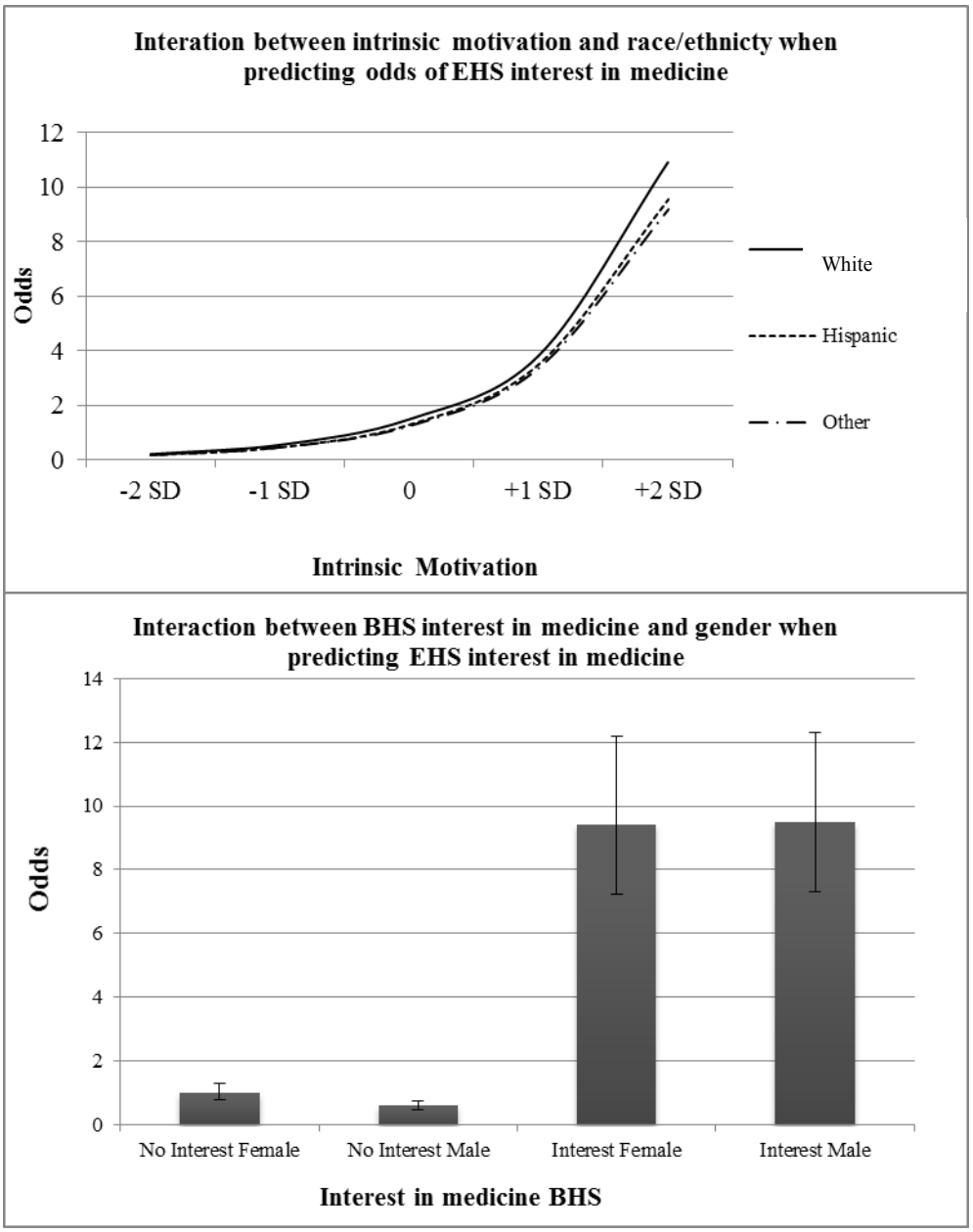

Figure 1. Interactions of logistic regression variables. Top: Odds predicting EHS interest in medicine vs. intrinsic motivation for White, Hispanic and Other race/ethnicities. Bottom: Interaction between BHS interest in medicine and gender when predicting EHS interest in medicine. Error bars indicate ±1 standard error (SE)

Describing detailed variable patterns

Addressing our second research question, we investigated to what extent the variables that were found to influence career interest in medicine at EHS showed differences by racial/ethnic groups. (Speaking more technically, we explored the collinearities of relevant independent variables.) Of the significant variables from Model 4 (Table 2), we examined the science composite, intrinsic motivation, and extrinsic motivation by race/ethnicity of the medically interested (Table 3 left) and non-medically interested (Table 3 right) groups. Looking specifically at the medically interested students by EHS we found that Black and Hispanic students had a lower science composite than White and Asian students, of which Asian students had the highest (Table 3). Our data also indicated complex differences in career motivations. Intrinsic motivation was highest among Black, Hispanic, and White students and lowest among Asian students. Black, Hispanic, and Asian students had the highest extrinsic motivation, not differing within ±1 standard error (SE). Extrinsic motivation was lowest among White students. Looking specifically at the non-medically interested students by EHS we found that Asian students had the highest science composite followed by White, Hispanic, and Black students, not differing by ±1 SE. Intrinsic motivation was highest among Black and Hispanic students and lowest among White and Asian students. Extrinsic motivation was highest among Black and Asian students, with Asian and Hispanic students not differing by ±1 SE. Hispanic students did differ from Black students by ±1 SE. Extrinsic motivation was lowest among White students.

Finally, we examined the differences between students interested in medicine at EHS and students not interested in medicine by EHS within race/ethnicity. Our data indicated that high school students with medical career aspirations tended to have a stronger science background (except among Black students) than did their peers (±1 SE) (Table 3). White and Black students interested in medicine had higher intrinsic and lower extrinsic career motivations than their non-medically interested counterparts. Asian students interested in medicine had lower extrinsic career motivations than Asian students not interested in medicine. The values from Table 3 were plotted in Figure 2 for ease of comparison.

Limitations

It is practically impossible to account for all variables associated with medical career interest by EHS. Clearly there were other variables, both positive and negative, at play that we did not measure. These may include scientific experiences students have within their high school courses, interactions with parents, teachers, or members of the medical community, as well as varying forms of media. Moreover, our study was correlational and could not prove causal connections between variables and outcomes. Nonetheless, the relationships identified by this kind of study are worthy of controlled, intervention studies (to the extent possible) that may establish, with increasing certainty, the suggested causal connections.

Table 3

Standardized Science Composite, Intrinsic Motivation, and Extrinsic Motivation variables by race/ethnicity of students with a medical interest at the end of high school (n=726) and students with non-medical interest at the end of high school (n=5,872)

	Medical Interest EHS (n=726)						Non-medical Interest EHS (n=5,872)					
Variables	White	Hispanic	Black	Asian	Other	All	White	Hispanic	Black	Asian	Other	All
Science Composite (±1 SE)	0.331 (0.286, 0.376)	0.157 (0.045, 0.269)	-0.080 (-0.206, 0.047)	0.608 (0.497, 0.719)	0.520 (0.388, 0.652)	0.306 (0.269, 0.342)	-0.018 (-0.033, -0.003)	-0.074 (-0.108, -0.041)	-0.227 (-0.275, -0.178)	0.257 (0.198, 0.317)	-0.034 (-0.090, 0.022)	-0.036 (-0.048, -0.023)
SD	0.963	1.116	1.029	0.785	0.960	0.999	0.964	0.978	1.06	1.02	1.04	0.995
Intrinsic Motivation (±1 SE)	0.219 (0.181, 0.256)	0.304 (0.229, 0.379)	0.354 (0.232, 0.476)	-0.043 (-0.151, 0.066)	-0.050 (-0.187, 0.087)	0.204 (0.173, 0.234)	-0.054 (-0.068, -0.040)	0.205 (0.172, 0.237)	0.177 (0.126, 0.227)	-0.060 (-0.118, -0.002)	-0.096 (-0.161, -0.032)	-0.023 (-0.037, -0.010)
SD	0.803	0.748	0.992	0.770	0.996	0.829	0.917	0.939	1.104	1.010	1.192	1.015
Extrinsic Motivation (±1 SE)	-0.170 (-0.211, -0.129)	0.203 (0.106, 0.300)	0.211 (0.094, 0.329)	0.043 (-0.074, 0.161)	-0.090 (-0.220, 0.040)	-0.077 (-0.110, -0.044)	-0.093 (-0.107, -0.079)	0.272 (0.237, 0.307)	0.464 (0.412, 0.515)	0.349 (0.288, 0.410)	-0.023 (-0.083, 0.037)	0.009 (-0.004, 0.023)
SD	0.868	0.965	0.953	0.831	0.946	0.899	0.906	1.015	1.131	1.055	1.111	1.010

Note: Brackets indicate ±1 SE; SD indicates standard deviation

Discussion and Conclusion

Our models showed that pre-high school factors predicted EHS interest in medicine more than any other tested variable. This result agreed with recent studies from the UK (Ferguson et al., 2012; Mcharg, Mattick, & Knight, 2007) and potentially highlight how early medical career intentions take shape and, thus, how important early strategies may be if one wants to foster students' interest in medicine. When considering our second research question we found almost no racial/ethnic differences in interest in medicine, when controlling for relevant factors (Model 4), with the exception that Asians showed an elevated interest in medicine. We also found complex racial/ethnic differences in career motivations related to interest in medicine (Figure 2). For example, intrinsic motivation was highest among Black, Hispanic, and White students and lowest among Asian students. Yet, Black, Hispanic, and Asian students had the highest extrinsic motivation, not differing within ±1 SE. (Note that the intrinsic and extrinsic motivation variables were independent: a racial/ethnic group could have high means or low means on both.) These findings highlighted the comparatively high overall motivational variables of Black and Hispanic students at the start of college and could perhaps be related to socioeconomic status (Greenhalgh, Seyan, & Boynton, 2004) or broad cultural trends (Twenge, Campbell, Hoffman, & Lance, 2010). Finally, our data showed that a lower average level of scientific achievement set apart the Black and Hispanic students from the other students interested in a medical profession (Figure 2).

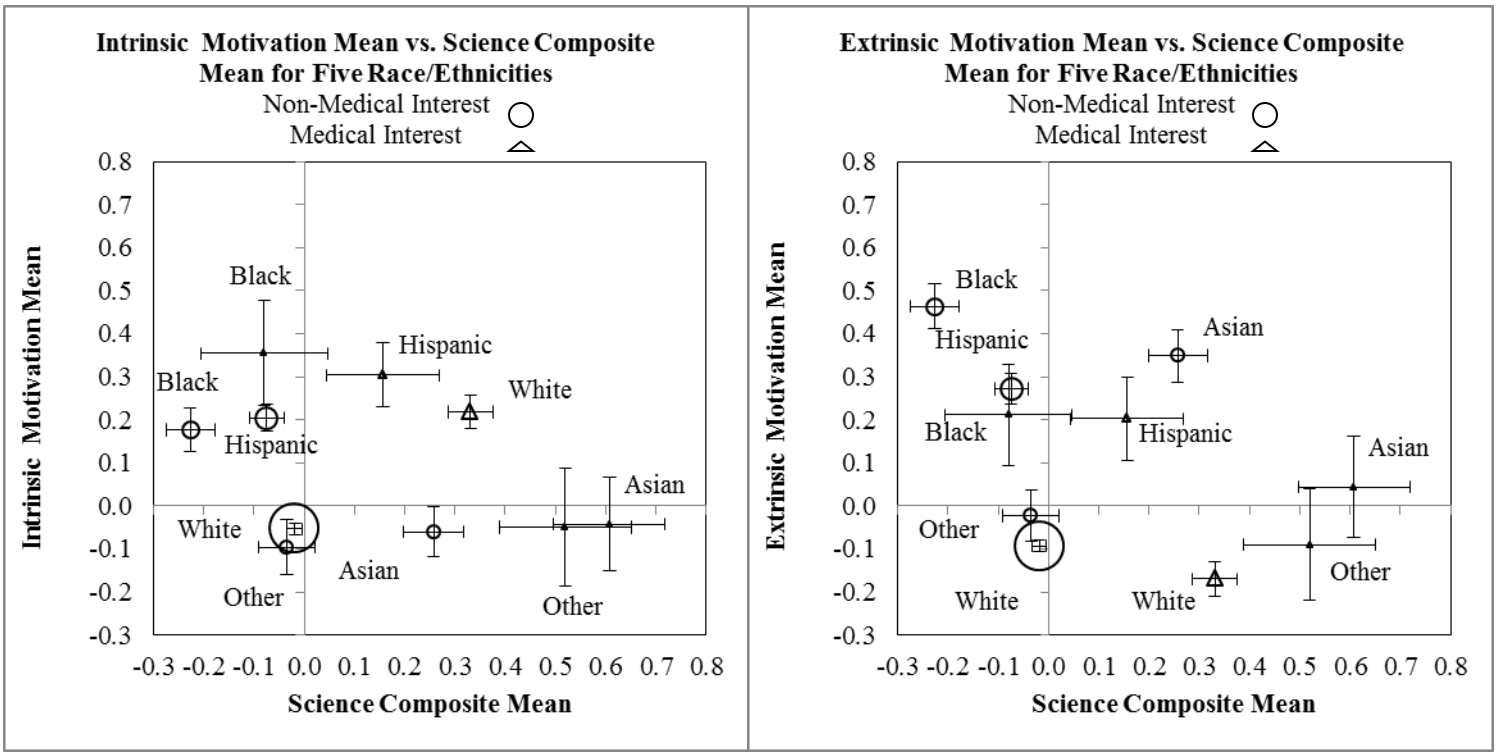

Figure 2. Standardized Intrinsic and Extrinsic Motivation means plotted against Science Composite means for five races/ethnicities by interest in medical and non-medical careers (n=6,598). Races/ethnicities include Black, Hispanic, White, Asian, and Other (Native American, Pacific Islander, Other). Area of circles and squares are proportional to N for each race/ethnicity. Errors bars indicate ±1 SE

Although sufficient numbers of Black and Hispanic students are interested in a career in medicine at the end of high school to contribute to the needed improvement in the racial/ethnic physician patient match, not enough students apply to, enroll in, or graduate from medical school (Association of American Medical Colleges, 2010; Association of American Medical Colleges, 2014). Limited proficiency in science may impede further progress through the medical pipeline. To reach medical school enrollment students must first advance through various educational merit barriers (Southgate, Kelly, & Symonds, 2015) and, in the U.S., obtain premedical undergraduate education (Cooper, 2003). In U.S. premedical education, it is not the motivations of the students that earn them competitive grades and program completion, but their scholastic and, particularly, scientific achievement. Any negative academic experiences these students have in college may dissuade them from applying to medical school (Barr & Matsui, 2008). If students thus leave the premedical path early, interventions that recommend reforming the medical school admissions procedure (e.g., less emphasis on quantitative measures of success) may not reach them (Girotti, Park, & Tekian, 2015; Keith & Hollar, 2012).

For those wishing to develop intervention strategies that support URM students on the path toward medicine, strengthening the scientific achievement of high school (or pre-high school) students who already have an interest in medicine is recommended. If such programs start early and capitalize on high student motivations, they could potentially aid the development of scientific aptitude that helps students progress through various educational barriers. Ideas could be appropriated from the four-day Mini-Med School (Shaikh, Babar, & Cross, 2013) where students were exposed to the structure and vernacular of medical education, the epistemology of physician diagnosis, and the sub-fields of medicine. Special attention should be paid to the science curriculum of the area to ensure that programs build scientific competency. Such programs could elicit the dual benefit of not only bolstering pre-college interest in medicine, but also addressing the major barriers post-secondary science education provides. Both a sustained career interest and persistent high academic performance are needed for ultimate positive outcomes. While various critics of the standards of medical school admissions may advocate reforms, such as less emphasis on STEM skills and more emphasis on other factors, the current cohort of aspiring medical students needs support in navigating the system as it exists (before any reform takes hold).

Future research should investigate how the studied academic and motivation variables play out in post-secondary education, and how they differ between races/ethnicities. Long-term effects of any interventions implemented should be studied.

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