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**An Intersectional Application of Expectancy-Value Theory in an Undergraduate
Chemistry Course**

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Abstract

The underrepresentation of women and Black, Latinx, and Native Americans within the United States scientific workforce is a persistent and multifaceted problem warranting an intersectional approach. Applying intersectionality to the expectancy-value theory of motivation, we examined initial motivation and subsequent achievement among a sample of undergraduate students ($n = 687$) enrolled in the STEM gateway course of introductory chemistry at a diverse four-year university. We found no racial/ethnic group differences in initial motivation, but small ($d = .30$) group differences in achievement. Results revealed a pattern of gender differences across both underrepresented (i.e., Black, Latinx, and Native American) and well-represented (i.e., White, Asian American) racial/ethnic groups such that, relative to men, women began the class with lower levels of confidence about their performance, but greater utility value and attainment value in learning chemistry. Consistent with expectancy-value theory, motivation at the beginning of the semester positively predicted final exam scores across gender and racial/ethnic intersectional groups. For Black, Latinx, and Native American students, attainment value was an especially strong predictor of subsequent achievement. Our findings point to the need to cultivate social contexts within undergraduate STEM education that promote all aspects of science motivation among students from underrepresented groups. *Additional online materials for this article are available on PWQ's website at* [\[PRODUCTION INSERT WEB ADDRESS\]](#).

Keywords: motivation, interest, academic achievement, intersectionality, racial and ethnic differences, human sex differences

An Intersectional Application of Expectancy-Value Theory in an Undergraduate Chemistry Course

The ultimate goal is to have participation in STEM fields mirror the population of the Nation. Every person interested in science and engineering should be able to consider a STEM career without concern about whether or not “people like me” fit into the STEM enterprise (National Science Foundation, 2014, p. 3).

Access to STEM fields is a social justice issue (Fine & Sojo, 2019; Handelsman et al., 2005; Harding, 2015). Women and Black, Latinx, and Native Americans, and individuals at the intersections of these diverse groups, remain underrepresented in the science, technology, engineering, and mathematics (STEM) workforce (Fry et al., 2021; National Center for Science and Engineering Statistics [NCSES], 2021). For example, across racial/ethnic groups in the United States (U.S.) in 2019, women held 29.4% of science and engineering jobs; that share dwindles to 2.4% for Latinas, 1.8% for Black women, and 0.6% for Native American women (NCSES, 2021). At the micro-level, such disparities impede the economic empowerment of members of these underrepresented gender and racial/ethnic groups in part because STEM careers offer greater financial benefits in comparison to other career fields (Carnevale et al., 2015; Melguizo & Wolniak, 2012). And, at the macro-level, the economic imperative to expand the U.S. STEM workforce continues to grow (e.g., Hoy, 2019; President’s Council of Advisors on Science and Technology, 2012). Evidence indicates that this workforce will be more effective if it is diverse: Gender and racial/ethnic diversity in the STEM workforce fosters productivity and creativity as well as innovation (e.g., Herring & Henderson, 2011; Hong & Page, 2004; Nielsen et al., 2017).

While many factors likely contribute to the underrepresentation of women and Black, Latinx, and Native Americans (diverse groups that are not mutually exclusive and may be fluid) in science, group differences in math and science abilities do not explain the disparities (Bowen et al., 2005; Else-Quest et al., 2010; Okahana et al., 2018; Pascarella & Terenzini, 1991; Wang & Degol, 2017). Instead, these factors include sexist and racist stereotypes, harassment, and discrimination in education (Chavous et al., 2008; Leaper & Starr, 2019; Spencer et al., 2016) and employment (Clancy et al., 2017; Eaton et al., 2020; Moss-Racusin et al., 2012; O'Brien et al., 2015) and other social, economic, and political disparities (Bowen et al., 2005; Cheryan et al., 2017; Pascarella & Terenzini, 1991), as well as student perceptions that science careers are incongruent with communal goals, which tend to be particularly strong among women and Black, Latinx, and Native American students (e.g., Diekman & Steinburg, 2013; Eccles, 2007; McGee, 2020; Thoman et al., 2015).

Educational persistence and achievement are shaped by student motivation for STEM, which develops and changes within a dynamic social, political, and cultural context (Eccles & Wigfield, 2020; Harackiewicz, Smith, & Priniski, 2016). However, because psychological scientists too often do not (or cannot) consider the intersectionality of power and oppression that shape our lived experiences (e.g., Collins & Bilge, 2016; Else-Quest & Hyde, 2016a), our understanding of undergraduate student motivation for STEM—much less for specific STEM disciplines or fields—is often limited and decontextualized. That is, social categories such as gender and race/ethnicity are most often analyzed additively or in isolation and without attention to the power and inequality they confer, such that knowledge about the development and outcomes of students' STEM motivation across diverse groups is incomplete and inadequate.

Thus, to better understand why women and Black, Latinx, and Native Americans remain underrepresented in STEM, in the current study we used an intersectional approach to examine initial motivation and subsequent achievement among undergraduate students at an early stage in their occupational development—the STEM gateway course of introductory chemistry. Experiences in STEM gateway courses are powerful predictors of persistence in STEM and introductory chemistry is typically the first of these courses that undergraduates encounter (Harris et al., 2020). In the Weston et al., (2019) review of nearly 300 STEM foundational courses at six universities, introductory chemistry and calculus were identified as the most significant weed out classes with an average of 20% DFWI rate (D or F grade, withdraw, or incomplete). That finding was corroborated with qualitative data from 147 students who identified general chemistry more than any other course as a “weed out” class that contributed to their decision to switch majors or persist (compared to other courses, such as biology, which had an average 10% DFWI rate). Guided by the theoretical frameworks of intersectionality (e.g., Cole, 2009; Collins & Bilge, 2016; Crenshaw, 1989, 1991) and expectancy-value theory (Eccles, 1994; Eccles & Wigfield, 2020), we explored differences as well as similarities in chemistry motivation and achievement across intersectional groups based on belonging to underrepresented and well-represented gender and racial/ethnic groups.

Intersectionality

An intersectional approach is essential when considering STEM participation among members of underrepresented groups. Intersectionality is a critical theory and interdisciplinary approach that recognizes that people belong simultaneously to multiple, interconnected social categories or groups that confer power and inequality (such as gender, race/ethnicity, and socioeconomic status), thereby providing a way to understand the human experience in light of

complex inequalities linked to those social categories (Collins & Bilge, 2016). Black feminist legal scholar Kimberlé Crenshaw (1989, 1991) initially coined the term in relation to the oppression and needs of Black women as members of a multiply-marginalized group that was made invisible by systems and approaches that examined gender or race/ethnicity only in isolation. However, intersectionality originated in 19th century Black feminist theory and activism, beginning with works such as Sojourner Truth's "Ain't I a Woman" speech (1851) and Anna Julia Cooper's *A Voice from the South* (1892). Later it continued in the writings of Frances Beale (1970), the Combahee River Collective (1982), Audre Lorde (1981), and others from disciplinary orientations across the humanities and social sciences (e.g., Cole, 2009; Collins & Bilge, 2016; May, 2015).

While the conceptualization and parameters of intersectionality vary across disciplines and among diverse theorists, scholars, and activists in important ways, there are shared assumptions among them as well. In a synthesis of intersectionality theorizing drawing from multiple disciplines, Else-Quest and Hyde (2016a) noted that those theories generally share the perspective that intersectionality (1) attends to the experience and meaning of belonging to multiple social categories or dimensions (e.g., gender, race/ethnicity, social class) simultaneously; (2) includes an examination of power and inequality; and (3) attends to social categories as properties of the individual (e.g., identity) as well as to the social context (e.g., social structures and contexts) and considers those categories and their significance or salience as potentially fluid and dynamic. These common assumptions are reflected in the diversity of intersectional approaches that researchers have used in psychology, including Cole's (2009) three intersectional research questions.

We draw upon two of Cole's (2009) questions to guide the current study. The first question—"Where are the similarities?"—explores the commonalities across diverse intersectional groups, expanding psychology's focus beyond the study of differences. This approach is consistent with the gender similarities hypothesis, which proposes that men and women are alike on most but not all psychological variables (Hyde, 2005; Zell et al., 2015). Within the context of STEM education, this can entail recognizing the commonalities or similarities among diverse intersectional groups that are typically framed by difference.

Cole's second question—"What role does inequality play?"—examines how power or lack of power (e.g., in the form of belonging to marginalized or minoritized groups) is linked to motivation to pursue science. For example, in one qualitative project, Latina STEM majors reported that faculty and peers perceived them as incompetent or out of place in STEM because of their gender and race/ethnicity (Rodriguez & Blaney, 2021). Yet, while greater rates of STEM participation among members of minoritized and marginalized groups can contribute to their economic empowerment, initiatives to boost their participation are often deficit-based, limited in scope, and only target one group at a time, leaving out members of multiply marginalized groups (Metcalf et al., 2018). For example, when considering underrepresentation of women in STEM, White women are often the target for intervention, leaving out Black and Latina women (Collins & Bilge, 2016). To inform the development of such interventions and maximize their impacts across intersectional groups, we need research that examines the development of student motivation and achievement across STEM disciplines, considering gender and race/ethnicity simultaneously and being attentive to how the social context confers power based on those social categories.

Cole's (2009) guidance to explore the role of inequality is aligned with Else-Quest and Hyde's (2016a) third assumption that intersectionality theories consider social categories as properties of both the individual and the social context. Given contemporary disparities in science participation, it is crucial that we examine motivation and achievement patterns across science disciplines, each of which have different social and historical contexts. That is, "science" is too broad a category when analyzing students' motivation (Cheryan et al., 2017), and there is no uniform pattern of gender or racial/ethnic differences in achievement across science disciplines (National Student Clearinghouse Research Center, 2015). For example, in high school, disciplines including the life sciences (e.g., biology) demonstrate gender similarities, whereas in the physical sciences (e.g., chemistry and physics) boys tended to outperform girls (OECD, 2016). On national assessments for K-12 science (2015 National Assessment of Educational Progress) and 8th grade technology and engineering (2014 NAEP Technology and Engineering Literacy Assessment), White and Asian American/Pacific Islander students tended to score higher than their Black/African American, Latinx, and Native American peers (National Science Board, 2019). These patterns of gender similarities in life sciences but differences in physical sciences and racial/ethnic group differences across science, technology, and engineering achievement are echoed in the gender and racial/ethnic group differences in degrees awarded and jobs held (Fry et al., 2021; NCSES, 2021). Thus, while introductory chemistry and introductory biology are both gatekeeper courses for all science and pre-health pathways, there are important differences between the courses and the social contexts they provide. An intersectional approach to science participation includes attention to social categories like gender and race/ethnicity within the social context of the specific science discipline. Too often, interventions to improve the participation of students from underrepresented groups focus on changing the students rather

than changing the context to make it more inclusive and supportive of those students. However, in this project, we focus specifically on the science discipline of chemistry as a unique social context that confers power and inequality based on gender and race/ethnicity.

Fundamentally, intersectionality theory is about social context and how inequalities and inequities are perpetuated within and by those contexts. Thus, within psychology, an intersectional approach to the underrepresentation of women and Black, Latinx, and Native American students in STEM can include comparative analyses that consider multiple social categories—such as by testing for multiple main effects and statistical interactions—with the caveat that all variables and findings are interpreted and framed with attention to power and inequality in social and historical context (Buchanan & Wiklund, 2021; Else-Quest & Hyde, 2016b). Likewise, an intersectional approach can be applied to existing psychological theories, such as expectancy-value theory.

Expectancy-Value Theory

Expectancy-value theory (or situated expectancy-value theory) posits that educational and vocational choices are driven most proximally by two sets of beliefs: (1) an individual's expectation for success, and (2) the value or importance that an individual places on the educational and vocational options they believe are available to them (Eccles, 1994; Eccles & Wigfield, 2020; Wigfield & Eccles, 2020). These expectations as well as social influences (e.g., influence from parents, teachers, and peers) are indicators of performance and academic-related choices (Eccles, 1994). This theory has been used to develop interventions that bolster student motivation in science, including values affirmation interventions and utility value interventions (Harackiewicz, Canning, et al., 2016). Expectancy-value theory also posits that, in some fields, men and women will develop different self-concepts, goals, values, and expectations for success

because of gender-role socialization and self-socialization. Thus, the social context—including the inequalities and inequities embedded within it—contributes to the ongoing development of motivation.

According to expectancy-value theory, one's expectations for success on a task are strongly influenced by one's *confidence about performance*, or the beliefs that one has about their ability to perform the task. Sometimes termed self-concept of ability, this motivational belief is specific to a domain (e.g., chemistry) and overlaps empirically with Bandura's concept of self-efficacy (Eccles & Wigfield, 2020). Expectancy-value theory posits that, when a student feels more confident about their ability to perform a task, their expectation for success in that task is greater and they are more likely to persist on the task. Abundant empirical research supports the link between self-concept or confidence and persistence (e.g., Else-Quest et al., 2013; Guo et al., 2015; Guo et al., 2016; Hsieh et al., 2021). In addition to this motivational belief, in the current study we focused on three types of value: attainment value, interest (or intrinsic value), and utility value.

Attainment value refers to an activity having value because engaging in it is consistent with one's identity and is important because it gives one an opportunity to explore and confirm aspects of the self (Eccles, 2005; Eccles & Wigfield, 2020). It is not an aspect or kind of identity, but rather the value of doing a task because it connects to one's identity. For example, in one study, Latina women were less likely to see themselves as “chemistry people” than Latino men, White women and men, and Black women and men (Hazari et al., 2013). Therefore, expectancy-value theory would predict that because Latina women do not see chemistry as being a salient part of their identities, they will be less likely to pursue chemistry. In this way, attainment value reflects one way that aspects of an individual's identity might be relevant to their motivation for

pursuing chemistry, though connections between attainment value and identity are not well understood (Eccles & Wigfield, 2020). Attainment value can help to explain individual differences in interest. (Eccles, 2005).

Interest refers to how much one enjoys doing a task. It is both a psychological state during which an individual may experience increased attention, effort, and affect (situational interest) and a predisposition to engage with a particular topic over time (individual interest; Harackiewicz, Smith, & Priniski, 2016; Hidi & Renninger, 2006). Something attention-grabbing in the situation or environment may trigger interest, which can then become more enduring over time and across situations. Wyss and colleagues (2012) found that providing middle school students with accurate information about STEM careers through videos of scientists promoted student's interest in STEM. Over time, if sustained, situational interest can be incorporated into an individual's identity and develop into individual interest. It can also be influenced by one's perception of a task. For example, in a study with elementary school children, student's perceptions of scientists influenced their interest in science as a career choice (Buldu, 2006). Thus, when a student finds a task or topic in chemistry enjoyable or interesting, they are more likely to persist in their chemistry course and potentially develop a sustained individual interest in chemistry.

Utility value describes the belief about whether a task helps a person reach their long-term goals, such as majoring in chemistry to eventually earn a medical degree and become a physician. Thus, when students find a task useful or relevant in this way, they are more likely to persist at the task. Helping students find relevance and usefulness in science may be a good way to help them develop and sustain interest and motivation in their courses (Harackiewicz, Smith, & Priniski, 2016). Consistent with expectancy-value theory, empirical research indicates that

utility value predicts interest, effort, and performance (Biegman Klebanv et al., 2017; Eccles, 1994; Eccles & Wigfield, 2020).

Several studies have examined gender differences in the motivational beliefs identified by expectancy-value theory within the context of science learning, though findings are inconsistent, particularly across science disciplines. For example, in an undergraduate introductory biology course, women tended to report greater utility value relative to male classmates (Harackiewicz, Canning et al., 2016). Yet, cross-national data indicate that adolescent boys tend to report greater interest in science relative to girls (OECD, 2016). Likewise, among 9th graders, boys reported greater science self-concept and only slightly greater science task value (i.e., combined utility value and interest) relative to girls (Jiang et al., 2020). A recent meta-analysis found negligible gender differences in science attainment value, task value, and utility value and a small gender difference in interest favoring male students (Parker et al., 2020).

Such findings about gender differences and similarities in science motivation are incomplete, however, without an intersectional approach that also considers race/ethnicity. For example, in a study with ethnically diverse high school students in the U.S., girls reported greater science task value relative to boys, a pattern that was consistent across White, African American, Latinx, and Asian American youth (Else-Quest et al., 2013). By contrast, the same study found gender differences (favoring boys) in science self-concept for Latinx and Asian American youth, but gender similarities among White and African American youth. In short, each aspect of science motivation may show a unique pattern of variation across intersectional groups.

Similarly, Harackiewicz, Canning, and colleagues (2016) used an intersectional approach to examine motivation and achievement among students and test an educational intervention in an introductory undergraduate biology course. At the start of the semester, women reported

greater utility value and confidence about performance in biology, a pattern of gender differences that was comparable across race/ethnicity and social class. Yet, while the intervention proved equally effective for men and women, it was most effective with students who were multiply-marginalized based on race/ethnicity and social class. Although these findings offer a more nuanced description of how students from diverse intersectional groups experience a biology course in different ways, the results cannot be generalized to other science disciplines, including chemistry. Indeed, to our knowledge, no study has described chemistry motivation among students from diverse intersectional locations or groups.

The Current Study

We take a novel approach to studying the underrepresentation of women and Black, Latinx, and Native Americans in science by incorporating intersectionality and exploring initial motivation and subsequent achievement of undergraduate students in the science domain of chemistry. Because experiences in STEM gateway courses are powerful predictors of persistence in STEM (Harris et al., 2020), we focused on an undergraduate introductory course in chemistry, which is typically among the first gateway STEM courses—and the most significant weed out STEM course (Weston et al., 2019)—that undergraduates encounter. We used an intersectional approach to examine motivation and achievement within the framework of expectancy-value theory. We drew upon questions and assumptions presented by Cole (2009) and Else-Quest and Hyde (2016a) and implement several of the methodological techniques recommended by Else-Quest and Hyde (2016b) for quantitative research examining intersectionality. As power and inequality are conferred to gender and racial/ethnic groups by the social context, we constructed and analyzed gender and racial/ethnic groups according to how well-represented they are in the social context of the chemistry discipline. Figure 1 further illustrates our intersectional

application and analytic approach, framing gender and racial/ethnic group by the context of chemistry and examining how initial motivation predicts subsequent achievement.

We addressed three research questions:

Question 1: How do initial chemistry motivation and subsequent achievement in an undergraduate introductory chemistry course vary across underrepresented and well-represented gender and racial/ethnic groups?

We explored whether, given the underrepresentation of women and Black, Latinx, and Native Americans in chemistry, students from those underrepresented groups would report lower initial motivation (i.e., confidence about performance, interest, utility value, and attainment value) relative to students from well-represented groups (i.e., men and Asian American or White/European American students). Likewise, we tested for such group differences in achievement at the end of the semester. We also explored whether main effects of gender and racial/ethnic group on motivation might accumulate, such that women from underrepresented racial/ethnic groups would report the lowest initial motivation for chemistry and that men from well-represented racial/ethnic groups would report the highest motivation.

Question 2: Does initial motivation predict achievement at the end of the semester?

Consistent with expectancy-value theory, we hypothesized that students with greater motivation in chemistry at the beginning of the semester would be more likely to complete the course and also earn higher final exam scores.

Question 3: Is the link between initial motivation and subsequent achievement similar for underrepresented and well-represented gender and racial/ethnic groups?

We explored whether belonging to an under- or well-represented group moderated the theorized links between motivation and achievement.

Method

Participants

We conducted this study at a four-year, public, coeducational university in the U.S., serving approximately 11,000 undergraduate students, of whom 53% identify as White, 19% as Asian American, 17% as Black or African American, 7% as Hispanic/Latinx, and 4% as belonging to other groups. Across three academic terms (fall semester in 2017, 2018, and 2019), we recruited undergraduate students enrolled in an introductory chemistry course (CHEM 101). The data for this study are drawn from a larger intervention project evaluating utility-value interventions in chemistry (Harackiewicz et al., 2022) based on the utility-value intervention tested by Harackiewicz, Canning, and colleagues (2016). Students in treatment conditions completed three writing assignments over the course of the semester that asked them to pose a scientific question, provide a summary of scientific evidence from class to answer the question, and reflect on the value of the course material for themselves or for prosocial purposes (i.e., they thought about the utility value of course topics). Students in control conditions posed questions and wrote summaries, but did not reflect on value. Treatment effects are still being analyzed. Manipulation checks reported by Harackiewicz, Canning, and colleagues (2016) revealed that, in biology courses, students in the intervention condition articulated significantly more utility value in their essays than students in the control condition.

In total, 2,186 students from three cohorts consented to participate in the study, reflecting approximately 91% participation across the three cohorts. Of those, 1,974 completed the course. Students ranged between 18 and 44 years old ($M = 19.33$, $SD = 1.97$). To eliminate any possible effects on achievement stemming from the interventions tested in the intervention project, only data from the control group of each cohort are included here. Thus, for this paper, the sample

included 687 participants (345 women, 341 men, and 1 trans man) who consented and completed study materials at the beginning of the semester, 605 of whom completed the final exam at the end of the semester. To account for variation across the three cohorts, we included cohort as a covariate in all analyses. Table 1 displays demographic characteristics of the sample.

In the context of the physical sciences in the U.S., White and Asian Americans are well represented and Black, Latinx, and Native Americans are underrepresented (NCSES, 2021). To implement an intersectional approach, we emphasized the role of representation within the social context of chemistry education in perpetuating educational and economic disparities across gender and race/ethnicity, such that, within that specific context, belonging to a well-represented group confers privilege whereas belonging to an under-represented group confers disadvantage. In addition, McCall's (2005) intersectionality theorizing notes that, despite the socially constructed and ambiguous nature of categories like gender and race/ethnicity, categories may be analyzed *provisionally* within an approach emphasizing intercategorical complexity to understand how inequalities are produced and perpetuated. Accordingly, students who identified as White/European American and/or Asian/Asian American were grouped together as the *well-represented* racial/ethnic groups and students who identified as Black/African American, Latinx/Hispanic, Native American, and/or Pacific Islander were grouped together as *underrepresented* racial/ethnic groups. In this way, we analyzed the power and inequality conferred upon gender and racial/ethnic groups by their representation within this specific social context. Thus, the sample comprised 121 women and 96 men from underrepresented racial/ethnic groups and 224 women and 245 men from well-represented racial/ethnic groups, and one trans man from a well-represented racial/ethnic group. Due to small *n*, the trans man was excluded from gender analyses.

Procedure

The university's Institutional Review Board approved the study protocol. During the last 15 minutes of the first lecture of the fall semester, chemistry instructors left the lecture hall while the principal investigator explained the study and research assistants distributed consent forms and questionnaires. Participants were asked to give written consent, which also granted permission to the researchers to access student academic records, including course performance throughout the semester, prior to completing the questionnaire during that lecture period. Participation was voluntary and students were not compensated for participating.

Measures

The beginning-of-semester questionnaire assessed four aspects of student motivation in chemistry—confidence about performance, interest, utility value, and attainment value—drawn from expectancy-value theory (Eccles, 1994; Eccles & Wigfield, 2020). We adapted scales previously used by Harackiewicz, Canning et al. (2016) to measure aspects of motivation regarding biology within a diverse undergraduate sample such that items in the current study refer to chemistry. The variables were measured on a Likert-type scale from 1 (*not at all true*) to 7 (*very true*).

Confidence about performance (or, self-concept of ability in the course) refers to one's perceptions of their ability to perform tasks and was measured with three items, such as "I am confident that I will do well in this course;" Cronbach's $\alpha = .84$ in the full sample. Across the four gender x racial/ethnic subgroups described here, Cronbach's α ranged from .80-.82.

Interest refers to the enjoyment, involvement, and meaning that an individual experiences in a field or a class (Hidi & Renninger, 2006; Sansone & Smith, 2000) and was measured using four items, such as "I'm really looking forward to learning more about chemistry;" Cronbach's α

= .93 in the full sample. Across the four gender x racial/ethnic subgroups described here, Cronbach's α ranged from .90-.92.

Utility value is derived from perceiving that what students are learning is useful or helps them reach their short- and long-term goals and was measured using four items, e.g., "Knowing about chemistry is useful to my everyday life;" Cronbach's α = .76 in the full sample. Across the four gender x racial/ethnic subgroups described here, Cronbach's α ranged from .72-.77.

Attainment value refers to the perceived importance of a task for an individual's identity or self-worth. Participants' attainment value for chemistry was measured using four items, e.g., "The study of chemistry is personally meaningful to me;" Cronbach's α = .85 in the full sample. Across the four gender x racial/ethnic subgroups described here, Cronbach's α ranged from .81-.87.

The final page of the questionnaire included demographic items, including gender, race/ethnicity, and parents' education. See online Supplemental Materials for full response options.

Participants' chemistry achievement was measured by (1) course completion (i.e., dropped vs. completed course) and (2) final exam score. The final exam was standardized and created by the American Chemical Society. Scores indicate percent correct on the exam.

Data Analytic Plan

To explore whether aspects of motivation at the beginning of the semester would differ between students from underrepresented groups and well-represented groups (Research Question 1), we conducted a 2 (gender: men vs. women) by 2 (racial/ethnic group: underrepresented racial/ethnic vs well-represented racial/ethnic groups) multivariate analysis of covariance (MANCOVA) with four aspects of motivation (i.e., confidence about performance, interest,

attainment value, and utility value) as outcome variables and cohort as a covariate. We also assessed group differences in achievement (i.e., final exam performance) with a 2 (gender: men vs. women) by 2 (racial/ethnic group: underrepresented racial/ethnic vs well-represented racial/ethnic groups) analysis of covariance (ANCOVA) with cohort as a covariate.

To examine if initial motivation predicted achievement at the end of the semester (Research Question 2), we first considered the outcome of course completion. We conducted a MANCOVA with confidence about performance, interest, attainment value, and utility value as outcome variables and cohort as a covariate, which assessed mean differences in initial motivation between 69 students who dropped the course and 618 who completed the course. Next, we considered the outcome of final exam score and excluded from the analysis the 82 students who did not complete the final exam, either because they dropped the course or stayed enrolled but failed to take the exam. Using hierarchical linear regression, we examined how well interest, confidence about performance, attainment value, and utility value predicted final exam score. Before running analyses, we confirmed that the assumptions of linearity, homoscedasticity, independence, and normality were met. In the first step of each model, we entered the covariate, the two cohort dummy-codes, and in the second step, we entered all four motivation variables (i.e., confidence about performance, interest, utility value, or attainment value).

To examine the third research question concerning the moderating roles of underrepresented and well-represented gender and racial/ethnic groups in the link between initial motivation and subsequent achievement, we performed four hierarchical linear regressions . Final exam score indexed achievement; thus, the 82 students who did not complete the final exam were excluded from these analyses. Due to power considerations, we considered each

aspect of motivation independently, predicting final exam scores from interest, confidence about performance, attainment value, and utility value with four separate regression models. Before running analyses, we confirmed that assumptions were met. In the first step of each model, we entered the covariate, the two cohort dummy-codes. In the second step, we entered the initial motivation variables (i.e., confidence about performance, interest, utility value, or attainment value), as described in the previous paragraph, and also entered gender (women coded as the reference group) and racial/ethnic group (underrepresented group coded as the reference group). In the third step, we entered the two-way interaction terms: the aspect of initial motivation by gender, motivation by racial/ethnic group, and gender by racial/ethnic group. In the fourth step, we entered the three-way interaction term, aspect of initial motivation by gender by racial/ethnic group.

Cohen's d (Cohen, 1988) and partial eta squared were reported as effect size measures. Post-hoc statistical power, i.e., the probability of rejecting the null hypothesis given $\alpha = .05$, the sample size, and the effect size observed in the present study (O'Keefe, 2007; Sun et al., 2011), was reported for all analyses.

Results

Group Differences in Motivation at the Beginning of the Semester

We began our analyses by examining group differences in motivation at the beginning of the semester. Table 2 displays means and standard deviations, as well as Cohen's d and post-hoc power analyses of gender differences within underrepresented and well-represented racial/ethnic groups. Multivariate tests revealed a significant main effect of gender, $F(4, 677) = 8.52, p < .001, \eta_p^2 = .05$, Pillai's trace = .05, but a nonsignificant effect of racial/ethnic group, $F(4, 677) = 2.12, p = .08, \eta_p^2 = .01$, Pillai's trace = .01, and a nonsignificant interaction of gender by racial/ethnic

group, $F(4, 677) = 1.26, p = .28, \eta_p^2 = .007$, Pillai's trace = .01. Follow-up univariate tests of gender revealed small (Cohen, 1988) significant gender differences in confidence about performance, $F(1, 680) = 13.81, p < .001, d = 0.29$, such that men reported greater confidence about performance relative to women. By contrast, relative to men, women reported greater utility value, $F(1, 680) = 7.23, p = .01, d = -0.26$, and attainment value, $F(1, 680) = 8.35, p = .01, d = -0.25$. The gender difference for interest was very small and nonsignificant, $F(1, 680) = 0.51, p = .47, d = -0.11$, with women reporting similarly to men. As shown in Table 2, average scores on attainment value were not very different from the midpoint of response options (i.e., 4), while average scores on other aspects of motivation were all above 5, reflecting greater average importance of those aspects to participants.

In sum, we found no evidence that students from underrepresented racial/ethnic groups reported lower initial chemistry motivation relative to students from well-represented racial/ethnic groups. We found gender similarities in interest, but greater utility value and attainment value in women and greater confidence about performance in men. These patterns of gender differences and similarities were consistent across students from underrepresented and well-represented groups.

Achievement at the End of the Semester

To examine the second part of our first research question, we conducted a 2 (gender: men vs. women) by 2 (racial/ethnic group: underrepresented racial/ethnic vs well-represented racial/ethnic groups) ANCOVA with cohort as a covariate. Table 2 displays means and standard deviations, as well as effect sizes (Cohen's d) of gender differences within underrepresented and well-represented racial/ethnic groups. We found a small ($d = .30$) and significant main effect of racial/ethnic group, such that students from underrepresented racial/ethnic groups had lower final

exam scores than students from well-represented racial/ethnic groups, $F(1, 598) = 10.28, p = .001, \eta_p^2 = .02$. The main effect of gender was very small ($d = .17$) and marginally significant, $F(1, 598) = 3.82, p = .051, \eta_p^2 = .01$, such that men ($M = 69.35, SD = 15.21$) performed slightly better than women ($M = 66.62, SD = 17.32$). We found no significant interaction of gender and racial/ethnic group, $F(1, 598) = 0.55, p > .05, \eta_p^2 = .001$.

The second research question tested whether initial motivation was associated with achievement at the end of the semester. Compared to students who completed the course, students who dropped the course had significantly lower initial confidence about performance ($d = -.28$); however, students did not differ on interest, utility value, or attainment value. Full analyses appear in online Supplemental Materials. Next, we used hierarchical linear regression to assess how well interest, confidence about performance, attainment value, and utility value predicted final exam score. Step 1 produced a significant change in R^2 , such that performance varied across the three cohorts, $F(2, 602) = 3.84, p = .02, R^2 = .01$. Step 2 also produced significant change, $F(4, 598) = 13.58, p < .001, R^2 = .095$. More specifically, coefficients indicated significant and positive effects of confidence about performance, $B = 2.42, SE = .69, \beta = .15, p < .001$, and interest, $B = 2.92, SE = .81, \beta = .22, p < .001$, but nonsignificant effects of utility value, $B = -0.26, SE = .92, \beta = -.02, p = .78$, and attainment value, $B = -0.18, SE = .73, \beta = -.02, p = .80$.

Tables 3-6 display the results for the four full regression models predicting achievement from confidence, interest, utility value, and attainment value, respectively; those tables also report post-hoc power analyses. Correlations among the major variables of the regression models, separately for men and women, appear in the online Supplemental Materials. In Step 1 of each of the four regression analyses, the cohort covariates significantly predicted final exam

scores, such that performance varied across the three cohorts. In Step 2, final exam scores were significantly and positively predicted by the aspect of initial motivation entered: confidence about performance, interest, utility value, and attainment value. These findings further supported the second hypothesis, that greater endorsement of these aspects of motivation at the beginning of the semester predicted higher final exam performance at the end of the semester. Step 2 also revealed that students from underrepresented racial/ethnic groups performed less well on the exam than students from well-represented racial/ethnic groups. However, in only one model (attainment value, see Table 6) did racial/ethnic group significantly predict final exam scores.

Steps 3 and 4 of the regression models explored our third research question, that the links between motivation and achievement would be consistent among students across diverse intersectional groups. In the models examining confidence about performance, interest, and utility value, the 2-way interaction terms in Step 3 and the 3-way interaction term in Step 4 did not significantly predict final exam scores. That is, results indicated that the links from initial confidence about performance, interest, and utility value to subsequent achievement in the chemistry course were consistent across gender and racial/ethnic groups.

However, regarding attainment value, the interaction with racial/ethnic group was statistically significant (see Table 6). The interaction was probed using the PROCESS macro, Version 3 in SPSS Statistics, Version 27 (Hayes, 2018). Because the 3-way interaction term between gender, ethnicity, and attainment value and the 2-way interaction between gender and attainment value were not significant, we ran model 1 in PROCESS with attainment value as the focal predictor, final exam score as the outcome variable, ethnic/racial group as the moderator, and gender and cohort as the covariates. The interaction between attainment value and racial/ethnic group was statistically significant, $\beta = -2.99$, 95% CI [-5.00, -0.99], $p = .004$. The

conditional effects of attainment value on final exam score were strongest for students from underrepresented racial/ethnic groups, effect = 4.26, $SE = .86$, 95% CI [2.57, 5.95], $p < .001$, and weakest for students from well-represented racial/ethnic groups, effect = 1.27, $SE = .55$, 95% CI [0.19, 2.35], $p = .02$. In other words, when probed, attainment value positively predicted exam scores more strongly for Black, Latinx, and Native American students than for White and Asian American students. No other interaction effects were significant.

In sum, these regression models indicated that confidence about performance, interest, utility value, and attainment value at the beginning of the semester significantly and positively predicted final exam scores in chemistry, consistent with expectancy-value theory. In nearly all instances, this pattern was not moderated by gender, race/ethnicity, or their interaction. The model examining confidence about performance explained 8.9% of the variance in final exam scores, the model examining interest explained 10.6% of the variance in final exam scores, the model examining utility value explained 7.3% of the variance in final exam scores, and the model examining attainment value explained 8.3% of the variance in final exam scores. Considered collectively and reflecting the shared or overlapping aspects of confidence, interest, utility value, and attainment value, these components of motivation explained 9.5% of the variance in final exam scores.

Discussion

Employing an intersectional approach to expectancy-value theory (Eccles, 1994; Eccles & Wigfield, 2020), we sought to extend the literature on STEM motivation and participation by exploring chemistry motivation and achievement among undergraduates from underrepresented and well-represented gender and/or racial/ethnic groups. Introductory chemistry is a critical gateway course to undergraduate STEM majors and careers, and student motivation is just one

potential contributor to or mechanism mediating the persistent underrepresentation of women and Black, Latinx, and Native Americans in STEM education and careers.

Differences between Students from Underrepresented and Well-Represented Groups

Within an individual, motivation is plastic and complex; it develops within their dynamic social, political, and cultural contexts and thus is not a fixed attribute or characteristic (Eccles & Wigfield, 2020; Harackiewicz, Smith, & Priniski, 2016). We focused on the unique context of chemistry, which confers power and inequality based on both gender and race/ethnicity. We examined gender within that context, comparing students from the well-represented group (i.e., men) to the underrepresented group (i.e., women). Consistent with previous findings that male students report feeling greater confidence and self-efficacy in their math and science abilities (e.g., Else-Quest et al., 2010; Else-Quest et al., 2013; OECD, 2016; Pomerantz et al., 2002), men reported greater confidence about their performance in chemistry. Yet, women in our study also saw chemistry as more valuable in their everyday lives, which is consistent with previous findings of gender differences in science task value (e.g., Eccles, 2007; Else-Quest et al., 2013; Harackiewicz et al., 2016). One explanation for this nuanced pattern in motivation is that because women tend to endorse communal goals and seek professions in which they are helping people (i.e., health professions), they are better at making connections between chemistry and their everyday lives (Diekman et al., 2010). Similarly, McGee et al. (2016) found that Black engineering doctoral students reported that a desire to help others strongly motivated their persistence in engineering education. Nonetheless, finding chemistry relevant and useful does not equate with feeling competent in chemistry, though these aspects of motivation are positively correlated.

Framing racial/ethnic group by the chemistry context, we compared members of underrepresented racial/ethnic groups (i.e., Black, Latinx, and Native Americans) to members of well-represented racial/ethnic groups in STEM (i.e., White and Asian Americans) and found no evidence of group differences in confidence about performance, interest, utility value, or attainment value at the beginning of the semester. This finding is consistent with the literature examining racial/ethnic group differences in initial self-confidence in STEM (Smith et al., 2014) and other aspects of motivation in biology (Harackiewicz, Canning et al., 2016).

In terms of achievement, our findings echo prior research (e.g., Harackiewicz, Canning et al., 2016; National Science Board, 2019; Seo et al., 2019). Men only slightly outperformed women on the final exam, consistent with the gender similarities hypothesis (Hyde, 2005). We also found that students from well-represented racial/ethnic groups performed better on their final exam than students from underrepresented racial/ethnic groups. Such achievement differences stem from many complex factors, including, social, economic, educational, and political disparities (Bowen et al., 2005; Pascarella & Terenzini, 1991), which may also contribute to differences in student motivation (Eccles & Wigfield, 2020).

Initial Motivation Predicts Subsequent Achievement Across Diverse Groups

An important finding from our project is that, regardless of gender and racial/ethnic group, students with greater initial motivation for chemistry—that is, confidence about performance, interest, utility value, and attainment value at the beginning of the semester—in turn performed better on their final exam. This finding is consistent with expectancy-value theory and adds to the literature supporting these links in the model within racially or ethnically diverse samples (e.g., Else-Quest et al., 2013; Harackiewicz, Canning et al., 2016). Additionally, this finding is novel and important considering our application of intersectionality.

We explored whether gender and/or racial/ethnic group moderated the links between initial motivation and subsequent achievement, such that belonging to a group that is underrepresented in STEM might be associated with lower motivation. Yet, our findings indicated that in this particular science context at this one university, these links are generally similar across gender and racial/ethnic groups, such that the expectancy-value model explained achievement similarly across diverse intersectional groups. This finding echoes Cole's (2009) first question for intersectional research—"Where are the similarities?"—which challenges assumptions about social categories like gender and race/ethnicity. Despite psychology's disciplinary focus on finding difference, there is value in identifying commonalities, particularly across diverse groups that may be stereotyped as different. While an intersectional lens guides researchers in exploring differences across intersectional locations, it does not hypothesize that particular differences exist (Else-Quest & Hyde, 2016a). Thus, our findings may be considered as evidence that expectancy-value theory has predictive value across intersectional locations based on gender and racial/ethnic group.

Building upon the links between achievement and these aspects of motivation, interventions to promote the engagement of underrepresented groups (i.e., women and Black, Latinx, and Native American students) in STEM have included fostering the development of utility value (e.g., Casad et al., 2018; Harackiewicz & Priniski, 2018). Moreover, utility value interventions attempt to improve student motivation and achievement in STEM by asking students to think about how STEM course content is relevant or useful to their lives (Brown et al., 2015; Harackiewicz, Canning et al., 2016; Harackiewicz et al., 2008; Hulleman et al., 2008). Promoting interest in STEM may be among the best strategies to boost students' confidence about performance in their science courses (Hulleman & Harackiewicz, 2009).

Yet, one aspect of motivation—attainment value—demonstrated an especially strong link to final exam performance for students from underrepresented racial/ethnic groups. In other words, believing that chemistry achievement is important to oneself and consistent with one's identity was a more robust predictor of subsequent achievement for students from underrepresented racial/ethnic groups, relative to students from well-represented racial/ethnic groups. The greater strength of this link for students from underrepresented racial/ethnic groups may stem from the power dynamics of the social context of chemistry education and multiple social categories (Thoman et al., 2013). That is, belonging to a racial/ethnic group that is underrepresented can convey a lack of “fit” with that social context for group members (Kim et al., 2018; Rodriguez & Blaney, 2021; Tajfel & Turner, 1986), underscoring the need to draw upon other psychosocial resources (e.g., attainment value) to persist and achieve in that space. Believing one is a “science person” or that achievement in chemistry is important to one's sense of self might compensate for the potentially deleterious effects of belonging to a group that is underrepresented in that context, reflecting the more powerful role of attainment value for members of such groups. Likewise, Latina students have reported that belonging to supportive identity-based student organizations, such as groups for other Latinas in STEM, sustained their motivation and achievement in their White male-dominated STEM majors (Rodriguez & Blaney, 2021). The development and maintenance of “science identity” is contingent on a complex combination of dynamic and interconnected social, political, cultural, and intrapersonal forces (Avraamidou, 2020). If this interaction effect is replicated in additional studies, it would highlight the unique importance and complexity of attainment value to STEM achievement in students from underrepresented racial/ethnic groups and affirm the importance of intersectional approaches to broadening participation in STEM.

Strengths and Limitations

In the current study, we approached group membership based on national trends in STEM participation (NCSES, 2021), opting to compare students from underrepresented racial/ethnic groups (i.e., Black, Latinx, Native American, and Pacific Islander) to students from well-represented racial/ethnic groups (i.e., White and Asian American). This analytic strategy carries its own strengths and limitations, which vary by specific social context. In focusing on the social context of STEM, our approach also aims to avoid essentializing race/ethnicity and acknowledges the dynamic nature of the salience and meaning of such social categories, consistent with intersectionality theory (Else-Quest & Hyde, 2016a). Nonetheless, we are mindful that these are diverse racial/ethnic groups with considerable within-group heterogeneity, and thus they are not comparable in many ways. Members of all groups bring complex and unique identities and lived experiences into the classroom, which are important issues for intersectional approaches to examine.

Likewise, although our study included a diverse sample of students, representative of the overall student population at the university in which the study took place, it was not possible to make meaningful and reliable comparisons among the many distinct racial/ethnic groups that were represented within the sample or examine deeper within-group heterogeneity. For example, a limitation of how we compared groups in this sample is that all Asian/Asian American students were grouped together as well-represented racial/ethnic group. Of course, Asian and Asian American students comprise many diverse subgroups. While some Asian ethnic and cultural groups (e.g., Chinese, Indian, Korean) are well represented in STEM, others (e.g., Thai, Cambodian, Vietnamese, Hmong) are underrepresented. This aspect of diversity needs deeper and more comprehensive study, particularly within intersectional approaches. Likewise, given

that only one student self-identified as trans or non-binary, gender was examined in terms of the gender binary (i.e., cisgender men compared to cisgender women). To some extent, these lumping errors are a perennial challenge when grouping participants based on characteristics like race/ethnicity and gender (Else-Quest & Hyde, 2016b). Given the moderate sample size in the present study, the post-hoc power was low for some effects, especially for the interaction effects. Statistical tests of interaction effects often have low statistical power (Aguinis & Stone-Romero, 1997). Thus, future studies should aim to have larger samples and thus higher levels of statistical power to examine a greater number of intersectional groups and analyze within-group heterogeneity more thoroughly, or else examine the motivations of specific gender and racial/ethnic groups in greater depth. In addition, future studies should examine social categories beyond gender and race/ethnicity, such as socioeconomic status, sexuality, and disabilities.

Our sample of CHEM 101 students largely mirrors the diversity of the university's undergraduate population, such that 31.6% reported belonging to underrepresented groups (compared to 28% of all undergraduates) and 68.4% reported belonging to well-represented racial/ethnic groups (compared to 72.0% of all undergraduates). Still, the sample is somewhat selective in the sense that, while the gateway course of CHEM 101 was required for any student seeking a Bachelor of Science degree, all of our participants chose to enroll in the course. The likely result is that gender differences and racial/ethnic group differences are minimized. That is, students who would score low on the aspects of motivation we measured are likely not to register for the course, thereby reducing variance in the variables and reducing the chance to detect group differences (Durik & Harackiewicz, 2007).

Practice Implications

We sought to shed light on psychological factors relating to the persistent underrepresentation of women and Black, Latinx, and Native American students in STEM, focusing on the unique context of a gateway STEM course at a 4-year university. Because institutions of higher education were built by and for White men (Biggs et al., 2018; Grant et al., 2000; Hoff, 2020), the environment may be unwelcoming and even hostile for students from underrepresented gender and ethnic groups, particularly in male-dominated fields like chemistry (McGee, 2020; Walton et al., 2015). In finding that, at the start of the semester women, on average, from both well-represented and underrepresented racial/ethnic groups found chemistry valuable and interesting but still felt less competent, we see a clear need to better support women in STEM at this stage in their education by promoting their own sense of competence. For example, colleges and universities can do this by fostering a more supportive and welcoming environment, using inclusive teaching methods, such as removing curved grading systems from STEM courses or adopting a Universal Design approach in the classroom to better meet the needs of students from all backgrounds (e.g., Bowen & Cooper, 2022; Hogan & Sathy, 2022; Sarju & Jones, 2022; Schreffler et al., 2019; Tanner, 2013; Wilson-Kennedy et al., 2020). Administrators and educators also can support the persistence of students from diverse underrepresented groups in STEM by designing courses and curricula that give students opportunities to apply their knowledge and skills to projects with humanitarian or social justice aims, including service learning, and by offering culturally affirming content or draw upon lived experience in the classroom, such as by asking students to write “STEM biographies” (McGee, 2020). And, institutions can hire, support, and retain diverse teaching staff, especially in historically White male-dominated contexts.

In addition to inclusive teaching practices, one strategy for better supporting underrepresented students and promoting their confidence about performance lies in microaffirmations— “subtle or ambiguous kindness cues that can include tone of voice, space left between people when interacting, subtle mimicry, and actions that convey vulnerability” (Estrada et al., 2018; Estrada et al., 2019). Just as microaggressions, or subtle, everyday messages of discrimination communicated to individuals in marginalized groups (Sue & Constantine, 2007) have deleterious effects on aspects of student motivation (Ellis et al., 2019; Gayles & Smith, 2019), microaffirmations can foster a sense of competence by communicating to students from underrepresented gender and ethnic groups that they are welcome and competent in that context (Rolón-Dow & Davison, 2021). Indeed, in articulating the practice, Rowe (2008) characterized microaffirmations as “tiny acts of opening doors to opportunity, gestures of inclusion and caring, and graceful acts of listening” (p. 46). Research with undergraduate STEM students reveals that microaffirmations promote student persistence in science in part by fostering a sense of self-efficacy or competence in science (Estrada et al., 2019). Teaching staff can cultivate a learning environment and context that supports students from underrepresented groups by engaging in microaffirmations during class and in informal conversations (Seidel et al., 2015).

Our findings on the value of an intersectional approach to student motivation are consistent with trends in research on broadening participation in STEM, often highlighting the chilly or unwelcoming climates and the importance of valuing students’ identities and lived experience (e.g., McGee, 2020; Strayhorn, 2018). For example, Ong and colleagues (2018) examined the role of *counterspaces* for women of color in STEM higher education, which are defined as safe or brave spaces that exist in the margins of mainstream higher education. The

study found that women of color were able to find the support they needed to persist in STEM in these counterspaces, which included peer-to-peer relationships, mentoring relationships, national STEM diversity conferences, STEM/non-STEM student groups, and STEM departments.

Conclusion

Many students decide to leave STEM majors after taking introductory or gateway coursework, such as introductory chemistry (Hilts et al., 2018). Despite more students entering STEM majors, fewer than half complete a STEM degree within 5 years, with especially low retention rates among students from underrepresented racial/ethnic groups (Gayles & Smith, 2019; NCSES, 2021). In contributing an intersectional approach to the study of initial motivation and subsequent achievement in chemistry, our findings demonstrate that confidence about performance, interest, utility value, and attainment value are important antecedents to the STEM achievement of students from underrepresented groups, just as they are for students from well-represented groups. As these aspects of motivation are plastic, effort must be invested in cultivating contexts that promote their development and maintenance, particularly among students who are less likely to persist despite the potential to achieve, such as members of multiply-marginalized groups.

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Figure 1

The Intersectional Application and Analytic Approach in which Gender and Racial/Ethnic Group are Framed by the Context of Chemistry and Initial Motivation Predicts Subsequent Achievement.

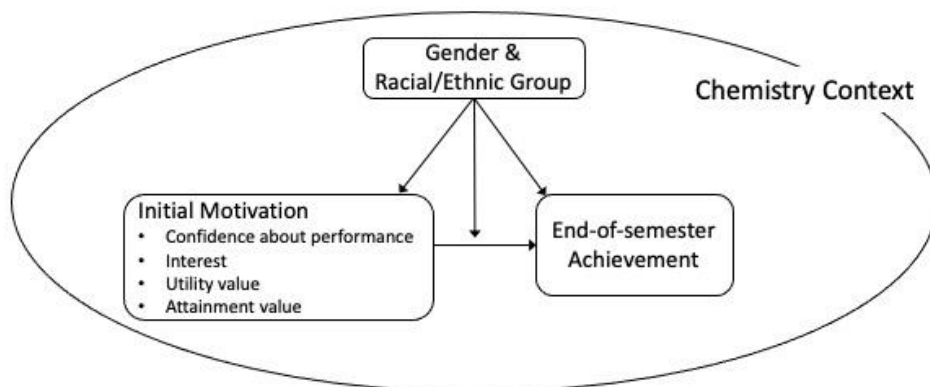


Table 1

Demographic Characteristics of Sample.

		<i>n</i>	%
Racial/Ethnic Group	Black/African American	152	22.1
	Latinx/Hispanic	55	8.0
	Native American	6	0.9
	Pacific Islander	4	0.6
	Asian/Asian American	202	29.4
	White/European American	268	39.0
Mother's Education	Elementary or Middle School	19	2.8
	High School	85	12.4
	Technical College	8	1.2
	Some College, no degree	76	11.1
	Associate's Degree	58	8.4
	Bachelor's Degree	258	37.6
	Graduate Degree	176	25.6
	N/A or unknown	4	0.6
	Chose not to respond	3	0.4
Father's Education	Elementary or Middle School	13	1.9
	High School	88	12.8
	Technical College	28	4.1
	Some College, no degree	67	9.8
	Associate's Degree	54	7.9
	Bachelor's Degree	220	32.0
	Graduate Degree	199	29.0
	N/A or unknown	14	2.0
	Chose not to respond	4	0.6
Household Income	<\$15,000	8	1.2
	\$15,001 - \$25,000	29	4.2
	\$25,001 - \$35,000	47	6.8
	\$35,001 - \$50,000	61	8.9
	\$50,001 - \$75,000	113	16.4
	\$75,001 - \$100,000	131	19.1
	\$100,001 - \$150,000	156	22.7
	>\$150,000	100	14.6
	Chose not to respond	42	6.1
	Full sample	687	100.0

Table 2

Gender Differences in Initial Motivation and Subsequent Achievement within Underrepresented Racial/Ethnic Groups (i.e., Black, Latinx, and Native American) and Well-Represented Racial/Ethnic Groups (i.e., White, Asian American).

	Total <i>M (SD)</i>	Women <i>M (SD)</i>	Men <i>M (SD)</i>	Cohen's <i>d</i> ^a	Post-hoc power
<i>Confidence About Performance</i>					
Underrepresented	5.49 (1.05)	5.36 (1.03)	5.66 (1.06)	0.28	0.54
Well-represented	5.36 (1.00)	5.20 (1.02)	5.50 (0.96)	0.30	0.91
Total	5.40 (1.02)	5.26 (1.03)	5.55 (0.99)	0.29	0.96
<i>Interest</i>					
Underrepresented	5.21 (1.32)	5.16 (1.29)	5.27 (1.35)	0.08	0.09
Well-represented	5.28 (1.20)	5.41 (1.16)	5.16 (1.22)	-0.21	0.64
Total	5.26 (1.24)	5.33 (1.21)	5.19 (1.26)	-0.11	0.30
<i>Utility Value</i>					
Underrepresented	5.43 (1.05)	5.48 (1.04)	5.36 (1.07)	-0.11	0.13
Well-represented	5.35 (1.03)	5.53 (1.00)	5.20 (1.03)	-0.32	0.94
Total	5.38 (1.04)	5.51 (1.01)	5.24 (1.05)	-0.26	0.93
<i>Attainment Value</i>					
Underrepresented	4.76 (1.38)	4.88 (1.35)	4.61 (1.41)	-0.20	0.31
Well-represented	4.71 (1.41)	4.91 (1.34)	4.53 (1.45)	-0.27	0.85
Total	4.73 (1.40)	4.90 (1.34)	4.55 (1.44)	-0.25	0.91
<i>Final Exam Score</i>					
Underrepresented	64.60 (16.86)	63.05 (18.05)	66.56 (15.00)	0.21	0.11
Well-represented	69.44 (15.94)	68.42 (16.70)	70.38 (15.19)	0.12	0.07
Total	66.41 (18.70)	65.71 (18.53)	67.02 (18.86)	0.07	0.15

^a Positive values of Cohen's *d* reflect higher scores among men.

Note: Confidence, interest, utility value, and attainment value were rated on a scale from 1 to 7. Final exam score is the percent correct on the exam.

Table 3

Confidence About Performance (CP) at the Beginning of the Semester Predicts End-of-Semester Achievement Across Gender and Racial/Ethnic Groups (n = 605).

	Model 1				Model 2				Model 3				Model 4			
	<i>B</i>	<i>SE B</i>	β	Post -hoc pwr.	<i>B</i>	<i>SE B</i>	β	Post -hoc pwr.	<i>B</i>	<i>SE B</i>	β	Post -hoc pwr.	<i>B</i>	<i>SE B</i>	β	Post -hoc pwr.
Cohort-1 ^a	-3.63	1.64	-0.10*	0.71	-2.49	1.60	-0.07	0.34	-2.65	1.61	-0.08	0.38	-2.65	1.61	-0.08	0.38
Cohort-2	0.39	1.62	0.01	0.05	0.65	1.56	0.02	0.07	0.51	1.57	0.02	0.06	0.48	1.57	0.14	0.06
CP					3.61	0.65	0.23***	1.00	3.54	0.65	0.22***	0.90	3.59	0.65	0.22***	0.50
Gender ^b					1.10	1.30	0.03	0.14	8.22	7.21	0.25	0.24	7.84	7.20	0.24	0.07
Rac./eth. group ^c					5.18	1.40	0.15***	0.96	4.34	7.74	0.12	0.11	6.29	7.85	0.18	0.07
CP x Gender									-1.30	1.30	-0.22	0.17	-1.25	1.30	-0.21	0.10
CP x Rac./Eth.									0.14	1.38	0.02	0.05	-0.15	1.40	-0.02	0.18
Gen. x Rac./Eth.									-2.06	2.87	-0.03	0.11	20.44	15.68	0.29	0.26
CP x Gen. x Rac./Eth.													-4.08	1.29	-0.32	0.31
<i>R</i> ² change	0.01				0.07				0.002				0.003			
<i>F</i> change	3.73*				15.57***				0.47				2.13			

^a Cohort-1 is coded 0 (Cohort I) and 1 (Cohorts II & III); Cohort-2 is coded 0 (Cohort III) and 1 (Cohorts I & II).

^b Gender is coded 0 (female) and 1 (male).

^c Racial/Ethnic group is coded 0 (underrepresented racial/ethnic groups) and 1 (well-represented racial/ethnic groups).

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4

Interest (I) at the Beginning of the Semester Predicts End-of-Semester Achievement Across Gender and Racial/Ethnic Groups (n = 605).

	Model 1				Model 2				Model 3				Model 4			
	<i>B</i>	<i>SE B</i>	β	Post -hoc pwr.	<i>B</i>	<i>SE B</i>	β	Post -hoc pwr.	<i>B</i>	<i>SE B</i>	β	Post -hoc pwr.	<i>B</i>	<i>SE B</i>	β	Post -hoc pwr.
Cohort-1 ^a	-3.63	1.64	-0.10*	0.71	-3.12	1.58	-0.09*	0.51	-3.16	1.58	-0.09*	0.51	-3.16	1.59	-0.09*	0.51
Cohort-2	0.39	1.62	0.01	0.05	0.70	1.55	0.02	0.07	0.74	1.55	0.02	0.08	0.73	1.56	0.02	0.08
I					3.38	0.52	0.25***	1.00	3.34	0.53	0.25***	1.00	3.35	0.53	0.25***	0.99
Gender ^b					2.81	1.27	0.09*	0.60	9.38	5.75	0.29	0.37	9.43	5.76	0.29	0.14
Rac./eth. group ^c					4.43	1.39	0.13***	0.89	13.69	6.03	0.39*	0.63	13.72	6.04	0.39*	0.34
I x Gender									-1.26	1.06	-0.21	0.22	-1.27	1.06	-0.21	0.09
I x Rac./Eth.									-1.78	1.11	-0.27	0.36	-1.79	1.11	-0.27	0.18
Gen. x Rac./Eth.									-0.75	2.79	-0.01	0.06	1.17	12.05	0.02	0.05
I x Gen. x Rac./Eth.													-0.37	2.22	-0.03	0.05
<i>R</i> ² change	0.01				0.09				0.01				0.00			
<i>F</i> change	3.73*				19.14***				1.51				0.03			

^a Cohort-1 is coded 0 (Cohort I) and 1 (Cohorts II & III); Cohort-2 is coded 0 (Cohort III) and 1 (Cohorts I & II).

^b Gender is coded 0 (female) and 1 (male).

^c Racial/Ethnic group is coded 0 (underrepresented racial/ethnic groups) and 1 (well-represented racial/ethnic groups).

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 5

Utility Value (UV) at the Beginning of the Semester Predicts End-of-Semester Achievement Across Gender and Racial/Ethnic Groups (n = 605).

	Model 1				Model 2				Model 3				Model 4			
	<i>B</i>	<i>SE B</i>	β	Post -hoc pwr.	<i>B</i>	<i>SE B</i>	β	Post -hoc pwr.	<i>B</i>	<i>SE B</i>	β	Post -hoc pwr.	<i>B</i>	<i>SE B</i>	β	Post -hoc pwr.
Cohort-1 ^a	-3.63	1.64	-0.10*	0.71	-3.97	1.61	-0.11*	0.69	-4.15	1.63	-0.12*	0.72	-4.19	1.63	-0.12*	0.73
Cohort-2	0.39	1.62	0.01	0.05	0.34	1.58	0.01	0.06	0.24	1.58	0.01	0.05	0.24	1.58	0.01	0.05
UV					2.67	0.62	0.17***	0.99	2.69	0.63	0.17***	0.97	2.67	0.63	0.17***	0.95
Gender ^b					3.01	1.30	0.09*	0.63	11.31	6.93	0.35	0.42	11.37	6.93	0.35	0.35
Rac./eth. group ^c					4.85	1.41	0.14***	0.93	16.06	7.41	0.45*	0.61	16.06	7.42	0.45*	0.55
UV x Gender									-1.55	1.26	-0.26	0.23	-1.56	1.26	-0.26	0.24
UV x Rac./Eth.									-2.10	1.34	-0.33	0.34	-2.08	1.34	-0.32	0.35
Gen. x Rac./Eth.									-2.10	2.84	-0.03	0.11	-11.98	14.82	-0.17	0.13
UV x Gen. x Rac./Eth.													1.82	2.68	0.14	0.10
<i>R</i> ² change	0.01				0.05				0.01				0.001			
<i>F</i> change	3.73*				11.19***				1.52				0.46			

^a Cohort-1 is coded 0 (Cohort I) and 1 (Cohorts II & III); Cohort-2 is coded 0 (Cohort III) and 1 (Cohorts I & II).

^b Gender is coded 0 (female) and 1 (male).

^c Racial/Ethnic group is coded 0 (underrepresented racial/ethnic groups) and 1 (well-represented racial/ethnic groups).

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 6

Attainment Value (AV) at the Beginning of the Semester Predicts End-of-Semester Achievement Across Gender and Racial/Ethnic Groups (n = 605).

	Model 1				Model 2				Model 3				Model 4			
	<i>B</i>	<i>SE B</i>	β	Post -hoc pwr.	<i>B</i>	<i>SE B</i>	β	Post -hoc pwr.	<i>B</i>	<i>SE B</i>	β	Post -hoc pwr.	<i>B</i>	<i>SE B</i>	β	Post -hoc pwr.
Cohort-1 ^a	-3.63	1.64	-0.10*	0.71	-3.55	1.60	-0.10*	0.60	-3.36	1.60	-0.10*	0.55	-1.60	1.85	-0.10*	0.55
Cohort-2	0.39	1.62	0.01	0.05	0.77	1.58	0.02	0.08	0.80	1.57	0.02	0.08	0.80	1.57	0.02	0.08
AV					2.14	0.47	0.18***	1.00	2.21	0.47	0.19***	0.99	2.21	0.47	0.19***	0.95
Gender ^b					2.99	1.30	0.09*	0.63	1.94	4.67	0.06	0.10	1.93	4.69	0.06	0.07
Rac./eth. group ^c					4.69	1.41	0.13*	0.91	19.25	5.12	0.54***	0.97	19.25	5.13	0.54***	0.80
AV x Gender									0.19	0.94	0.03	0.06	0.19	0.94	0.03	0.05
AV x Rac./Eth.									-3.06	1.03	-0.43**	0.84	-3.07	1.03	-0.43**	0.56
Gen. x Rac./Eth.									-2.01	2.82	-0.03	0.11	-1.70	10.24	-0.02	0.05
AV x Gen. x Rac./Eth.													-0.07	2.06	-0.01	0.05
<i>R</i> ² change	0.01				0.06				0.01				0.00			
<i>F</i> change	3.73*				12.11***				3.05*				0.00			

^a Cohort-1 is coded 0 (Cohort I) and 1 (Cohorts II & III); Cohort-2 is coded 0 (Cohort III) and 1 (Cohorts I & II).

^b Gender is coded 0 (female) and 1 (male).

^c Racial/Ethnic group is coded 0 (underrepresented racial/ethnic groups) and 1 (well-represented racial/ethnic groups).

* $p < .05$. ** $p < .01$. *** $p < .001$.