# Factors Predicting Out-of-Class Participation for Underrepresented Groups in STEM

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## Abstract

Undergraduate student participation in out-of-class activities yields a range of documented benefits and represents an area of study that can inform efforts to increase persistence in science, technology, engineering or mathematics (STEM) majors, particularly for underrepresented groups. This study was designed to explore how selected engagement and demographic factors might predict participation in out-of-class activities by undergraduate students pursuing STEM degrees. We surveyed 909 undergraduate STEM students from five universities in the United States with a focus on institutions that awarded STEM degrees to a relatively high number of underrepresented students. Logistic regression was used to build a prediction model of out-of-class activity participation using six affective engagement factors and student demographic factors. Significant results were found for year in college, generation in college, high school participation profile, and type of institution. There were also significant interaction effects involving generation in college and major valuing with race/ethnicity and gender. The model suggests actionable steps to help improve undergraduate STEM student participation in out-of-class activities.

*Keywords*: co-curricular activities, affective engagement, first generation in college, women, extracurricular activities, out-of-class activities, underrepresented groups

## Introduction

For any undergraduate student, the college experience is a combination of in-class and out-of-class activities (OCAs). College students have a limited amount of time and energy; therefore, students must make choices about how to spend their time (Astin, 1984). College students can choose to be involved in a range of experiences that are related to academic content to varying degrees. In-class activities have been the dominant focus of research examining the college experience, yet undergraduate students spend only 7.7% of their waking hours in a formal learning setting (Bell, Lewenstein, Shouse, & Feder, 2009). Undergraduate students in the United States (U.S.) are spending less time on coursework than they did 40 years ago and less time in comparison to their European contemporaries (Bok, 2013). The decreased formal learning time provides a greater opportunity to explore the importance and value of what undergraduate students are doing outside of class.

A growing body of research suggests a range of benefits (e.g., improved persistence and retention, increased academic achievement) associated with college students' participation in out-of-class activities (Mayhew et al., 2016; Simmons & Groen, 2018). Given these benefits, educators would benefit from a clear understanding of student participation in OCAs; yet, few studies have explored undergraduate STEM students' participation in OCAs beyond perceived and documented outcomes. Understanding STEM students' involvement in OCAs takes on increased importance when working with students from underrepresented groups. Despite significant efforts to increase the number of STEM majors from underrepresented groups, the STEM fields in the U.S. do not accurately reflect the diversity of the country (Lisberg & Woods, 2018; NCSES, 2019; Pierszalowski, Vue, & Bouwma-Gearhart, 2018; Starks & Matthaeus, 2018). An underrepresented group in this study describes a subset whose representation in education and employment is smaller than their representation in the U.S. population (NCSES, 2019). While students from underrepresented groups in STEM may have the most to gain from participation in OCAs, they may also have lower levels of engagement in OCAs when compared to their peers (Simmons, Ye, Ohland, & Garahan, 2018; Wasley, 2006; Zell, 2010). The purpose of this study is to provide an improved understanding of factors that predict STEM students' participation in OCAs. A better understanding of OCA participation would support efforts to improve the persistence and retention of students, including students from underrepresented groups in STEM.

## Literature Review

OCAs encompass an immense variety of activities that can include time spent doing homework, working an on- or off-campus job or internship, hanging out with friends, participating in club activities, engaging with social media, and playing sports, among others. Based on the level of connection to formal coursework, Simmons, Creamer, and Yu (2017) defined three types of OCAs: curricular, co-curricular, and extracurricular. Curricular activities connect directly to student coursework and include homework, studying, and group projects. Co-curricular activities are more loosely tied to the formal curriculum, such as internships and undergraduate research. Extracurricular activities are not connected to a particular class or plan of study. Examples of extracurricular activities include sports, social clubs, and jobs.

Researchers have identified numerous benefits of undergraduate student participation in curricular, co-curricular, and extracurricular activities, such as academic achievement; cognitive, intellectual, moral, and psychosocial development; college engagement and persistence; and career readiness and attainment (Mayhew et al., 2016; Simmons & Groen, 2018). Descriptions of high impact educational practices in higher education frequently include curricular and co-curricular activities such as group projects, internships, learning communities, undergraduate research, and service learning (Association of American Colleges and Universities & National Leadership Council, 2007; Kuh & O'Donnell, 2013; Webber, Krylow, & Zhang, 2013).

Focusing on STEM undergraduate students, Table 1 shows some of the positive outcomes that researchers have suggested can result from OCA participation, with much of the research focusing on curricular and co-curricular activities. Table 2 shows examples of positive outcomes of OCAs specifically for members of underrepresented groups in STEM.

In this study, student engagement is defined as the degree to which learners engage with educational activities (Simmons, Ye, Hunsu, & Adesope, 2017). Few studies have explored engagement factors in OCAs and most of the scant literature that has examined engagement and OCAs has focused on undergraduate students in general, not on STEM students specifically. For example, three studies examined undergraduates students in the United Kingdom and Switzerland and reported that students participate in OCAs mainly for personal reasons such as wanting to have fun, desiring social interaction and a sense of belonging, looking for stress relief, and wanting to do something meaningful (Clark, Marsden, Whyatt, Thompson, & Walker, 2015; Roulin & Bangerter, 2013;

| Author, Date | Examined OCAs | Reported positive outcomes |
|---|---|---|
| Thiry, Laursen, and Hunter (2011) | Internships, clinical work, and undergraduate research experiences | Development of professional and scientific identities and learning gains |
| Schneider, Bickel, and Morrison-Shetlar (2015) | Living-learning community | Improved critical thinking skills, GPA, and retention in a STEM major |
| Carter, Ro, Alcott, and Lattuca (2016) | Undergraduate research experiences | Improved communication skills |
| Lewis (2017) | Research internships and public-engagement volunteer experiences | Improved professional skills and employability |
| Stanford, Rocheleau, Smith, and Mohan (2017) | Undergraduate research experiences | Increased retention rates and learning gains |
| Najmr et al. (2018) | Chemistry course with service-learning activities | Improved scientific communication skills |
| Goralnik, Thorp, and Rickborn (2018) | Field-based group projects | Development of STEM identities |

**Table 1. Selected Studies Reporting Positive Outcomes Associated with Participation in OCAs**

| Author, Date | Study sample | Examined OCAs | Reported positive outcomes |
|---|---|---|---|
| Espinosa (2011) | Undergraduate STEM women | STEM-related student organizations and undergraduate research | Increased persistence |
| Palmer, Maramba, and Dancy (2011) | Students from underrepresented groups in STEM | STEM-related student organizations and STEM summer programs | Increased persistence and retention |
| Maltby, Brooks, Horton, and Morgan (2016) | Underrepresented minority and first-generation in college (FGC) women undergraduates | Living-learning community | Increased persistence |
| Hernandez, Woodcock, Estrada, and Schultz (2018) | Students from underrepresented groups in STEM | Faculty-mentored research | More likely to graduate with a science major, get accepted into a graduate science program, and remain in a science field after graduation |

**Table 2. Selected Studies of Students from Underrepresented Groups in STEM Reporting Positive Outcomes Associated with Participation in OCAs**

Thompson, Clark, Walker, & Whyatt, 2013). Tran (2017) studied Vietnamese undergraduates and found that levels of engagement in OCAs differed based on field of study and year in college. Tran also identified factors that impeded out-of-class involvement, such as lack of time and negative perceptions of OCAs. In one study that did focus specifically on a subset of STEM students, Simmons et al. (2018) reported that civil engineering undergraduates participate in OCAs to fulfill personal interests and face barriers to participation due to lack of time and scheduling conflicts.

## Affective Engagement in OCAs

Student engagement has been strongly linked to achievement and learning (Kahu, 2013) and researchers have embraced its role in increasing persistence in STEM majors and careers (Sinatra, Heddy, & Lombardi, 2015). Although no universal definition of student engagement has been agreed upon by scholars, the term has been repeatedly identified as comprising three dimensions: cognitive, behavioral, and affective engagement (Fredricks, Blumenfeld, & Paris, 2004; Jimerson, Campos, & Greif, 2003). Affective engagement focuses on students' emotions (an internal process) toward their school, program of study, instructors, classmates, and classwork (Reschly & Christenson, 2012) and consists of feelings of involvement (e.g., belonginess, connectedness) and valuing (e.g., enthusiasm, satisfaction, enjoyment; Finn & Zimmer, 2012; Skinner & Pitzer, 2012). In terms of outcomes of affective engagement, previous research has suggested an indirect link between affective engagement and academic achievement, and direct links between affective engagement and academic motivation, persistence, and learning behaviors (Appleton, Christenson, & Furlong, 2008; Finn & Zimmer, 2012; Lawson & Lawson, 2013; Osterman, 2000). Additionally, Appleton et al. (2008) has described a mutually reinforcing relationship between affective engagement and student participation in school activities.

Affective engagement is an understudied area in higher education as much of the existing research on student engagement in higher education has adopted a behavioral perspective (i.e., focuses on effective teaching practice) of engagement (Beard, Clegg, & Smith, 2007; Kahu, 2013; Zhoc, Webster, King, Li, & Chung, 2019). However, a growing number of studies have examined sense of belonging (one aspect of affective engagement), particularly as it relates to persistence and retention in STEM fields (e.g., Good, Rattan, & Dweck, 2012; Johnson, 2012; Rainey, Dancy, Mickelson, Stearns, & Moller, 2018; Wilson et al., 2015). Very few studies have examined the connection between affective engagement and OCA participation of college students. One exception is a study by Zhoc et al. (2019) in which they reported the development of a survey instrument to measure student engagement. Based on survey results, Zhoc et al. (2019) suggested participation in OCA leads to stronger feelings of belonging.

To help address this gap in the higher education literature, this study focuses on the role of affective engagement for predicting college student participation in OCAs (with a focus on STEM students). Additionally, as researchers have suggested affective engagement impacts the other dimensions of student engagement, a better understanding of affective engagement will support an improved understanding of student engagement more broadly (Jimerson et al., 2003; Reschly & Christenson, 2012; Simmons, Ye, Hunsu, & Adesope, 2017). We build on previous research that has identified discrete and measurable factors of affective engagement using survey items from the Postsecondary Student Engagement (PosSE) Survey, which explores student participation in OCAs (Simmons, Ye, Hunsu, & Adesope, 2017).

## Study Purpose

The purpose of this study was to identify factors that predict undergraduate STEM students' participation in OCAs with a focus on affective engagement factors. We sought quantifiable evidence to inform a model of undergraduate STEM student involvement in OCAs. Additionally, we explored the role of gender and race/ethnicity in undergraduate STEM student involvement in OCAs. Our research questions were:

1. What factors predict undergraduate STEM students' participation in OCAs?
2. Do these identified factors differ based on gender and race/ethnicity?
    a. Are the factors that predict undergraduate STEM students' participation in OCAs different for men versus women?

b. Are the factors that predict undergraduate STEM students' participation in OCAs different based on race/ethnicity?

# Methods

## Data Collection

The data in this study were derived from selected responses to the PosSE Survey, an instrument comprised of questions about students' participation in OCAs; reasons for and outcomes of their participation; levels of engagement; and student demographic and background information. Confirmatory Factor Analysis (CFA) was previously conducted to provide evidence for the instrument's validity and reliability (Simmons, Hunsu, & Adesope, 2019). For this study, responses were analyzed from the following questions:

- A dichotomous (Yes/No) item that asked if students had participated in OCAs while in college
- A dichotomous (Yes/No) item that asked if students had participated in OCAs while in high school
- 8 demographic questions that asked for students' (1) gender, (2) race/ethnicity, (3) year in college, (4) generation in college, (5) family income, (6) STEM major, (7) U.S. Citizenship Status, and (8) name of their institution.
- 23 Likert items (4-point scale; 1=Strongly Disagree, 2=Disagree, 3=Agree, 4=Strongly Agree) that asked about various aspects of student engagement (The 23 items and their associated factors are provided in the Appendix.)

The 23 Likert items were included to measure six factors of affective student engagement identified in a previous study using exploratory and confirmatory analysis (Simmons et al., 2019). The following six factors comprise a model of student engagement in OCAs and were used in the logistic regression model for this study:

- *Major Satisfaction*: 5 items asked if students were happy with and enthusiastic about their major, if they had plans to change their major, and if they found their major interesting.
- *Academic Discipline Belonging:* 3 items asked students if they felt like they were part of their academic discipline and if they were emotionally attached to their discipline.
- *Major Valuing*: 3 items asked students about the importance of doing well in their major.
- *Achievement Striving*: 5 items asked students about their willingness to overcome obstacles and ability to identify opportunities.
- *Peer Interaction*: 4 items asked if students discussed different types of issues with their peers.
- *Positive Faculty Relationship:* 3 items asked students how they felt about instructors and faculty in their major program of study.

Data for the study were obtained from a total of 909 STEM undergraduate students who responded to the PosSE Survey during a two-year time period from 2015 to 2017. The survey was distributed at 5 four-year, large, public universities located in the southern and mid-Atlantic regions of the U.S. Four of the universities are classified as having very high research activity and the fifth university is classified as having high research activity (Carnegie Classification of Institutions of Higher Education, n.d.). Two of the universities are Predominantly White Institutions (PWIs), two are Hispanic-Serving Institutions (HSIs), and one is a Historically Black College and University (HBCU). The institutions selected for sampling were ones where a significant number of STEM degrees are awarded to women and underrepresented racial/ethnic groups, which ensured our sampling included students from underrepresented groups in STEM. The survey was administered online and distributed using existing listservs at the university, college, and departmental levels. Several instructors were asked to announce the survey during class and to encourage their students to complete the survey. To increase the response rate, survey participants were entered into a drawing for gift cards.

# Data Analysis

This study identifies prediction factors of OCA participation by focusing on the differences between students who participated in OCAs and students who did not participate in OCAs. The study introduces two different models driven by the two main reseach questions: *What factors predict undergraduate STEM students' participation in OCAs? and Do these identified factors differ based on gender and race/ethnicity?* The outcome variable of participation in OCAs was derived from responses to the dichotomous question that asked students if they participated in OCAs during college. Since the outcome variable of undergraduate participation in OCAs is binary, we used binary logistic regression to construct the models. Across the models, a total of ten variables were selected for inclusion based on prior research suggesting each variable as potentially impacting participation in OCAs. The ten variables were: affective engagement (Appleton et al., 2008), citizenship status (Wilson et al., 2014), family income (Kezar et al., 2015), gender (Polmear, Anh, & Simmons, 2021), generation in college (Pike & Kuh, 2005), high school participation in OCAs (Roulin & Bangerter, 2013), institution (Ponjuán & Hernández, 2020), race/ethnicity (Polmear et al., 2021), type of STEM major (Estrada, 2014), and year in college (Foubert & Grainger, 2006).

Model 1 used six affective engagement factors and the variables of citizenship status, family income, generation in college, high school OCAs participation, type of institution, type of STEM major, and year in college to estimate the probability of a student participating in any out-of-class activity relative to a nonparticipating student. Each of these measures was calcualted as described below:

- The measures of student engagement were calculated as a composite score on the relative engagement items associated with each of the six engagement factors: Major Satisfaction, Academic Discipline Belonging, Major Valuing, Achievement Striving, Peer Interaction, and Positive Faculty Relationship.
- For citizenship status, the survey asked students to select the statement that best described them. We grouped responses of "U.S. Citizen: born in the U.S." and "U.S. Citizen: naturalized" into one group and responses of "Permanent Resident" and "International Student (on F-1 or J-1 visa)" into a second group.
- For family income, the survey asked the income level of the respondent's household. According to the U.S. Census Bureau, the median household income in the United States in 2018 was $61,937 (Guzman, 2019). We grouped responses of family income below $60,000 into one group and responses indicating family income level above $60,000 into another group.
- For generation in college, the survey asked students the highest level of formal schooling completed by their parents/guardians. Students having at parents/guardians with the highest level of formal schooling completed below a Bachelor's or other 4-year degree were classified as First Generation in College (FGC) students in this study.
- For high school participation in OCAs, students who indicated "yes" they had participated in OCAs in high school were grouped into one group and students who indicated "no" were grouped into another group.
- For type of institution, students were grouped based on whether they attended a PWI, HSI, or HBCU.
- For type of STEM major, students were grouped as either an engineering major (engineering or construction) or non-engineering major (science, technology, or mathematics).
- For year in college, students were grouped into first year, sophomore, junior, senior, or fifth year to align with the answer options provided on the survey.

Within each model, responses with missing values were removed from the analysis. Controls for these effects did not alter any of the statistically significant results or substantive interpretations.

In Model 2 the interaction terms between gender and race/ethnicity with the aforementioned variables from Model 1 were introduced to examine the combined effects of gender and race/ethnicity on student participation in OCAs. We measured gender as either men or woman and race/ethnicity as either an underrepresented group (African Americans, American Indians/Alaska Natives, and Latinos) or overrepresented group (all other groups).

## Results

The full sample for this study consisted of 909 undergraduate STEM students who completed the PosSE Survey. Descriptive statistics for the sample are provided in Table 3. Across our sample, 41.9% of students were women, and 48.2% were from racial and ethnic groups that are underrepresented in STEM fields in the U.S. Most students (83.9%) majored in engineering or construction. More than half (65.3%) of our sampled students came from two Predominantly White Institutions (PWIs), and a majority of students in the sample (87.7%) hold U.S. citizenship.

Descriptive statistics of the six affective engagement factors are shown in Table 4. CFA was used to provide evidence for the validity and reliability of the six-factor affective engagement model. The final CFA model included items with standardized loading ranging from .652 to .931. The model fit indices are $\chi2(df = 215) = 1473.31$, GFI = .906, CFI = .932, RMSEA = .066, and SRMR = .047, which provides evidence for construct validity. Cronbach's alpha ranged from .821 to .902, which also provides evidence for construct reliability.

On average, the majority of students (82.8%) in our sample had participated in OCAs during college, and most students (88.4%) had also participated in OCAs when they were in the high school. 35.3% of the sampled students were FGC students. Almost half (42.2%) of the students came from families with an annual income less than $60,000. Survey respondents reported a mean value of between 3.004 to 3.424 on the engagement factors (on a scale from 1 to 4).

*Summary of Students' Demographics (N = 909)*

| Variable | N | % |
|---|---|---|
| Gender | | |
| Women | 381 | 41.9% |
| Men | 528 | 58.1% |
| Race/Ethnicity | | |
| Underrepresented Groups | 438 | 48.2% |
| Overrepresented Groups | 471 | 51.8% |
| Year in College | | |
| First year | 223 | 24.5% |
| Sophomore | 170 | 18.7% |
| Junior | 222 | 24.4% |
| Senior | 236 | 26.0% |
| Fifth year and beyond | 58 | 6.4% |
| Generation in College | | |
| First Generation in College (FGC) | 321 | 35.3% |
| Continuing Generation in College (CGC) | 588 | 64.7% |
| Family Income | | |
| ≤ $60,000 | 384 | 42.2% |
| > $60,000 | 525 | 57.8% |
| High School OCA Participation | | |
| Yes | 804 | 88.4% |
| No | 105 | 11.6% |
| STEM Major | | |
| Engineering | 763 | 83.9% |
| Non-Engineering (Science, Technology, Mathematics) | 146 | 16.1% |
| U.S. Citizenship Status | | |
| US Citizen | 797 | 87.7% |
| Non-US Citizen | 112 | 12.3% |
| Institutions | | |
| Predominantly White Institutions (PWI) | 594 | 65.3% |
| Hispanic-Serving Institutions (HSI) | 253 | 27.8% |
| Historically Black Colleges and Universities (HBCU) | 62 | 6.8% |
| Current OCA Participation | | |
| Yes | 753 | 82.8% |
| No | 156 | 17.2% |

**Table 3. Summary of Students' Demographics (N = 909)**

| Variable | Mean | Std. Dev. |
|---|---|---|
| Major Satisfaction | 3.391 | .522 |
| Academic Discipline Belonging | 3.004 | .768 |
| Major Valuing | 3.424 | .562 |
| Achievement Striving | 3.175 | .517 |
| Positive Faculty Relationship | 3.205 | .563 |
| Peer Interaction | 3.161 | .628 |

**Table 4. Measures and Associated Descriptive Statistics (Continuous Variables)**

## Part I: Factors that Predict STEM Students' Participation in OCAs

Table 6 lists the key results from Model 1. The overall Nagelkerke R2 of Model 1 is .172. The Nagelkerke R2 reflects the amount of variation accounted for by the logistic model, with 1.0 indicating perfect model fit (Hair et al., 2019). We identified four significant factors that predict STEM students' participation in OCAs. The four factors were year in college, generation in college, high school OCA participation, and type of institution. The odds ratio of year in college was 1.255 ($p < .01$), which indicated the odds of participation in OCAs increase by a factor of 1.255 for each year. First generation in college students were .566 less likely to participate in OCAs than continuing generation in college students. Students' previous participation in OCAs during high school was also shown as a strong predictor ($p < .01$) of their current OCA participation. Students who participated in OCAs during high school are almost two times more likely (1.900) to participate in OCAs during college. We also note that students from HSIs and HBCUs showed levels of high significance ($p < .001$) for participation in OCAs. The results indicate that students from HSIs and HBCUs are about .339 and .291 times less likely to participate in OCAs compared to students in PWIs.

## Part II: Differences in Student Affective Engagement Based on Gender and Race/Ethnicity Group

Table 6 lists the estimates from the main effect models and interaction models separately. Each student demographic characteristics variable (gender and race/ethnicity) was added separately to the model to answer research questions 2a and 2b. Columns 2 and 3 of Table 6 show the odds ratios of the two regression models without any interaction terms. These two models are constructed to analyze the main effects of each prediction factor when adding gender and race/ethnicity. Women were 1.512 times more likely to participate in OCA than men. When comparing Table 5 and Table 6, the effects of year in college, generation in college, high school OCA participation, and type of institution are observed as not having major changes when introducing gender and race/ethnicity into Model 1. These results strengthened the estimate results in Table 5.

Columns 4 and 5 of Table 6 show the estimates of the two regression models with the interaction terms of gender and race/ethnicity. We found three significant estimates for the interaction terms of gender with first generation in college ($p < .01$), race/ethnicity with *Ma-*

*jor Valuing* ($p < .001$). Although Model 1 indicates first generation in college students generally are less likely to participate in OCAs, Model 2 found generation in college had different impacts on women and men. Specifically, first generation in college women are 3.371 times more likely to participate in OCAs than the other three groups (first generation in college men, continuing generation in college women, and continuing generation in college men).

Although *Major Valuing* and race/ethnicity did not show significant estimates, their interaction term did. The results indicate underrepresented students with high *Major Valuing* are 3.074 more likely to participate in OCAs compared to other groups (overrepresented groups with either low or high Major Valuing and underrepresented group with low Major Valuing). The Nagelkerke R2 of the main effect models with gender is .179 and with race/ethnicity is .177. For the interaction effect models, the Nagelkerke $R^2$ for model with gender is .207 and model with race/ethnicity is .202.

*Regression Results from Model 1*

| Variable | Beta | Std. Error | Odds Ratio |
|---|---|---|---|
| Constant | -.507 | .851 | .602 |
| Affective Engagement | | | |
| Major Satisfaction | .077 | .260 | 1.081 |
| Academic Discipline Belonging | .022 | .143 | 1.022 |
| Major Valuing | .208 | .216 | 1.231 |
| Achievement Striving | .376 | .233 | 1.456 |
| Positive Faculty Relationship | -.140 | .214 | .869 |
| Peer Interaction | .158 | .164 | 1.172 |
| Year in College | .227 | .078 | 1.255** |
| First Generation in College | -.569 | .209 | .566** |
| Family Income (≤ $60,000) | -.206 | .226 | .814 |
| Participated in High School OCA | .642 | .256 | 1.900** |
| Engineering Major | -.508 | .295 | .602 |
| US Citizen | -.046 | .271 | .955 |
| Institution | | | |
| HSI | -1.082 | .234 | .339*** |
| HBCU | -1.233 | .345 | .291*** |

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

Table 5. Regression Results from Model 1

| Variable | Odds Ratio | | | |
|---|---|---|---|---|
| | Main Eff. Model | | Interaction Eff. Model | |
| | With Gender | With Race/Eth. | With Gender | With Race/Eth. |
| Constant | .517 | .564 | .338 | .314 |
| Affective Engagement | | | | |
| Major Satisfaction | 1.087 | 1.096 | 1.234 | 1.330 |
| Academic Discipline Belonging | 1.017 | 1.021 | .834 | 1.083 |
| Major Valuing | 1.211 | 1.267 | 1.252 | .673 |
| Achievement Striving | 1.465 | 1.438 | 1.677 | 2.047 |
| Positive Faculty Relationship | .873 | .872 | .969 | .733 |
| Peer Interaction | 1.166 | 1.155 | 1.300 | 1.489 |
| Year in College | 1.250** | 1.260** | 1.247** | 1.272** |
| First Generation in College | .559** | .533** | .385*** | .456* |
| Family Income (≤ $60,000) | .800 | .784 | .745 | .808 |
| High School OCA Participation | 1.805* | 1.858* | 1.353 | 2.389 |
| Engineering Major | .662 | .567 | .506 | .475 |
| US Citizen | .951 | .924 | 1.096 | 1.782 |
| Institution | | | | |
| HSI | .353*** | .271*** | .331*** | .273*** |
| HBCU | .312*** | .266*** | .306*** | .305*** |
| Gender (Woman) | 1.512* | | 3.294 | |
| Race/Ethnicity (Underrepresented) | | 1.490 | | 4.655 |
| Woman*Major Satisfaction | | | .706 | |
| Woman*Academic Discipline Belonging | | | 1.835 | |
| Woman*Major Valuing | | | .995 | |
| Woman*Achievement Striving | | | .771 | |
| Woman*Positive Faculty Relationship | | | .658 | |
| Woman*Peer Interaction | | | .779 | |
| Woman*First Generation in College | | | 3.371** | |
| Woman* Family Income (≤$60,000) | | | 1.278 | |
| Woman*Participated in High School OCA | | | 2.656 | |
| Woman*Engineering Major | | | 1.537 | |
| Woman*US Citizen | | | .673 | |
| Underrepresented*Major Satisfaction | | | | .625 |
| Underrepresented*Academic Discipline Belonging | | | | .918 |
| Underrepresented*Major Valuing | | | | 3.074*** |
| Underrepresented*Achievement Striving | | | | .528 |
| Underrepresented*Positive Faculty Relationship | | | | 1.385 |
| Underrepresented*Peer Interaction | | | | .650 |
| Underrepresented*First Generation in College | | | | 1.369 |
| Underrepresented*Family Income (≤$60,000) | | | | 1.026 |
| Underrepresented*High School OCA Participation | | | | .612 |
| Underrepresented*Engineering Major | | | | 1.471 |
| Underrepresented*US Citizen | | | | .324 |

*Note:* *** $p < .001$, ** $p < .01$, * $p < .05$

Table 6. Regression Results from Model 2

## Discussion

OCAs provide undergraduate students with a range of documented benefits that can contribute to increased retention of STEM students (Mayhew et al., 2016; Simmons & Groen, 2018). While research has examined the potential positive (and negative) outcomes of OCAs, less research has been conducted to explore what factors predict undergraduate STEM students' participation in OCAs (Thompson et al., 2013). A clearer understanding of students' OCA participation can facilitate the development and implementation of programs designed to engage STEM students in OCAs. We used regression modeling to analyze data from 909 undergraduate responses to a survey about student engagement to identify significant engagement and demographic factors of participation in OCAs. Due to the importance of OCAs for students from underrepresented groups (Palmer et al., 2011; Yang, Xu, Yeh, & Fan, 2019), we further explored the effect of gender and racial/ethnic group on factors of STEM students' participation in OCAs.

The regression results identified four significant factors in the model: high school OCA participation, year in college, generation in college, and type of institution. Results of Model 1 indicated the probability of students' current (undergraduate) participation in OCAs for those who reported high school participation was close to twice that of those who did not. This is a logical finding suggesting those involved in high school activities carry over this involvement into their college experience. Prior research supports this finding; Swiss undergraduate students reported one of their main reasons for participating in OCAs in college was continued participation based on activities they participated in when they were younger (Roulin & Bangerter, 2013).

According to the data, as students progress through college, they are likely to increase their level of participation in OCAs. Past research appears to support the idea that student engagement and involvement in OCAs will differ based on year in college, but the exact nature of this relationship is unclear and may vary based on type of activity (Foubert & Grainger, 2006; Wang & Kennedy-Phillips, 2013). For example, Chen, Snyder, and Magner (2010) reported a decrease in commitment to sport-related activities as students spent more time in college. In contrast, Engberg and Fox (2011) reported levels of participation in service-learning increased as students progressed, with the lowest level of service-learning participation among first-year and the highest level among seniors. Additional study should examine the relationship between OCA participation and year in college at a more nuanced level to determine if type of OCA impacts the relationship (see Limitations and Future Work section).

FGC students in general were less likely to participate in OCAs than students with one or more parents who had graduated from college. Pike and Kuh (2005) reported similar findings regarding FGC students, noting lower levels of engagement in this population. Surprisingly, we found that FGC women are more likely to participate in OCAs than the group of continuing generation in college women and all men. This finding indicates that there may be differences between the impact of generation in college factor for men and women. Previous studies do indicate some potential differences in OCA participation based on gender (Chachra, Chen, Kilgore, & Sheppard, 2009) and suggest students from underrepresented groups may also differ in their experiences with OCAs (Zell, 2010).

Participating institutions likely varied on a number of characteristics, such as level of support for participation in OCAs and number and type of activities offered, and it is not surprising that differences in factors would emerge based on institution attended. Prior research has suggested certain institutional differences can impact student experiences and outcomes (Astin & Oseguera, 2005; Lattuca & Stark, 2011). For example, Bureau, Cole, and McCormick (2014) reported that student participation in service-learning is more common at private institutions and at institutions granting master's and baccalaureate degrees, when compared to public institutions and doctorate-granting institutions. Strayhorn and DeVita (2010) found the level of engagement of Black male college students in activities involving peer cooperation also varied based on institution type. We grouped the five institutions based on whether they were PWIs, HSIs, or HBCUs, given the focus of this study on potential impacts of race/ethnicity on OCA participation. Our finding that students from HSIs and HBCUs are less likely to participate in OCAs compared to students in PWIs demonstrates the potential impact of institution type and raises questions about why these differences emerged.

Finally, although the *Major Valuing* variable alone was not identified as a significant prediction factor, the variable showed significance when race/ethnicity was considered. Students from underrepresented groups with high perception of *Major Valuing* are more likely to participate in OCA than students with low *Major Valuing* and students from overrepresented groups with high *Major Valuing*. Wilson et. al. (2014) also found that an affective engagement variable alone did not show significant association with participation in cocurricular activities, but demonstrated significance when the interaction with self-efficacy was considered. These findings suggest that *Major Valuing* alone cannot predict OCA participation, but it strengthens the effects of other variables on student participation in OCAs.

## Limitations and Future Work

The nature of our sample of STEM undergraduates imposes several limitations on the data and results. While the sample did include students from science, technology, and mathematics, over 85% of the students in the sample were engineering majors. Due to this overrepresentation of engineering students, the results may not be representative of all STEM majors. Future work could expand the sample to include more non-engineering STEM students. Our analyses were based on a sample of STEM undergraduates from a small number of institutions located in southern and mid-Atlantic regions of the U.S., all of which reported to have higher than average numbers of STEM graduates from underrepresented groups. The sample may not represent broader populations including students from other types of institutions or in different parts of the U.S. Again, future work broadening the sample could address this and other limitations regarding sampling.

We also note that although we leveraged our data sample to support our inferences, we may have omitted variables from our analysis that would have altered our inferences. An example is how OCAs include a wide range of activities and experiences, but our analyses based on the available data collapsed all OCAs into one group. Future research could ask students for more information about their participation in OCAs (to include details about the specific OCAs in which they have been involved).

In discussing prior research, we have referenced several studies that examined the reasons and motivations for OCA participation as we felt these studies are relevant to our work to predict OCA participation. However, we did not directly ask students about why and how they made their decisions about OCA participation and therefore our results cannot make claims about student motivations. A logical next step could be qualitative research designed to deeply explore students' reasons and motivations for participating in OCAs.

Finally, in this research we investigated the impact of gender and race/ethnicity separately and as binary variables. Future research could apply intersectionality approaches to examine the combined effects of gender and race/ethnicity to the participation of OCAs and, conversely, could conduct analyses where gender and race/ethnicity are treated as non-binary variables to more accurately and realistically reflect the nuances of gender and race/ethnicity.

## Implications for Practice

Based on our review of the evidence showing the benefits from OCAs, we echo past calls for increased support for undergraduates' participation in OCAs. Our results identified factors and interaction terms that can predict the participation in OCAs of STEM undergraduates and identification of these potentially impactful variables suggests several implications. Educators may need to offer additional support in regards to OCAs for FGC students, who may benefit greatly from OCAs but may be less likely to participate compared to students with parents who have completed college. Additional support may also help first and second-year students find and become involved in high quality OCAs since they may have trouble navigating college life and the many options competing for their limited time and energy. Given the possible connection between high school participation in OCAs, support for OCAs needs to start early, before students even arrive on a college campus. These initial supports, especially for students from underrepresented groups, may greatly promote later engagement in OCAs during college. Finally, educators need to be aware that participation in OCAs is not "one size fits all." Programs that support participation in OCAs need to be aware of and acknowledge differences based on demographic factors like gender and racial/ethnic group.

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# Appendix

## Identified Factors of Affective Student Engagement an Associated Survey Items

### *Major Satisfaction (MS)*

1. Overall, I am happy with the major I've chosen.
2. I don't intend to change my major from current major to another major.
3. I am enthusiastic about my major.
4. I think I will be very happy to spend the rest of my career in my current major.
5. My major is interesting to me.

### *Academic Discipline Belonging (ADB)*

6. I do not feel like "part of the family" in my academic discipline. (Reversed)
7. I do not feel "emotionally attached" to my academic discipline. (Reversed)
8. I do not feel a strong sense of "belonging" to my academic discipline. (Reversed)

### *Major Valuing (MV)*

9. Success in my major at school is very valuable to me.
10. It matters to me how well I do in my major at school.
11. Being good at my major is an important part of who I am.

### *Achievement Striving (AS)*

12. I excel at identifying opportunities.
13. If I see something I don't like, I fix it.
14. If I believe in an idea, no obstacle will prevent me from making it happen.
15. I love being a champion for my ideas, even against others' opposition.
16. I am constantly on the lookout for new ways to improve my life.

### *Peer Interaction (PI)*

17. I discuss career issues with peers.
18. I discuss academic issues with peers.
19. I discuss social issues with peers.
20. I discuss cultural issues with peers.

### *Positive Faculty Relationship (PFR)*

21. The instructors in my program respect me.
22. I am satisfied with the faculty in my major.
23. I am treated with as much respect by faculty as other students in my program.