**Online Supplemental Materials**

**Switching within STEM: Examining the Motivational Concerns that College Students Report Considering When Changing Career Plans Within STEM Fields**

**Process of Identifying the Sample for the Present Study**

Our final sample of 561 was a subsample of a larger group of students who completed a broader study about motivation and STEM career participation (N = 2,312). We engaged in a multi-step coding process to identify the sample for this study.

First, we **identified unique, consenting, participants** who met broad study inclusion criteria. Initially during data collection, we received 2,816 survey responses. We first screened all responses for consent or participation-related issues, excluding 504. Specifically, 104 responses represented repeat survey attempts from existing participants, 369 participants did not release their data for research purposes or were not 18 at the time of the survey, 9 participants were not undergraduate students, and 22 participants responded to all of the motivational questionnaires with a single response (i.e., all 7’s) and thus did not show evidence of engaging meaningfully with the items.

Second, we **screened whether participants maintained STEM career plans across college** and excluded those who did not. To identify individuals who had retained STEM career plans across college, we used a coding procedure adapted from prior research (Authors, 2021b). We began by classifying all students’ self-reported long-term career plans at the time of the survey as being related to STEM or non-STEM fields. Participating students were asked to respond to the open-ended question, “Right now, what is the career you expect to be doing 10 years after you graduate college?” Participants either wrote in their career plans, or they could check one of two boxes to indicate if they were undecided about their career plans or were considering multiple career plans. Students who were considering multiple career plans were asked two follow-up questions: “What are all of the career plans you are considering?” and “Right now, if you had to choose, which of these career plans are you most interested in pursuing or think you are most likely to pursue?”

Each student’s self-generated long-term career plans were then coded as being related to STEM or not by matching it to the closest career title(s) listed on the O\*Net Career Database. The O\*Net database is run by the U.S. Department of Labor and Bureau of Labor Statistics and it provides a taxonomy of common career paths pursued in the United States. The database provides detailed information about each career included in it, such as the educational requirements, skills and knowledge required for each, and whether or not each career is classified as a STEM career (https://www.onetonline.org/find/stem?t=0). The list of STEM careers was used to classify students’ career plans as being STEM or non-STEM. If students were considering multiple different career options, they were classified as pursuing STEM careers if the career they indicated as the most likely option was classified as STEM.

Not all students had clear career plans, and some students articulated vague or broad plans that did not align clearly with a specific O\*Net title (e.g., work in the health care industry, do genetics research). For any students whose stated career paths were not an exact match to a specific O\*Net career category, two trained research assistants classified that career as being STEM, non-STEM, or unable to classify, with disagreements resolved by consensus (interrater agreement = 91.6%).

After doing this classification process, any students whose long-term career plans were not related to STEM fields were excluded from the final sample, along with students who indicated they were fully undecided about their long-term career plans or students whose plans could not be clearly classified. This process excluded any students who did not have distinct STEM career plans at the time of the study.

We also excluded students who did not report *entering* college with STEM career plans. That is, we excluded those who switched into STEM career plans from non-STEM fields of study or those who did not begin college with clear career plans. If students indicated that they had changed their career plans during college, they were asked to write in their original career plans. We coded students’ original career plans as being related to STEM or non-STEM fields, using the same classification system just discussed for long-term career plans. The only difference is that all students’ career plans were coded by two research assistants instead of only students whose careers did not immediately match an O\*Net title, due to the smaller number of students in this category (interrater agreement: 95.9%). Students whose initial career plans were not in STEM fields, students whose initial career plans could not clearly be classified as being STEM or non-STEM, and students who were undecided about their initial career plans were excluded from the final sample.

Based on this procedure, we excluded 585 students who did not clearly retain STEM career plans across college. The majority of these students (*n* = 422) did not have career plans that could be clearly classified as being related to STEM or non-STEM (e.g., because they were undecided about their career plans, equally considering careers in both STEM and non-STEM fields, or had career plans that were too vague to be classified). An additional 88 students entered STEM career paths during college, 34 left STEM career paths, and 41 never had an interest in a STEM career path. This left a sample of 1,727 students who remained in STEM career paths throughout the duration of the study.

The third step in determining the sample was to **identify students who changed career plans within STEM across college.** To identify students who changed their career plans during college, students responded to a yes/no question, “Have your long-term career plans changed since the beginning of college?” Students who responded yes were categorized to have changed their career plans. This step left us with our final sample of 561 students.

**Classifying Field of Study**

We determined students’ field of study by classifying students into groups based on their self-reported college major or intended major. We then determined whether students were pursuing majors related to the fields of biology, computer science, engineering, or other fields. We determined which majors fell in each field of study category using lists of majors from the university where the research was conducted (i.e., from the websites of different schools and departments at the university). Our three major categories reflected areas in which students were required to take similar patterns of coursework to complete their undergraduate degrees. The majors included as “biology-related” were any that were offered by departments classified as part of the University’s Division of Biosciences. The majors included as “computer-science-related” were any that were offered by the University’s School of Computing. The majors included as “engineering-related” were any that were offered by the University’s College of Engineering. If students wrote in majors that were not official majors at the university, they were classified in the “other” fields of study category, unless it was clear that their description of their major aligned with one of the three field of study focal groups and not any others. Students who were pursuing majors in more than one of the focal fields of study (e.g., a student with double majors in Biology and Computer Science)(*n* = 7) were classified in the “other” fields of study category.

**More Details about Research Question 4**

**Family-wise error rate correction.** For Research Question 4, there were multiple related analytical models used to examine how student characteristics predicted the likelihood of selecting different types of SEVT beliefs. Specifically, each student-level predictor was included in either eight related models (i.e., to predict referencing the four different motivational constructs from situated expectancy-value theory, for both most influential and all reasons for changing plans) or six related tests (i.e., to predict referencing reasons related to attraction, disenchantment, or both factors, for both most influential and all reasons for changing plans). These repeated, related tests might lead to an inflated risk of false-positive significance tests in our results. We therefore used a False Discovery Rate procedure (Benjamini & Hochberg, 1995) to decrease the chance of making a Type 1 error in interpreting the results of the data across each family of 6-8 similar tests,. All tables report unadjusted p-values in the manuscript but designate which p-values were robust to the family-wise error rate correction, and we interpret only robust values as being statistically detectable effects throughout the manuscript.

To do this process, among each group (“family”) of related tests, we rank-ordered the tests in each family from the lowest to highest *p*-values. Instead of comparing the *p*-value of each test to a standard threshold of .05, we compared each test in the “family” of related tests to a threshold computed using the formula (*i/m)\*q*, which accounts for the desired false discovery rate across the test family (*q*), the number of tests in the family (*m*), and the relative rank-ordering of the *p*-value of that particular test (*i*). We computed adjusted thresholds for detecting meaningful effects separately for each family of related tests (i.e., the family of eight tests looking at gender differences, the four families of eight tests looking at each type of race/ethnicity difference, the three families of eight tests looking these analyses for each type of field of study difference, the four families of eight tests looking at these analyses for each type of year in school difference, and the families of six tests looking each of the characteristics just mentioned as predictors of disenchantment/attraction reasons). In all test groups, we used a family-wise false discovery rate of *q* = .10.

**Selection of attraction versus disenchantment.** Tables S1 and S2 report the results of student-level characteristics predicting the likelihood of students selecting attraction-related only, disenchantment-related only, or both types of reasons for influencing their career decision-making within STEM. For the analyses of predicting overall selection of these factors, very few students chose only attraction-related or disenchantment-related factors, leading to unusual estimates in the results. As can be seen, none of the student-level factors were statistically detectable predictors of the likelihood of selecting these factors, either in terms of all reasons selected or the most influential reasons selected, after adjusting for multiple comparisons.

**Class membership.** We tested whether each student-level characteristic was associated with latent class membership by using our latent class analytical model to classify each student in the sample’s most likely latent class membership. We used this variable in SPSS and tested its associations with other student characteristics using crosstabs analysis (for gender) or multinomial logistic regression with class membership as the outcome (for race/ethnicity, year in school, field of study, and GPA). In the multinomial logistic regressions we tested each characteristic in a separate model as a predictor, using the same operationalizations and codes as were used in the other analyses for Research Question 4. We used the smallest group in the sample (*Predominant Focus on Competence-Related Beliefs)* as the reference group for the multinomial logistic regression.

Results of the multinomial logistic regression models are presented in Table S3. As can be seen, there were no statistically detectable associations between any student-level characteristics and class membership for gender, race/ethnicity, field of study, or year in school. For GPA, we found a statistically detectable effect such that students with higher college GPAs at the time of the survey were more likely to belong to the *Predominant Focus on Values* and *Focus on* *Multifaceted Concerns* classes compared to the *Predominant* *Focus on Competence-Related Beliefs* class.

Table S1

*Logistic Regressions Predicting Selecting Attraction or Disenchantment Reasons, Overall*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Attraction Only** | | | | **Disenchantment Only** | | | | | | **Both Types of Reasons** | | | |
| **Predictor** | **B** | **S.E.** | ***p*** | **O.R.** | | **B** | **S.E.** | ***p*** | **O.R.** | **B** | | **S.E.** | ***p*** | **O.R.** | |
| Intercept | -4.53 | 0.99 |  |  | | -4.11 | 1.74 |  |  | 3.91 | | 0.86 |  |  | |
| Gender | 0.06 | 0.61 | 0.917 | 1.07 | | -0.74 | 1.52 | 0.626 | 0.48 | 0.07 | | 0.55 | 0.899 | 1.07 | |
| Race/Ethnicity |  |  |  |  | |  |  |  |  |  | |  |  |  | |
| B/AA v. White | 1.07 | 0.72 | 0.136 | 2.91 | | 0.32 | 1.47 | 0.828 | 1.38 | -0.95 | | 0.64 | 0.137 | 0.39 | |
| A/AA v. White | 0.61 | 0.79 | 0.439 | 1.84 | | -16.07 | 3088.32 | 0.996 | 0.00 | -0.35 | | 0.73 | 0.629 | 0.70 | |
| H/L v. White | 1.25 | 0.81 | 0.125 | 3.48 | | -15.78 | 4233.70 | 0.997 | 0.00 | -0.92 | | 0.75 | 0.223 | 0.40 | |
| Other v. White | 1.35 | 1.24 | 0.276 | 3.87 | | -15.72 | 6808.16 | 0.998 | 0.00 | -0.98 | | 1.20 | 0.414 | 0.38 | |
| Year in School |  |  |  |  | |  |  |  |  |  | |  |  |  | |
| Second v. First | 1.11 | 1.03 | 0.281 | 3.03 | | -16.58 | 4860.58 | 0.997 | 0.00 | -0.65 | | 0.97 | 0.500 | 0.52 | |
| Third v. First | 0.31 | 0.97 | 0.753 | 1.36 | | 0.33 | 1.52 | 0.831 | 1.39 | -0.37 | | 0.82 | 0.654 | 0.69 | |
| Fourth v. First | 0.86 | 0.68 | 0.204 | 2.37 | | -16.15 | 2312.13 | 0.994 | 0.00 | -0.54 | | 0.61 | 0.374 | 0.58 | |
| Other v. First | -17.71 | 6500.32 | 0.998 | 0.00 | | -15.22 | 5473.87 | 0.998 | 0.00 | 17.82 | | 6625.26 | 0.998 | 54816667.64 | |
| Field of Study |  |  |  |  | |  |  |  |  |  | |  |  |  | |
| CS v. Bio | -1.50 | 1.06 | 0.158 | 0.22 | | 1.03 | 1.46 | 0.481 | 2.80 | 0.90 | | 0.78 | 0.250 | 2.45 | |
| Eng. v. Bio | -17.73 | 6529.18 | 0.998 | 0.00 | | -15.70 | 5708.26 | 0.998 | 0.00 | 17.93 | | 6631.28 | 0.998 | 61063619.84 | |
| Other v. Bio | -0.08 | 1.09 | 0.939 | 0.92 | | -15.42 | 6810.80 | 0.998 | 0.00 | 0.19 | | 1.08 | 0.862 | 1.21 | |
| College GPA | 0.68 | 0.38 | 0.071 | 1.98 | | -0.23 | 0.66 | 0.731 | 0.80 | -0.54 | | 0.33 | 0.106 | 0.58 | |

*Note*: CS = Computer science-related fields of study. Eng. = Engineering-related fields of study. Bio = Biology-related fields of study. B/AA = Black or African American students. A/AA = Asian or Asian American students. H/L = Hispanic or Latino/a students. Other = students who identified with other ethnicities or races. GPA = Grade point average. \* denotes *p-*value that is statistically detectable after adjustments for multiple comparisons using family-wise error rate corrections (Benjamini & Hochberg, 1995), with a family-wise error rate of 0.1. O.R. = Odds ratio.

Table S2

*Logistic Regressions Predicting Selecting Attraction or Disenchantment Reasons, Most Important*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Attraction Only** | | | | **Disenchantment Only** | | | | | **Both Types of Reasons** | | | | |
| **Predictor** | **B** | **S.E.** | ***p*** | **O.R.** | | **B** | **S.E.** | ***p*** | **O.R.** | | **B** | **S.E.** | ***p*** | **O.R.** | |
| Intercept | -0.20 | 0.29 |  |  | | -1.20 | 0.37 |  |  | | -0.81 | 0.32 |  |  | |
| Gender | -0.16 | 0.22 | 0.471 | 0.86 | | 0.13 | 0.29 | 0.659 | 1.13 | | 0.10 | 0.24 | 0.684 | 1.10 | |
| Race/Ethnicity |  |  |  |  | |  |  |  |  | |  |  |  |  | |
| B/AA v. White | 0.28 | 0.24 | 0.248 | 1.32 | | -0.56 | 0.30 | 0.058 | 0.57 | | 0.14 | 0.26 | 0.601 | 1.15 | |
| A/AA v. White | 0.19 | 0.24 | 0.438 | 1.21 | | -0.66 | 0.31 | 0.032 | 0.52 | | 0.29 | 0.26 | 0.257 | 1.34 | |
| H/L v. White | 0.47 | 0.30 | 0.113 | 1.60 | | -0.38 | 0.36 | 0.284 | 0.68 | | -0.24 | 0.33 | 0.478 | 0.79 | |
| Other v. White | 0.38 | 0.48 | 0.422 | 1.47 | | -1.05 | 0.70 | 0.131 | 0.35 | | 0.28 | 0.49 | 0.568 | 1.32 | |
| Year in School |  |  |  |  | |  |  |  |  | |  |  |  |  | |
| Second v. First | 0.13 | 0.36 | 0.727 | 1.13 | | -0.53 | 0.52 | 0.303 | 0.59 | | 0.18 | 0.38 | 0.639 | 1.19 | |
| Third v. First | 0.42 | 0.30 | 0.156 | 1.53 | | -0.47 | 0.41 | 0.259 | 0.63 | | -0.20 | 0.32 | 0.536 | 0.82 | |
| Fourth v. First | 0.02 | 0.21 | 0.930 | 1.02 | | 0.15 | 0.26 | 0.552 | 1.17 | | -0.15 | 0.23 | 0.508 | 0.86 | |
| Other v. First | 0.03 | 0.37 | 0.931 | 1.03 | | 0.64 | 0.41 | 0.122 | 1.89 | | -0.59 | 0.43 | 0.167 | 0.55 | |
| Field of Study |  |  |  |  | |  |  |  |  | |  |  |  |  | |
| CS v. Bio | 0.02 | 0.23 | 0.943 | 1.02 | | 0.23 | 0.28 | 0.404 | 1.26 | | -0.20 | 0.25 | 0.425 | 0.82 | |
| Eng. v. Bio | -0.17 | 0.37 | 0.637 | 0.84 | | 0.13 | 0.46 | 0.781 | 1.14 | | 0.10 | 0.39 | 0.788 | 1.11 | |
| Other v. Bio | 0.21 | 0.43 | 0.631 | 1.23 | | 0.11 | 0.53 | 0.836 | 1.12 | | -0.35 | 0.49 | 0.470 | 0.70 | |
| College GPA | 0.20 | 0.10 | 0.047 | 1.22 | | -0.18 | 0.12 | 0.144 | 0.84 | | -0.09 | 0.10 | 0.362 | 0.91 | |

*Note*: CS = Computer science-related fields of study. Eng. = Engineering-related fields of study. Bio = Biology-related fields of study. B/AA = Black or African American students. A/AA = Asian or Asian American students. H/L = Hispanic or Latino/a students. Other = students who identified with other ethnicities or races. GPA = Grade point average. \* denotes *p* value that is statistically detectable after adjustments for multiple comparisons using family-wise error rate corrections (Benjamini & Hochberg, 1995), with a family-wise error rate of 0.1. O.R. = Odds ratio.

Table S3

*Multinomial Logistic Regressions Predicting Class Membership*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Race/Ethnicity** | **B** | **S.E.** | ***p*** | **O.R.** |
| *Values vs. Competence* |  |  |  |  |
| Intercept | 1.773 | 0.184 |  |  |
| B/AA v. White | -0.030 | 0.574 | .958 | 0.970 |
| A/AA v. White | -0.538 | 0.343 | .117 | 0.584 |
| H/L v. White | -0.687 | 0.474 | .148 | 0.503 |
| Other v. White | -0.602 | 0.610 | .324 | 0.548 |
| *Multifaceted vs. Competence* |  |  |  |  |
| Intercept | 1.311 | 0.192 |  |  |
| B/AA v. White | -0.100 | 0.604 | .869 | 0.905 |
| A/AA v. White | -0.117 | 0.348 | .736 | 0.889 |
| H/L v. White | -0.805 | 0.514 | .117 | 0.447 |
| Other v. White | -0.356 | 0.627 | .570 | 0.700 |
|  |  |  |  |  |
| **Year in School** | **B** | **S.E.** | ***p*** | **O.R.** |
| *Values vs. Competence* |  |  |  |  |
| Intercept | 1.493 | 0.247 |  |  |
| Second v. First | 0.031 | 0.365 | .933 | 1.031 |
| Third v. First | 0.409 | 0.420 | .330 | 1.506 |
| Fourth v. First | -0.001 | 0.444 | .998 | 0.999 |
| Other v. First | 0.048 | 0.683 | .944 | 1.049 |
| *Multifaceted vs. Competence* |  |  |  |  |
| Intercept | 1.209 | 0.255 |  |  |
| Second v. First | -0.171 | 0.380 | .653 | 0.843 |
| Third v. First | 0.420 | 0.430 | .328 | 1.522 |
| Fourth v. First | -0.271 | 0.469 | .563 | 0.763 |
| Other v. First | -0.11 | 0.714 | .877 | 0.896 |
|  |  |  |  |  |
| **Field of Study** | **B** | **S.E.** | ***p*** | **O.R.** |
| *Values vs. Competence* |  |  |  |  |
| Intercept | 1.758 | 0.280 |  |  |
| CS v. Bio | -0.116 | 0.526 | .826 | 0.891 |
| Eng. v. Bio | 0.223 | 0.469 | .635 | 1.250 |
| Other v. Bio | -0.321 | 0.348 | .356 | 0.725 |
| *Multifaceted vs. Competence* |  |  |  |  |
| Intercept | 1.369 | 0.289 |  |  |
| CS v. Bio | -0.217 | 0.550 | .694 | 0.805 |
| Eng. v. Bio | -0.676 | 0.521 | .194 | 0.508 |
| Other v. Bio | -0.073 | 0.357 | .837 | 0.929 |
|  |  |  |  |  |
| GPA | **B** | **S.E.** | ***p*** | **O.R.** |
| *Values vs. Competence* |  |  |  |  |
| Intercept | 1.627 | 0.149 |  |  |
| GPA | 0.451 | 0.128 | <.001 | 1.569 |
| *Multifaceted vs. Competence* |  |  |  |  |
| Intercept | 1.255 | 0.155 |  |  |
| GPA | 0.293 | 0.128 | .022 | 1.341 |
|  |  |  |  |  |

*Note*: CS = Computer science-related fields of study. Eng. = Engineering-related fields of study. Bio = Biology-related fields of study. B/AA = Black or African American students. A/AA = Asian or Asian American students. H/L = Hispanic or Latino/a students. Other = students who identified with other ethnicities or races. GPA = Grade point average. O.R. = Odds ratio.