Motivation in STEM and non-STEM College Applicants

Carlos Diaz

Group N, University of California, Riverside

PSYC 012: Psychological Methods: Research Procedures

Dr. John M. Franchak

August 27, 2022

Abstract

The purpose of this study was to determine the comparative differences between motivation levels amongst undergraduate participants pursuing a STEM or non-STEM degree. Unlike past research, this study provides a novel observation of young, undergraduate students (ages 17-20) and their level of motivation to pursue their field of study in the earlier years of their degree. Over the course of this study, two anonymous surveys were distributed to the participants, one which acted as a preliminary survey to determine participant eligibility (based on major type and age), as well as a second survey that recorded the final 200 participants' motivation levels using a Likert scale. The results of this study indicate that STEM majors are more likely to possess a higher level of motivation to pursue their degree when compared to their non-STEM peers and reveal the potential need for programs and interventions that increase youth engagement, motivation to pursue, and retention rates in higher education for non-STEM related fields, as well as STEM related fields.

Keywords: STEM, non-STEM, motivation, undergraduate degree, persistence

Motivation in STEM and non-STEM College Applicants

Given the growing need for educated professionals within the sphere of technical and educational careers, student engagement, interest, and persistence in higher education pertaining to both STEM and non-STEM fields is all the more necessary to meet the ever-increasing demand. Furthermore, if youth interest and motivation to pursue STEM or non-STEM related education and careers is diminished in the present and coming years, the ever-increasing need for educated professionals will be difficult to match. Thus, it was both the goal and expectation of this study to not only discover a comparative difference in motivation levels between undergraduates pursuing one of two major types, but to observe that STEM majors are more motivated to pursue their degree than their non-STEM peers. The hope was that this outcome would indicate that, just as there is a continuous need for STEM oriented programs throughout youth and adolescent education, there is a similarly dire need for programs that increase student engagement, interest, and motivation in non-STEM related fields.

Whether a STEM or non-STEM degree, an individual's choice of major can be explained by any number of reasons, though the most common appear to be future career choices, interest in the area of study, and level of ease (Skatova & Ferguson, 2014; Smith et al., 2014). While it is true that some students truly do pursue a field of study on the basis of expanding their knowledge in an area of great interest, the perception of future benefit in the

form of potential careers seems to be the strongest motivator for most individuals pursuing a degree (Huss-Keeler et al., 2013). Moreover, the influence of perceived future benefit on one's decision to attend university and obtain a degree is especially powerful when an individual comes from a lower socioeconomic status. However, students in STEM courses that identify with only one of the aforementioned factors, or weakly with most of them, are not likely to possess a similarly high level of motivation in regards to their STEM studies. In the case that a student lacks the motivation necessary to persist in STEM, it is much more likely that that will change majors to instead study a subject they might find more interesting, beneficial to a future career, or easier to earn a degree in. Yet, when considering the rigorous nature of STEM subjects and related courses, it seems unlikely that any individual persisting in their pursuit of a STEM degree or career (for any reason whatsoever) is not highly motivated to do so.

A study by Wilson & Kittleson (2013) observed how first-generation female persistence in studies within STEM was affected not only by the participants' struggles as first-generation female students in higher education, but also because of a highly competitive environment cultivated by students and instructors. The participants' desire to persist and thrive within their respective area of study was also hindered by several external factors, some of which include: managing time for home life, work, and school, as well as weighing their many academic and personal priorities against one another. With youth involvement and interest in STEM on the decline in both male and (especially) female students as they

transition from middle school into high school, the competitive nature of STEM compounded with a lack of interest in the field makes it is all the more apparent how higher levels of motivation and persistence are required of an individual seeking an education or career in STEM (Stringer et al., 2020). And while STEM oriented extracurricular programs have proven to be effective in increasing interest in female youth and maintaining interest in male youth, the voluntary nature of extracurricular STEM programs again only highlights the students who are already motivated and confident in their ability to pursue an education or career in STEM. In a sense, it would seem that previous studies suggest that, if students continue to display engagement with STEM throughout their journey into higher education, they more than likely possess high levels of interest and motivation to pursue a degree or future career in STEM. Additionally, if an individual continues their pursuit of a STEM degree in spite of the numerous threats towards their ability to persist, as well as the highly competitive nature of the field, it is very likely that they too possess high levels of motivation to pursue a degree and future career in STEM.

With all things considered, this study differs from previous research in that it looks directly at undergraduate students who are currently pursuing either a STEM or non-STEM degree. While others have looked (more generally) at potential motivators/factors that contribute to an individual's decision to pursue a particular field of study or career, they have not determined whether levels of motivation vary amongst young undergraduates based on their degree of choice. Likewise, past research has neglected to look specifically at young undergraduate students' motivation to pursue a degree when completing the first few years of

their undergraduate studies. In other words, this study uniquely focuses on the comparative differences between motivation values for young, undergraduate participants pursuing a STEM or non-STEM degree, rather than looking at the reasons behind motivation for an individual's degree of choice. In addition, this study expected there to be a statistically significant difference in motivation values between the STEM and non-STEM participant groups, the former being more likely to have higher levels of motivation to pursue their degree of choice. Ultimately, the hope is that this study can bring to light the need for youth programs and interventions that not only maintain youth engagement, motivation to pursue, and persistence in STEM related fields, but also increases youth engagement, motivation to pursue, and persistence in non-STEM related fields.

Method

Participants

A total of 200 undergraduate students from a university in Southern California were sampled for this study. Of the 200 participants, 100 identified as STEM majors while the other 100 identified as non-STEM majors. Each of the 200 undergraduate participants was randomly sampled from a larger set of 500 applicants who were recruited online after the completion of a preliminary survey. Each applicant was ensured anonymity and compensated with a $5 lunch voucher for completion of the preliminary survey regardless of whether they were recruited for the second survey. For the second survey, the 200 participants that were randomly sampled from the initial set of applicants were again, ensured anonymity and compensated with a $10 lunch

voucher for completion of the second survey. Although data on the 200 participants' age (M = 18.54, SD = 0.88), and reported family income (M = 79,330.21, SD = 37,156.71) was collected, the participants were separated by their major type rather than the aforementioned demographics. To be more specific, the second survey allowed the participants to record their major type, identifying themselves as either non-STEM majors (areas of study surrounding the arts, humanities, business, etc.) or STEM majors (areas of study surrounding science, technology, engineering, or mathematics).

Design

To determine the eligibility of each participant for the second survey (which was filled out anonymously by participants), a preliminary survey was first distributed via email and allowed for undergraduate applicants to record their major along with age and family income, all while being ensured anonymity. While age and family income were reported on the preliminary survey, they were not included in the calculation of results or the t-test analysis. However, age (range of 17-20 years) was taken into account for the eligibility of the final, randomly selected 200 participants (100 STEM and 100 non-STEM participants). After sampling the 200 participants, a second survey was distributed amongst the two groups to measure their level of motivation for pursuing their respective degree. Together, participant major and motivation levels were factored into the calculation of the results and the t-test analysis to determine if the difference in motivational means between the two participant groups was statistically significant.

Materials

Two anonymous surveys were distributed to the participants during the course of this study. The first of the two surveys was distributed in the initial email sign-up and assessed participant major type (STEM or non-STEM), age, and family income (see Appendix). The second survey determined the participants' motivation levels which were later used for the calculation of group means and the t-test analysis. The survey, which made use of a Likert scale, allowed for the participants to record their level of motivation on a scale of one to five, "1" indicating that a participant was "not motivated" and a value of "5" indicating that a participant was "highly motivated" (see Appendix).

Procedure

As was stated in the Materials section, the 200 participants for this study were first recruited online via an email sign-up that was sent out to undergraduates attending a university in Southern California. The initial email contained a preliminary survey that allowed applicants to anonymously record their major, age, and family income so as to determine the eligibility of their later participation in the second survey. After completion of the preliminary survey, each participant was compensated with a $5 lunch voucher. After the collection of 500 completed preliminary surveys, the 500 applicants were assessed on the demographic information they anonymously provided in the survey materials and deemed eligible for the second survey if they identified themselves as a STEM/non-STEM major and were within the range of 17-20 years of age. Of the 500 applicants, 400 were deemed eligible, but only 100 undergraduate STEM majors

and 100 undergraduate non-STEM majors were randomly selected to participate in the second survey. The second survey (also anonymous) used a Likert scale to determine the motivation values of each participant which were then used at a later time to calculate the motivational means of each participant group. Following the completion of the second survey, the 200 participants were compensated with a $10 lunch voucher. After group means were calculated using the recorded motivation values, they were then compared in a t-test analysis to determine both the statistical significance of the results as well as which group had more motivation to pursue their respective major.

Results

The current study hypothesized that there would be a difference in levels of motivation [to pursue a degree] when comparing the mean motivational values for STEM and non-STEM participant groups. Furthermore, the difference between group means was expected to be statistically significant and indicate that undergraduate STEM majors are more motivated to pursue their degree than undergraduate, non-STEM majors, irrespective of the participants' sex, age, and reported family income.

Following the collection of all 200 participant survey responses (100 STEM undergraduate participants and 100 non-STEM undergraduate participants), the study compared the mean motivational (motivation to pursue a degree) values of each group and determined that there was, in fact, a difference in mean values between non-STEM ($M = 2.56$, $SD = 1.27$) and STEM ($M = 3.23$, $SD = 1.28$) participant groups. Using an independent t-test, the difference in motivational means between the STEM and non-STEM participant groups was found to be

statistically significant ($t(99) = -3.71$, $p < .001$) and supported the hypothesis of the current study (see Figure 1 in Appendix).

Discussion

This study aimed to bring to light the potential differences in experienced levels of motivation between undergraduate STEM and non-STEM majors to better understand youth interest, persistence, and motivation towards the field of STEM. As hypothesized, the study found a statistically significant difference in mean motivation values between the two groups, a greater mean being attributed to the undergraduate STEM majors when compared to the mean of the undergraduate non-STEM majors. Simply put, the results of this study found that undergraduate participants pursuing a STEM degree were more likely to be motivated to pursue that degree when compared to individuals pursuing a non-STEM related degree. The findings of this study confirm the work of past research (students who persist in their pursuit of a STEM degree seem to possess higher levels of motivation) and also provides an unique look into how invested and motivated young, undergraduate students are to pursue their degree of choice, regardless of whether or not they are a STEM or non-STEM major.

While this study did not explicitly make an association claim, the relationship between level of motivation to pursue a degree and major type was the main relationship being observed. Because of this, external validity and construct validity were of a higher priority, as measuring a statistically significant difference between the two participant groups would have the ability to generalize to a larger undergraduate population. That being said, the use of a wide range of

students from various socioeconomic backgrounds aided the external validity of the study. The use of random sampling to select the 200 participants for this study also helped to produce a much more generalizable finding, at least in regards to undergraduates from varying economic statuses. While education and careers in STEM are often seen as a field limited to those of a higher socioeconomic status, this study's use of a broader, more economically diverse set of students allows the results to be much more applicable and generalizable.

In a similar way, ensuring participant anonymity on both the preliminary and second surveys increased the construct validity of the study. To be more specific, because participants remained anonymous, they might have been more comfortable to answer in a way that aligned more accurately with their actual level of motivation to pursue their degree, effectively increasing the likelihood of truthful response in the surveys and as a result, increasing the legitimacy of the measurement of motivation. Also, the use of a Likert scale in the second survey also allowed participants to easily identify their level of motivation on a scale of one to five, something that may have lessened the variability of participant responses and increased measurement reliability. Simply put, the use of a Likert scale decreased the potential variability of participant response.

On the other hand, the study contained many key limitations that hindered its ability to accurately measure participant motivation, be generalizable, and measure actual relationships that impact and undergraduate's motivation to pursue a STEM (or non-STEM degree) The first key limitation of this study was the weak operationalization of the motivation variable. Although the study assessed "motivation to pursue a degree," it did not provide a clear enough definition of what classified as "motivation" within the scope of the study. Because participants were simply

asked to rate their motivation levels with a Likert scale provided in the second survey, any given participant could have interpreted "motivation to pursue a degree" in any number of ways. Another key limitation of this study was its lack of collected data on participant sex and ethnicity. Without data on sex and ethnicity, it is quite difficult to generalize the findings of this study to a broader population of undergraduate students. At most, this can generalize to young undergraduate students in their first few years at university and not much further. Also important to note, while the study gathered data on the participants' estimated family income, it did not make use of the data to determine if there existed any financial discrepancies amongst the two groups, or even amongst different sexes as well as ethnic groups. Looking further into each of these variables could have had the potential to reveal much more about the motivation levels of each participant group, respectively

Yet, it was the hope of the current study to utilize the collected data to inform future research and studies. Ideally, future research would delve deeper into the topic of STEM field motivation and identify some of the factors that influence an undergraduate student's motivation to pursue the STEM field. For example, future research could ask more questions pertaining to participant interest in their field of study and perception of potential future benefits to not only better understand the differences in motivation between STEM and non-STEM majors, but also what influences their motivation. Though it was not the goal of the current study to determine a relationship between motivation to pursue a STEM degree and sex or income, future research should look for potential relationships amongst these variables (and others) that would better explain the increased motivation STEM majors feel over their non-STEM peers.

References

Huss-Keeler, R., Peters, M., & Moss M. M. (2013). Motivation for attending higher education from the perspective of early care and education professionals. *Journal of Early Childhood Teacher Education*, *34*(2), 121-139. https://doi.org/10.1080/10901027.2013.787475

Skatova, A., & Ferguson, E. (2014). Why do different people choose different university degrees? Motivation and the choice of degree. *Frontiers in Psychology*, *5*. https://doi.org/10.3389/fpsyg.2014.01244

Smith, J. L., Deemer, E. D., Thoman, D. B., & Zazworsky, L. (2014). Motivation under the microscope: Understanding undergraduate science students' multiple motivations for research. *Motivation and Emotion*, *38*(4), 496-512. https://doi.org/10.1007/s11031-013-9388-8

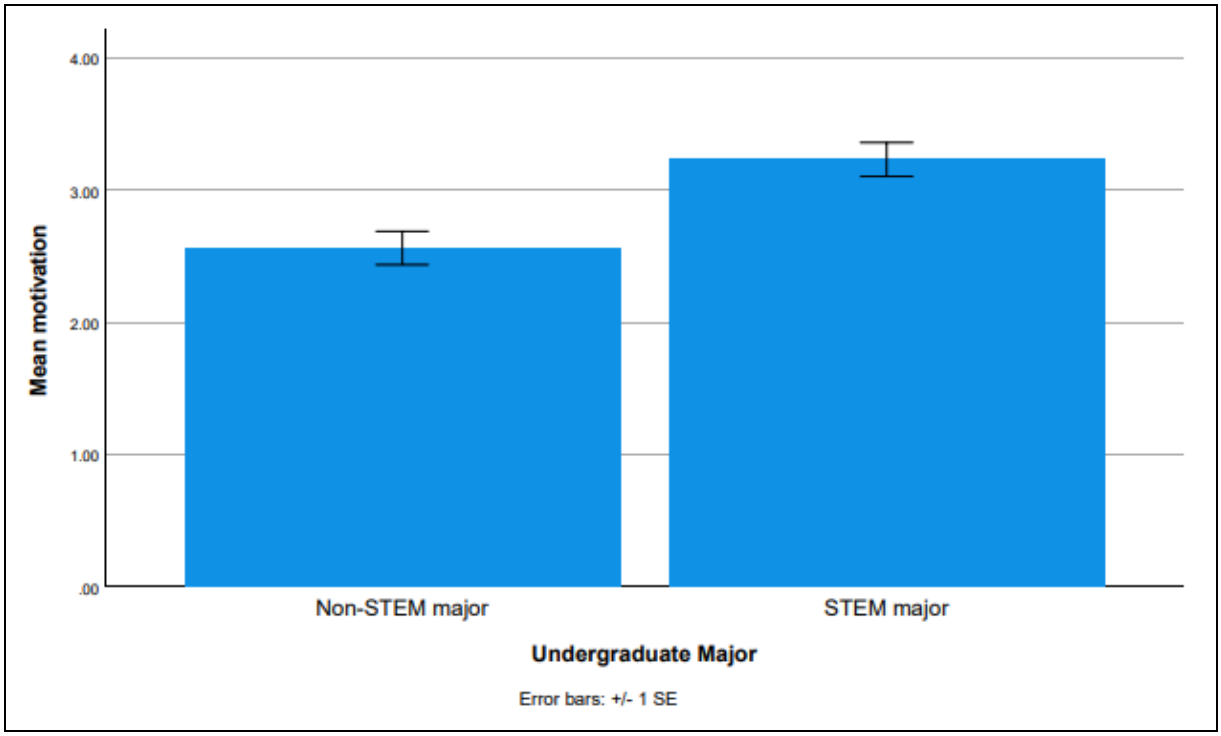
Stringer, K., Mace, K., Clark, T., & Donahue, T. (2020). STEM focused extracurricular programs: Who's in them and do they change STEM identity and motivation? *Research in Science & Technological Education*, *38*(4), 507–522. https://doi.org/10.1080/02635143.2019.1662388

Wilson, R. E., & Kittleson, J. (2013). Science as a classed and gendered endeavor: Persistence of two white female first-generation college students within an undergraduate science context. *J Res Sci Teach*, *50*(7), 802-825. https://doi.org/10.1002/tea.21087

Appendix

Figure 1.

Graph of Undergraduate Mean Motivation vs Undergraduate Major



Note. Graphed results of the mean motivational values for the undergraduate STEM and non-STEM participant groups. The graph displays the difference in motivational means between the two participant groups, with the mean motivational value for undergraduate non-STEM majors being lower than the mean motivational value for undergraduate STEM majors.

Appendix

Survey Questionnaire

Fill the boxes below and record your major type, age, and estimated family income. For family income, it is acceptable to use an estimation. For your major type, write "STEM" if your area of study includes: the sciences, technology, engineering, or mathematics. Write "non-STEM" if your area of study includes: the arts, humanities, business, etc.

Major	**Age**	**Family Income**

Survey Questionnaire (5 Point Likert Scale)

Use the scale below to measure your level of agreement with the following statement: "I am motivated to pursue my undergraduate degree." A value of 1 indicates you are "not motivated," and a value of 5 indicates that you are "highly motivated."

	1 **Strongly Disagree**	**2** **Disagree**	**3** **Neutral**	**4** **Agree**	**5** **Strongly Agree**
I am motivated to pursue my undergraduate degree.					