Exploring Engineering Major Choice and Self-concept Through First-year Surveys

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Choosing an appropriate major is an important factor in ensuring a productive and successful college experience. Major choice determines the type of work the students will engage in and the faculty and peers that they will come in contact with, both of which have been shown to impact student learning, satisfaction, and persistence. For engineering students, the selection of a discipline can be an overwhelming task. Many first-year students have only vague notions about what engineering is and a limited understanding of the scope of the work that might be typical of a given field. As a result, some students make uninformed decisions when choosing a major and are less likely to persist in their engineering program. One approach to this problem is to provide a common first-year engineering (FYE) program that all engineering students are required to complete, regardless of whether or not they arrive with a particular engineering major in mind. This approach has been widely adopted and nearly 60% of engineering programs in the U.S. have established a FYE course sequence.

With the increasing popularity of FYE programs, it is important to understand how they affect students’ major choice and their intention to remain in engineering majors. FYE courses are typically the first courses that students enroll in with “engineering” in the title, which could have an unexpected impact on their decision-making process. A better understanding of how these courses impact major and career intentions, and how those choices may change during the course of the first year, could help inform advising, curriculum, and other retention strategies. In the present study, we utilized existing survey data and university records collected over a three-year period to determine how students’ perceptions of motivation and identity constructs (e.g. engineering identification, engineering utility) change over their first year of which the FYE experience is a significant part. In addition, we examined how these constructs measured during the first semester may relate to engineering major choice at the end of the year.

Literature Review

Many engineering programs across the country have established common introductory engineering courses in the first year, aiming to increase retention in engineering, provide students with design experience, improve teamwork skills, and increase success rates for students with nontraditional backgrounds. Another advantage of a common FYE program is that it can provide access to a wide array of engineering experiences to help students choose a good fit for themselves. This is, of course, useful for students who arrive undecided about their major choice, but also for those who arrive having made one choice based on the limited information they had about options before arriving. Thus, the common first-year curriculum can be a time for students to learn about the various disciplines, address any misconceptions about different fields, and hopefully, end the year having picked a major that will allow them to thrive for the remainder of their undergraduate experience.

Orr et al. analyzed longitudinal data from ten U.S. institutions to determine outcomes of different matriculation pathways into engineering. The two most prevalent matriculation pathways were Direct Matriculation (DM) to a specific major (N=28,173) and FYE programs (N=38,602). FYE programs were found to promote persistence within engineering as a whole and also seem to be more successful in preparing students to make informed major choices, as evidenced by the high percentage (89%) of FYE students that graduated in the first engineering major they chose after FYE, compared to 78% of DM graduates who stayed with their first major choice. FYE programs also have the
Engineering program belonging can be a result of fewer FYE students changing their majors as every change of discipline within engineering requires an average of two additional semesters. Motivation theories attempt to explain the relationships between beliefs, values, and goals with respect to action and thus, may be useful for studying major choice. A number of identity and motivation constructs have been associated with retention and success within engineering. Specifically, researchers have shown that domain identification, utility, perceived ability, and belonging all influence students’ decision to major in engineering and their academic success in engineering programs. The goal of the present study was to contribute to the growing body of literature on FYE programs by investigating how student perceptions of engineering-based identity and motivation constructs change throughout the first-year while they are enrolled in a FYE course sequence. In addition, we examined how these constructs measured during the first semester may relate to engineering major choice at the end of the year. We examined the constructs of domain identification, utility, belonging, and expectancy. These constructs relate to values and beliefs held by the student without reference to a particular course and are useful in predicting student choice in majoring in engineering, persistence in engineering programs, and intent to pursue careers in engineering.

Engineering identification. Domain identification is a measure of the extent to which an individual considers a particular domain, such as engineering, to be highly self-defining and a critical component in their global self-evaluation process. Identity formation in the context of academics has been described as the process in which students (1) develop a more accurate perception of their abilities; (2) come to accurately understand their values; and (3) perceive these values as the foundation of their self-esteem. Domain identification can be useful in predicting success and understanding experiences within a given domain. For example, academic identification has been linked to course grades and GPA, deep cognitive engagement and self-regulation, and attendance. Engineering identification is also important when considering major choice and persistence in engineering. Jones, Ruff, and Paretti examined four factors (i.e., engineering identification, gender identification, gender stereotype endorsement, and engineering ability perceptions) to determine how they impact student’s achievement and persistence in engineering during their first year of an undergraduate engineering program. Their analysis showed that students with high engineering identification tended to perceive their engineering ability higher, earn a higher GPA, and were less likely to report they planned to change their major than students with low engineering identification. They also found that engineering identification was the best predictor of the likelihood that students would change majors, even more so for women than for men.

Engineering utility. Engineering utility is a measure of the perceived usefulness of engineering for an individual’s short- or long-term goals. The utility value construct is commonly studied in the context of the expectancy-value model of motivation. Expectancy-value theory suggests that an individual’s attitude, choice, and performance can be explained by their competence and value beliefs. Jones et al. found that engineering utility was one of the most significant predictors of first-year engineering students’ intention to pursue an engineering career. Similarly, Matusovich, Streveler, and Miller documented that high engineering utility can lead to persistence in engineering despite low domain identification in the field. Put another way, a student who does not strongly identify with engineering may still be likely to persist if they perceive becoming an engineer as important for their future goals. Their research also highlighted differences in the types of value or personal importance that influence students’ decision to earn an engineering degree, suggesting many constructs should be considered when examining students’ major choice.

Engineering program belonging. While domain identification is the extent to which a student values engineering as an important part of his or her self, the program belonging construct is meant to assess the students’ perception of how connected he or she is to a specific group. Belongingness includes “the extent to which students feel personally accepted, respected, included and supported by others in the school social environment”. In the context of the present study, engineering program belonging refers to the degree to which students feel they are accepted, respected, included and supported by faculty members and other students in the General Engineering program. A sense of belonging in engineering is conducive to positive learning experiences and eases the transition to college for first-year students. In contrast, lack of belonging in engineering has shown to be related to students’ choice to leave engineering. Jones et al. found that engineering belonging was the most significant predictor of first-year engineering students’ intention to remain in their selected engineering major.
Engineering program expectancy. Expectancy is a subjective evaluation of one’s competence in a particular domain. Self-perceptions of competence are central to many theories in the field of motivation, such as self-concept theory, self-efficacy theory, and expectancy-value theory. An individual’s expectancy beliefs are influenced by many factors including past experiences (e.g., how well they performed in a high school math class), the influences of socializers (e.g., parents, teachers and peers) and their identity beliefs. Engineering expectancy has been linked to higher achievement, which could in turn affect major choice.

MUSIC model of academic motivation. While the previous constructs are considered to be associated with the student themselves, they do not pertain to specific courses. To this end, the MUSIC model of academic motivation was used to measure student motivation in the FYE courses. Academic motivation is important because motivated students tend to engage in activities that promote learning and achievement in an academic setting. The five key principles of the MUSIC model are that students are more motivated when they perceive that (1) they are empowered, (2) the content is useful, (3) they can be successful, (4) they are interested, and (5) they feel cared for by others in the learning environment. Thus, the MUSIC model inventory measures student perceptions of empowerment, usefulness, success, interest, and caring. This model can be used both for assessment purposes, and to inform course design.

Relationships among constructs. Osborne and Jones developed and validated a model of domain identification which describes the relationships between (1) background factors; (2) identification with an academic domain; (3) motivational beliefs; and (4) choices, effort, and persistence. The aim of this study was to explore relationships between constructs included in this model and the likelihood students’ change their major by the end of the first year. A modified version of the model including the constructs and variables used in this study is shown in Figure 1. Student level of identification with engineering has been linked with several motivational beliefs. Engineering utility, engineering program belonging, and engineering program expectancy were chosen for this study because they have been identified as useful constructs for predicting engineering student choices, effort, and persistence. More specifically, they have been linked to major choice in engineering and persistence in engineering programs, as noted in the prior section. According to the model, identification and motivational beliefs are also influenced by background factors, including group membership (race, gender, social class) and formal and informal educational experiences. For this study, gender, tuition classification (in-state vs. out-of-state), underrepresented minority status (URM), and first-generation status were obtained from university records data and included in the analysis. The MUSIC inventory items are also considered background factors, as they pertain to the educational experience in the first-year engineering courses. Many aspects of students’ educational experiences can affect their motivational beliefs and identification with a domain. For example, an individual’s experience in a FYE course can affect their engineering expectancy, which in turn impacts their level of identification with engineering.

![Figure 1: Modified version of the Osborne and Jones model of domain identification showing the relationships between the variables and constructs in this study.](image-url)
**Research Questions**

This study utilized existing survey data collected over a three-year period to explore relationships between incoming students’ perceptions of identity and motivation constructs (e.g. engineering identification, engineering utility), demographic information, and engineering major choice at the end of the first year. Specifically, the following research questions were addressed:

1. How do student perceptions of engineering-based identity and motivation constructs change throughout the first-year program?
2. What is the relationship between incoming data (motivation constructs and demographic data), and the likelihood that students will change their major by the end of their first year?

**Methods**

All first-year and transfer students are initially admitted to a General Engineering program at this institution. After completing the first-year curriculum, students are eligible to declare an engineering major. Surveys were administered to the general engineering students at the beginning and end of their first semester and again at the end of their second semester. This study includes data collected since 2014 when the survey was last updated. Survey items collect information about respondents’ preferred choice of any of the engineering majors offered as well as an option to indicate “undecided”. Additional items are designed to collect information about future intention to pursue engineering as a major and career, as well as items associated with existing validated scales described in the following sections.

<table>
<thead>
<tr>
<th>Term</th>
<th>Enrolled</th>
<th>Responses</th>
<th>Response Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2014</td>
<td>1379</td>
<td>1015</td>
<td>73.60</td>
</tr>
<tr>
<td>Fall 2015</td>
<td>1721</td>
<td>1296</td>
<td>75.31</td>
</tr>
<tr>
<td>Fall 2016</td>
<td>1541</td>
<td>1128</td>
<td>73.20</td>
</tr>
</tbody>
</table>

**Table 1**: Course enrollment and survey response rate by term.

All students enrolled in the first-year courses were invited to take the survey. In Table 1, we report total number of enrolled students and the number of consented survey responses per Fall semester. There are no known systematic non-response biases and so we believe the sample is representative of the population.

**The Instrument.** Each of the following scales included on the first-year survey consists of 4-8 items measured on a 6 point Likert scale (1 – strongly disagree, 6 – strongly agree).

*Domain identification.* Jones, Ruff, and Paretti [9] developed an engineering identification scale by adapting an established academic identification scale by Schmader, Major, and Gramzow [26]. This scale included four items and they reported Cronbach’s alpha[^1] to be good (α = 0.89). An example question on the first-year survey is “Being good at engineering is an important part of who I am.”

*Engineering utility.* These six items were adapted from the General Utility Scale[^27] (α = 0.90). Jones et al. [8] used the same 6-item scale to measure engineering utility and reported a high Cronbach’s alpha (α = 0.97). This adjusted scale has been used in previous published work[^25]. Items on the first-year survey are worded to ask about both timeless/current goals (e.g. “Having a solid background in engineering is worthless to me”), as well as future goals (e.g. “After I graduate, an understanding of engineering will be useless to me”). These items were all reverse-scored so that a higher score indicated a higher engineering utility value.

[^1]: Cronbach’s alpha is a measure of internal consistency, higher values indicate that items vary with one another.
Engineering expectancy and ability. The items on this scale are based on the engineering ability perception scale[9] (α = 0.87). The word “mathematics” was replaced with “engineering” in each item. The modified scale was validated by Jones et al. [8] (α = 0.93). The first-year survey includes both relational, e.g. “compared to other engineering students, I have high engineering-related abilities” and individual, e.g. “I have been doing well in my engineering-related courses this year” items.

Engineering program belonging. These eight items on the first year survey are specifically about belonging in the General Engineering program, rather than the field of engineering more broadly. They were adapted from the 18 item Psychological Sense of School Membership Scale[28] which has had Cronbach’s alpha reported to be between 0.78 and 0.95 depending on the study[29]. The modified 8-item scale was also validated by Jones et al. [8] (α = 0.81). Items on the first year survey include statements like “I feel like a real part of the General Engineering program” and “the instructors in the General Engineering program respect me.”

Music model items. Because the MUSIC items pertain to students experience in the course, they are only included on the surveys offered at the end of the first and second semesters. Students reported their perceptions of each of the MUSIC model components using the MUSIC Model of Academic Motivation Inventory – College Student version[30], which includes five empowerment items, five usefulness items, four success items, six interest items, and six caring items. This inventory has been validated in several studies and has been shown to adequately represent the five-factor structure of the MUSIC model with college students (empowerment α = 0.75; usefulness α = 0.90; success α = 0.90; interest α = 0.83; and caring α = 0.75 ). Items on the survey related to the MUSIC model include “I had options in how to achieve the goals in the course” (Empowerment), “In general the coursework was useful to me.” (Usefulness), “I was confident that I could succeed in the coursework.” (Success), “The instructional methods used in this course held my attention.” (Interest), and “The instructor was willing to assist me if I needed help in the course” (Caring).

Additional Items. In addition to the items that were pre-identified as contributing to the identity and motivation constructs listed above there were items on the survey that did not map to any known constructs. To include information from these items in further analysis we did a factor analysis and found two factors that we named “conviction” and “course objectives”. Items loading onto the “conviction” factor include:

- I am confident in my choice of a specific major.
- I am confident that I want to study engineering.
- My eventual career will directly relate to engineering.
- I plan to continue on in an engineering major.

Items loading onto the “course objectives” factor include:

- I can identify the fields of engineering that contribute to the development of an engineering product or process.
- I can identify and access appropriate sources of information.
- I can write an effective summary of synthesized information and appropriately cite sources.
- I can develop and deliver an effective oral presentation
- I actively monitor and evaluate my contributions to teamwork.
- I can articulate and elaborate on skills used in problem solving.
- I can effectively estimate a solution.
- I can represent an engineering system visually.
- I am aware of global issues and emerging technologies and their impact on engineering practice.
It is important to note that while the Tucker Lewis Index of the fit was 0.93 which is considered good, the root-mean-square of the residuals was 0.15 which suggests that additional factors should be extracted. However, attempting to extract more than two factors did not improve fit statistics or residuals so we caution that the resulting factors may not be especially meaningful. Judging by the items included in each factor, the “conviction” factor seems to be reasonable as all items pertain to student confidence about their choice in engineering. This factor was later found to contribute meaningfully to the logistic regression analysis.

**University Records Data.** In addition to the survey instrument, we obtained access to university record data containing demographic data and major selection for all students admitted to the engineering program since Fall 2014. IRB approval was obtained with a protocol that allowed only project PIs access to student identifying data. The project PIs then aggregated certain markers (e.g., condensing individual ethnicities to a single underrepresented minority status flag) and made de-identified data available to the rest of the research team. De-identified data were linked to survey responses by a study id. Initial major selection was requested during pre-orientation for the college of engineering. The data set also contains first choice of major as well as final enrolled major for each student. First-year engineering students at this institution are accepted into the general engineering program and once specific course requirements are complete, they become eligible to declare an engineering major. However, only students with an overall GPA above a certain GPA requirement are guaranteed their first major choice. Students with an overall GPA below the requirement may or may not be placed in their first choice based on space availability.

**Data Analysis.** To explore major change between pre-orientation selection and final enrollment we start by generating a frequency table shown in Table 2. There were four small majors that are relatively specific to our institution that were lumped into an “Other” category. We can see those majors collectively had the highest percent change. This is likely due to these majors being less well known to incoming students than some other more familiar choices such as Mechanical Engineering (ME), Electrical Engineering (EE), and Computer Science (CS).

<table>
<thead>
<tr>
<th>Major</th>
<th>Major Code</th>
<th>PreOrientation</th>
<th>FirstChoice</th>
<th>Change</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace Engineering</td>
<td>AE</td>
<td>346</td>
<td>306</td>
<td>-40</td>
<td>-11.56</td>
</tr>
<tr>
<td>Biological Systems Engineering</td>
<td>BSE</td>
<td>102</td>
<td>130</td>
<td>28</td>
<td>27.45</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>CE</td>
<td>203</td>
<td>322</td>
<td>119</td>
<td>58.62</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>CHE</td>
<td>276</td>
<td>244</td>
<td>-32</td>
<td>-11.59</td>
</tr>
<tr>
<td>Computer Engineering</td>
<td>CPE</td>
<td>265</td>
<td>329</td>
<td>64</td>
<td>24.15</td>
</tr>
<tr>
<td>Computer Science</td>
<td>CS</td>
<td>392</td>
<td>572</td>
<td>180</td>
<td>45.92</td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>EE</td>
<td>248</td>
<td>300</td>
<td>52</td>
<td>20.97</td>
</tr>
<tr>
<td>Industrial Systems Engineering</td>
<td>ISE</td>
<td>110</td>
<td>357</td>
<td>247</td>
<td>224.55</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>ME</td>
<td>743</td>
<td>823</td>
<td>80</td>
<td>10.77</td>
</tr>
<tr>
<td>Material Systems Engineering</td>
<td>MSE</td>
<td>56</td>
<td>121</td>
<td>65</td>
<td>116.07</td>
</tr>
<tr>
<td>Other</td>
<td>Other</td>
<td>68</td>
<td>208</td>
<td>140</td>
<td>205.88</td>
</tr>
<tr>
<td>Undecided</td>
<td>Undecided</td>
<td>903</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Number of students declaring interest in each major at pre-orientation and their first choice of major at the end of the first year. These data span Fall 2014 through Fall 2016. A student’s first choice of major may not be the major they officially enroll in due to various eligibility requirements.

We also look at the frequency and proportions of the dichotomous variables Gender, Tuition, underrepresented minority status (URM), FirstGeneration, and Change Major displayed in Table 3. The “Change Major” variable was generated from the pre-orientation major selection and final enrollment and is TRUE when the two are different. Note that these data include both undecided students, and students who were admitted to the university in a college other than engineering but later changed their major into engineering.

**Identity and motivation constructs during the first-year engineering program.** The first goal of this study was to investigate how student perceptions of the identity and motivation constructs change throughout the first-year engineering program. To address this question, 2-sample t-tests were conducted on student responses to the first and
Table 3: Frequency and proportion of each dichotomous variable used from the university records dataset. Data spans Fall 2014 through Fall 2016 and only observations that included final enrollment in an engineering major are included.

Table 4: A comparison of mean values of variables for beginning and end of year surveys.

**d > 0.50, medium effect; *d > 0.20, small effect

Relationship between identity and motivation constructs and likelihood to change major. To explore relationships between the identity and motivation constructs and likelihood to change major by the end of the first year, we conducted a logistic regression analysis. Logistic regression is a method to develop a model to predict a binary outcome (e.g. does a student’s intended major change or not) given a set of predictor variables.

An outcome variable changeMind was generated from pre-orientation major selection and first choice of major at the end of the first year for each student. If these two were the same, then changeMind=No, otherwise changeMind=Yes. In this data set, all students who are initially “Undecided” declare a first choice of major at the end of the year; thus, the number of students who are “Undecided” and do not change their mind is zero. Logistic
regression can not generate a valid solution when there are empty cells like this, so for this part of the analysis we filter the data to include only those students who declare an interest in a major other than “Undecided” during pre-orientation (N = 3,139). Using the \texttt{rms} package for R and the procedure for fitting and reducing a logistic model described in\textsuperscript{23} we fit a logistic model for the this outcome with the identity constructs (domain identification, engineering utility, engineering expectancy, and program belonging), MUSIC model items (empowerment, usefulness, success, interest, caring), and demographic information (gender, tuition, first generation status, and pre-orientation major selection) as potential predictors. To simplify the model by removing predictors that were likely not contributing significantly to the outcome we used the \texttt{fastbw} function which implements an algorithm based on\textsuperscript{24} The result of this model reduction resulted in a reduced model containing only conviction, first generation status, and pre-orientation major selection as predictors. The odds ratio for each of these predictors is shown in Table \ref{tab:odds_r}. An odds ratio greater than one indicates that an increase in that predictor increases the odds of a student changing majors while an odds ratio less than one indicates an increase in that predictor decreases the odds of a student changing their mind. For categorical variables with more than two categories, such as pre-orientation major intent, predictors are generated for each value compared to a reference value. In this case the reference value is industrial systems engineering (ISE) because students who selected it as their pre-orientation choice were least likely to change their mind. For example the odds ratio of 1.11 for “CS” is interpreted to mean that the odds of someone changing their mind are 1.11 times greater for CS as compared to ISE. The 95% confidence intervals of odds ratio also reported in Table \ref{tab:odds_r} help assess the strength of each predictor. Predictors with odds ratio confidence intervals that cross 1 should not be taken to be significant since in those cases a particular direction of influence can not be determined.

<table>
<thead>
<tr>
<th></th>
<th>Odds ratio</th>
<th>Lower 0.95</th>
<th>Upper 0.95</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conviction</td>
<td>0.67</td>
<td>0.60</td>
<td>0.74</td>
</tr>
<tr>
<td>FirstGeneration - Y:N</td>
<td>1.54</td>
<td>1.18</td>
<td>2.01</td>
</tr>
<tr>
<td>CS</td>
<td>1.11</td>
<td>0.60</td>
<td>2.04</td>
</tr>
<tr>
<td>AE</td>
<td>3.43</td>
<td>1.89</td>
<td>6.21</td>
</tr>
<tr>
<td>CHE</td>
<td>3.84</td>
<td>2.11</td>
<td>7.00</td>
</tr>
<tr>
<td>ME</td>
<td>2.75</td>
<td>1.55</td>
<td>4.87</td>
</tr>
<tr>
<td>EE</td>
<td>4.41</td>
<td>2.42</td>
<td>8.03</td>
</tr>
<tr>
<td>CE</td>
<td>1.28</td>
<td>0.67</td>
<td>2.47</td>
</tr>
<tr>
<td>CPE</td>
<td>4.06</td>
<td>2.21</td>
<td>7.43</td>
</tr>
<tr>
<td>MSE</td>
<td>1.39</td>
<td>0.56</td>
<td>3.45</td>
</tr>
<tr>
<td>BSE</td>
<td>4.72</td>
<td>2.33</td>
<td>9.54</td>
</tr>
<tr>
<td>Other</td>
<td>6.72</td>
<td>3.02</td>
<td>14.95</td>
</tr>
</tbody>
</table>

Table 5: Summary of reduced model fit to data with Undecided records removed. All majors are PreOrientation Intent relative to ISE. For example the odds of changing one’s mind of intended major are 1.11 greater for CS as compared to ISE.

Discussion

Considerations. It is important to note that the data used for this analysis do not capture all possible data that would be important to understanding how student’s intended major change. For example, we do not have information on instructors of the first-year courses so we can not determine if particular course instructors are more or less influential in students changing their minds. Also, meetings with academic advisors and information sessions about different majors offered are not captured in these data but are likely significant influences to students’ major choice decisions.

Changing Intended Major. The results of the logistic regression indicated that neither identity constructs, nor MUSIC model constructs measured in the first-year data were significant predictors of whether a student would change their intended major from their pre-orientation choice. Upon reflection this is not surprising as these constructs measure student’s perception regarding engineering as a whole, rather than specific disciplines. The
factors that did result in the final model as significant predictors were conviction, first generation status, and pre-orientation major choice.

**Conviction** The conviction score was calculated from items that asked students about their intent to change major, and an odds ratio for conviction of 0.67 indicates that the probability of changing majors goes down as conviction increases. The directionality of this relationship is as we would expect and the inclusion of conviction in the final model indicates that student’s self-reported confidence in their initial major choice may be a useful predictor of whether or not they actually will remain with their initial choice or not.

**First generation** The odds ratio of 1.54 indicates that the odds of changing engineering major from the pre-orientation choice is higher for first generation students compared to their peers. The inclusion of first generation status in the logistic model could be explained by the likelihood that incoming first generation students have less information about the different engineering majors than students who’s parents went to college. If their pre-orientation choice is made from limited information, then we would expect that after learning more about the field of engineering over the course of their first year they may discover a different engineering major is a better choice.

**Pre-orientation major selection** The inclusion of the pre-orientation major selection in the model could be explained because certain engineering majors such as electrical, mechanical, and civil are more familiar to incoming students and so they may select from these familiar majors during pre-orientation. During the first year all students learn more about the different majors, including majors they did not know existed during pre-orientation. It is not surprising then that some students may change their mind to a major they were not aware existed when they first enrolled.

In summary, the identity and motivation constructs measured with the first year survey did not show any statistically significant changes over the first year, nor were they significant predictors of changing majors. The absence of a relationship between these constructs and changing majors within engineering is not surprising as the constructs measure perceptions of engineering as a whole rather than specific disciplines. An implication of this finding could be that we must ask students different questions if we want to learn how their perceptions of engineering change of the first year. In other words, because students tend to score high on identity and motivation constructs both at the beginning and end of their first year, these scales may not be particularly useful for addressing questions of impact of the first-year program. In the university record data described here we also have information about whether students leave the college of engineering for a non-engineering major. It is possible that further analysis will indicate a relationship between the measured constructs and the probability of changing to a non-engineering major.

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