Understanding How Female Students Navigate through Undergraduate Engineering Programs via an Examination of Their Intended and Declared Majors

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Abstract

Some engineering students find choosing a discipline to study in college a challenge while others seem to have a clear cut path toward their degree. How strongly students believe they are in the right major will affect their perceived ability to succeed, and the likelihood they will stay in engineering. Students may be introduced to engineering majors in high school or early college, and proper introductions can help students make informed choices on their chosen majors. However, if students do not receive timely and appropriate introductions to majors, they may find themselves in the 'wrong' major, with respect to their interests or goals. Students feel pressure to choose the 'right' major very early in their academic career, due to possible negative consequences of switching.

Prior research with the MIDFIELD database has done a thorough job of examining how engineering students navigate to their degrees by studying major pipelines, pathways, and most recently ecosystems. This study, however, drills down to a specific cohort of students - female students in their first semester of a First-Year Engineering (FYE) program. It has been estimated that roughly one-half of these students enter into a major their sophomore year different from what they initially planned at the beginning of their freshman year. This longitudinal study examines the intended and declared majors of five cohorts of female students as they progressed through FYE, into an engineering discipline, and finally to their earned bachelor degree. Two types of students: Dedicated and Unsure, and three categories of majors: Confident, Middle Ground, and Unknown have been identified and defined. Results will be used to better understand the 'major pathway' that female students take through engineering and to develop timely and impactful interventions to aid students as they come to decision points along their pathways.

Introduction

Understanding the pathways that female engineering students navigate through the engineering curriculum may provide insight into the types of majors that attract the different students. Selecting a specific discipline within the field of engineering may be a challenge and stress point for some. Proper introduction to engineering majors may help these students fully explore the variety of majors. If, however, a student finds themselves in the 'wrong' major they can elect to stay within a

major that may not fit their interests or goals, or to migrate to other majors (either within engineering or outside the field), which may be difficult due to required courses[1,2] or could have negative consequences on their time to degree[3]. As such, students may feel pressure to choose the 'right' major early on.

Research shows that the perceived fit of a student's major is correlated with their self-efficacy[4] and that interest/major fit is an important factor in major persistence[5]. Optimism with a major, closely related to perceptions and confidence, has also been shown to predict satisfaction with a major[6]. Therefore, the magnitude of a student's belief that they are in the right major, as well as their optimism toward that major, affect not only their perceived ability to succeed, but also their satisfaction with that major and the likelihood they will persist.

Prior research on engineering students found that when students switched between STEM majors, they were switching due to major and department fit, rather than just academic difficulties[7]. Lower self-confidence in female engineering students increases the chances of leaving their major[8]. Similarly, female engineering students are more likely than male to transfer out of a major after failing a course and they attribute their poor performance to their own "lack of ability" whereas men attribute their poor performance to "lack of hard work" or being "treated unfairly"[9].

Pierrakos et al.[10] found that freshman engineering students who persist have meaningful experiences and exposure to engineering both prior to entering college and during their freshman year, whereas the students who switched out of engineering had limited knowledge or even mis-perceptions of engineering prior to college, and developed a negative attitude toward the major during their freshman year. These findings may also be applied to engineering students who migrate between majors, as they may have limited knowledge or misinformation about the various disciplines.

A plethora of research has been completed by the Multiple-Institution Database for Investigating Engineering Longitudinal Development (MIDFIELD) team who utilizes this vast database to examine how students maneuver through the engineering curriculum[11]. Prior work has explored students who switch or persist between majors, inside and out of STEM fields. Ohland et al.[12] states that it is common for undergraduates to "choose, un-choose and re-choose their college majors", for all majors, not just engineering. Other MIDFIELD work has explored Direct Matriculation versus First-Year Engineering (FYE) programs, and found advantages and disadvantages to each in engineering student persistence[1]. For example, students in FYE programs (where students are afforded more time to select their major as they matriculate into their discipline after their first year), seem to make informed choices about specific engineering majors, and students in direct programs may struggle to switch majors in the case of a poor initial match.

This longitudinal study examines the intended and declared majors of five cohorts of female engineering students from a large, Midwestern research university where all engineering students begin in a FYE program and typically matriculate to their specific engineering discipline at the start of their sophomore year. It has been estimated that roughly one-half of these students enter into a major their sophomore year different from what they initially planned at the beginning of their freshman year (unpublished institutional data). At the study institution, FYE advisors assist students in deciding on and transferring into their major discipline. A study on community college transfers into universities showed that poor advising was a large source of confusion and disappointment to

the students[13]. In addition, women and minorities within different STEM programs may need different types of mentoring and advising[14]. This highlights the vital role that advising plays along a student's major pathway. Results will not only provide a better understanding of the pathways that female students navigate through engineering, they will also be used to develop meaningful and timely interventions to aid in student persistence and time to degree.

Methods

This study explores the major pathways of five cohorts of first-year female engineering students who entered the institution from 2008 to 2012. All engineering students at the study institution begin in an FYE program and typically matriculate into a specific engineering major at the beginning of their sophomore year. The participants for this study were first semester students who elected to enroll in a one credit Women in Engineering seminar course that explores engineering majors and professions, and allows students to network with alumnae.

Table 1 lists the abbreviations of the engineering majors at the study institution. Note that IDE and MDE are separate majors but have been combined for the purposes of this study. Also, EEE previously existed within IDE/MDE and was first granted as a stand-alone degree in 2013. Hence, EEE data are not consistent across cohorts and while the data are shown for completeness, EEE will only be included in limited discussions.

Table 1: Abbreviations of Majors

Abbreviation	Major
AAE	Aeronautical and Astronautical Engineering
ABE	Agricultural and Biological Engineering
BME	Biomedical Engineering
CE	Civil Engineering
CEM	Construction Engineering and Management
ChE	Chemical Engineering
ECE	Electrical and Computer Engineering
EEE	Environmental and Ecological Engineering
IDE/MDE	Interdisciplinary or Multidisciplinary Engineering
IE	Industrial Engineering
ME	Mechanical Engineering
MSE	Materials Engineering
NE	Nuclear Engineering
UND	Undecided

The data used in this study were collected from FYE female students who elected to enroll in a one credit Women in Engineering seminar. All students completed a course pre-survey in August and a course post-survey in December. Official departmental enrollment and earned degree information for each participant was obtained from the institution. The study years (2008 through 2012) were intentionally selected to accommodate a six-year graduation rate, which has previously been shown to accurately predict overall graduation rates[15].

A complete major pathway was created for each participant that included up to three prospective majors indicated in August of their first-year, the one preferred major indicated in December of

their first-year, their subsequent declared major(s) as they progressed through the institution, and their earned bachelor's degree (Figure 1). Major pathways of participants were investigated to identify discernible trends or patterns in the data.

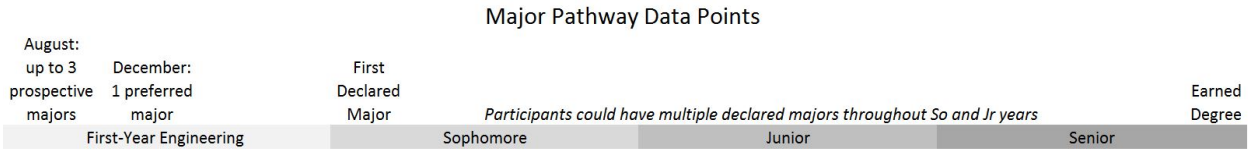

Figure 1: Timeline of Major Pathway data collection points. Students were able to list up to three perspective majors in August and one preferred major in December.

Results

There were a total of 776 participants over the five cohorts, 693 (89.3%) of whom graduated with a bachelor's degree from the study institution within six years. The majority of participants, or 583 (75.1%), earned engineering degrees, 50 (6.4%) earned degrees in other STEM fields, 60 (7.7%) earned degrees in non-STEM fields, 79 (10.2%) did not graduate from the study institution, and 4 (0.5%) have yet to graduate (Table 2).

Table 2: Percentage of Degrees Earned by Field and Cohort

Degree Earned	2008	2009	2010	2011	2012
Engineering	68.6%	76.8%	76.6%	72.1%	79.8%
Other STEM	7.4%	8.0%	7.6%	5.8%	4.8%
Non-STEM	14.9%	4.5%	8.3%	6.8%	5.8%
Did Not Graduate	9.1%	10.7%	7.6%	15.3%	7.7%
Not Yet Graduated	0.0%	0.0%	0.0%	0.0%	1.9%
Total Count	121	112	145	190	208

A breakdown of the engineering degrees earned by participant versus the prospective major(s) they listed on the August pre-survey is provided in Table 3. For example, of the 37 AAE degrees earned, 33 of the students mentioned only AAE in August, one mentioned only ChE, one mentioned both AAE and EEE, one mentioned both NE and MSE, and one mentioned only EEE. An August Mention Rate (AMR), defined as the total number of mentions by major divided by total mentions, was also calculated and is provided in Table 3. In total, the 583 engineering degree earners mentioned 696 prospective majors on the August pre-survey. August Mention Rates ranged from a high of .20 to a low of .00 and the 14 majors clearly clustered into three groups: a 'High' rate was defined for ME, ChE and BME with an AMR of .15 or greater, a 'Moderate' rate was defined for CE, AAE, IE and ECE with an AMR of less than .15 down to .05, and the remaining majors had a 'Low' AMR of less than .05.

Of the 583 participants who earned engineering degrees, 43.1% (or 251) are considered Dedicated students, meaning that they listed only one major in August, that same major again in December, matriculated into, and graduated from that dedicated major. The other 332 graduates (56.9%) are

Table 3: Student Mentions: Engineering Degrees Earned vs. Prospective Majors

		Prospective Majors													
Majors	Number earned	AAE	ABE	BME	CE	CEM	ChE	ECE	EEE	I/ MDE	IE	ME	MSE	NE	UND
AAE	37	34					1		2				1	1	
ABE	52	2	9	16	5		13	1	8	1	2	3	2	1	
BME	63	1		61	1		8					1		1	1
CE	45	3	1	1	29		4		3		3	6			2
CEM	9				5	1	2	1				1			
ChE	91	1	2	17	3		72	2			2	4	3	1	5
ECE	37	1	1	2	1		2	25			3	6			1
EEE	13			5	1		3		3			1	1		1
I/MDE	11			5	2		2			1		2	1		
IE	94	6	1	14	10		4	9	2		31	20	1		11
ME	99	12	2	15	11		7	5	1		5	59	2	1	9
MSE	26			3	2		14	1			1	2	6	1	1
NE	6	1												6	
Total Mentions		61	16	139	70	1	132	44	19	2	47	105	17	12	31
August Mention Rate (AMR)		.09	.02	.20	.10	.00	.19	.06	.03	.00	.07	.15	.02	.02	.04

Rows will not sum to total degrees earned as participants were able to indicate up to three prospective majors on August pre-survey

labeled as Unsure. They either indicated multiple majors in August, listed a December major different from those indicated in August, had declared other disciplines before transferring into their final major, or some combination of these events. Even though students were asked to only list their one preferred major on the December post-survey, 45 students listed more than one major. These students are also defined as Unsure. Table 4 details both the Unsure and Dedicated students by the degree earned.

Table 4: Number and Percentage of Unsure and Dedicated Students by Degree Earned

Degree Earned	# Unsure	% of all Unsure	# Dedicated	% of all Dedicated
AAE	6	1.8%	31	12.4%
ABE	47	14.2%	5	2.0%
BME	17	5.1%	46	18.3%
CE	22	6.6%	23	9.2%
CEM	8	2.4%	1	0.4%
ChE	38	11.4%	53	21.1%
ECE	16	4.8%	21	8.4%
EEE	11	3.3%	2	0.8%
IDE/MDE	11	3.3%	0	0.0%
IE	73	22.0%	21	8.4%
ME	59	17.8%	40	15.9%
MSE	23	6.9%	3	1.2%
NE	1	0.3%	5	2.0%
Total Count	332		251	

Discussion

All entering engineering students at the study institution begin in a common FYE program. FYE programs are intentionally designed to allow first-year students the opportunity to explore various engineering fields prior to declaring a major. Students typically transition, through a semi-competitive process, into their specific engineering discipline at the start of their sophomore year. While the institution records official enrollment information, this research was able to capture additional insight into the preferred majors of FYE students at two different times during their first semester. This study explores the major pathways of 776 female engineering students who elected to enroll in a Women in Engineering seminar course their first semester of FYE. While these major pathways have been generated and examined, student intent was not collected, which raises questions as to *why* a student made a particular decision and is an interesting avenue for future work.

Each of the cohorts in the study earned engineering degrees at a higher rate than their institutional peers when compared to the six-year graduation rates of both the overall engineering student body (from 5% to 15% higher) and the female engineering student body (7% to 12% higher). The percentage of total female engineering students who left the study institution with no degree was equal to or greater than those who were enrolled in the course (see Table 2 for participant data, study institution information gathered from public data sets at www.purdue.edu). Hence, enrollment in the Women in Engineering seminar course is associated with an increase in persistence for first-year female engineering students.

The data are examined first from the perspective of the students and secondly from the perspective of the majors. General categories are proposed to help understand how different types of students navigate the curriculum and how different types of majors may attract students. The discipline of Industrial Engineering proved to yield interesting results and a brief case study is presented.

Students: Dedicated versus Unsure

Understanding the major pathways of female engineering students as they navigate from FYE to their earned bachelor's degree may allow for the development of appropriate and timely interventions to aid students while making decisions regarding their major. The 583 students who earned engineering degrees were divided into two groups; those whose pathways were Dedicated (43.1%) and those whose were Unsure (56.9%).

A majority (68%) of the Dedicated students earned degrees in four different fields: ChE (21.1%), BME (18.3%), ME (15.9%), and AAE (12.4%) (Table 4). ChE, BME, and ME all saw high AMRs and AAE a moderate rate (Table 3). A majority of the Unsure students (65%) earned degrees in four areas: IE (22%), ME (17.8%), ABE (14.2%), and ChE (11.4%) (see Table 4). IE had a moderate AMR and ABE a low AMR (Table 3).

ChE and ME are majors that are attractive to both Dedicated students and Unsure students. These are long-standing, well-established engineering fields where graduates are able to work in a vast array of industries. BME and AAE, on the other hand, are specialized fields but also attracted

Dedicated students whereas IE and ABE are broader disciplines and attracted Unsure students.

It is worth noting that BME had the highest AMR (Table 3) however, it is a highly competitive major at the study institution. Of the 135 students who initially mentioned BME, only 61 (or 45.2%) earned that degree. The majority of the others earned degrees in ABE, ChE, IE, and ME, which are all areas that enable graduates to work in the biomedical field if desired.

Majors: Final Degrees versus Prospective Majors

Major pathways are examined by comparing final degree earned with prospective major(s) indicated in August, preferred major indicated in December, and First Declared Major. Figure 2 shows the Degree Earners Interest Percentage (DEIP) of students who mentioned their earned degree at each of the first three pathway points (August, December, and First Declared Major). The majors have been grouped by the August DEIP and divided into three categories: Confident, Middle Ground, and Unknown. The majors categorized as Confident are NE, BME, and AAE and are defined by an August DEIP of 90% or greater; the vast majority of degree earners indicated their majors in August which is interpreted as strong confidence in their pathway decision. The Middle Ground majors are ChE, ECE, CE, and ME with an August DEIP of 50% to less than 90%; interpreted as students having a knowledge of the existence of the major and moderate level of interest in pursuing it. The Unknown majors are IE, MSE, EEE, ABE, CEM, and IDE/MDE with an August DEIP of less than 50%; these majors have a low to moderate AMRs and few degree earners seem to know about or have little interest in pursuing these fields.

The Confident majors, NE, BME and AAE, can be considered speciality majors where the curriculum is targeted to preparing students for work in those specific industries. Students who earn degrees in these fields indicate their interest very early on with an August DEIP over 90% and a December DEIP at 100% for AAE and NE. There is, however, ample student interest in AAE and BME as shown in the AMRs (see Table 3), but many students go on to pursue other majors. Another interesting aspect of Confident majors is that within each discipline, they had the fewest percentage of Unsure students and conversely the largest percentage of Dedicated students earning degrees (Figure 3). Overall, the overwhelming majority of students who earned AAE, BME, and NE degrees exhibit confidence by remaining steadfast in that one major for the duration of their undergraduate studies. It is also important to note that only 7% of all Unsure students elect to pursue one of these three fields.

The Middle Ground majors are ChE, ECE, CE, and ME. Of the students who earned these degrees, between 50% to 80% mentioned their major in August (Figure 2). These majors are more broad, as compared to those in the Confident group, in that graduates are able to work or conduct research in a wide variety of fields. These fields also garnered moderate to high interest by students in August (Table 3). It is important to recognize that the four Middle Ground majors well-established and therefore well-known. They are in the top six largest departments by student body at the study institution, and are four of the five oldest fields of engineering based on the year their respective professional societies were formed (American Society of Civil Engineers established in 1852 (www.asce.org/about asce); American Society of Mechanical Engineers established in 1880

	Earned Degree	August	December	First Declared Major
Confident	NE	100.0%	100.0%	100.0%
	BME	96.8%	92.1%	100.0%
	AAE	91.9%	100.0%	100.0%
Middle Ground	ChE	79.1%	87.9%	98.9%
	ECE	67.6%	73.0%	97.3%
	CE	64.4%	82.2%	100.0%
	ME	59.6%	77.8%	99.0%
Unknown	IE	33.0%	64.9%	85.1%
	MSE	23.1%	76.9%	96.2%
	EEE	23.1%	38.5%	46.2%
	ABE	17.3%	65.4%	88.5%
	CEM	11.1%	66.7%	100.0%
	IDE/MDE	9.1%	18.2%	63.6%

Figure 2: Degree Earners Interest Percentage (DEIP): The percentage of students who mentioned their earned degree at each of the first three pathway points. The majors have been categorized by the August DEIP into Confident (90% or more of the students mentioned their earned degree in August), Middle Ground (50% up to 90%), and Unknown (less than 50%) .

(www.asme.org/about-asme/engineering-history); American Institute of Electrical Engineers that went on to become the Institute of Electrical and Electronics Engineers established in 1884 (www.ieee.org/about/ieee-history); American Institute of Chemical Engineers established in 1908 (www.aiche.org/about/institute-milestones)). Of the degrees awarded in these four fields, 40.7% went to Unsure students (Table 4). However, more than 97% of the students in these Middle Ground majors matriculated to their earned degree field directly from FYE as indicated by the First Declared Major DEIP (Figure 2). Many students who originally indicated interest in the more specialized fields, such as AAE or BME, landed in these broad majors, where they would still have the opportunity to work in their desired specialized fields. The Middle Ground majors are also a landing spot for UND students; of the students who listed Undecided on their August survey, 54.8% of them earned a degree in a Middle Ground major (see Table 3).

Among all the Confident and Middle Ground majors, 375 of the 378 (or 99.2%) students earned degrees in their First Declared Major fields. This result supports the findings of Orr et al.[1] who found that 89% of FYE students graduate in their first declared major underscoring the importance that FYE programs afford students time to make informed choices about specific engineering majors.

The third category of majors is classified as Unknown: IE, MSE, EEE, ABE, CEM and IDE/MDE (Figure 2). These majors, with the exception of IE, all had a low AMR (Table 3). However, each of these majors saw the majority of their degrees go to Unsure students (Figure 3). The Unknown group of majors obviously become known or appealing to the students during their first semester as

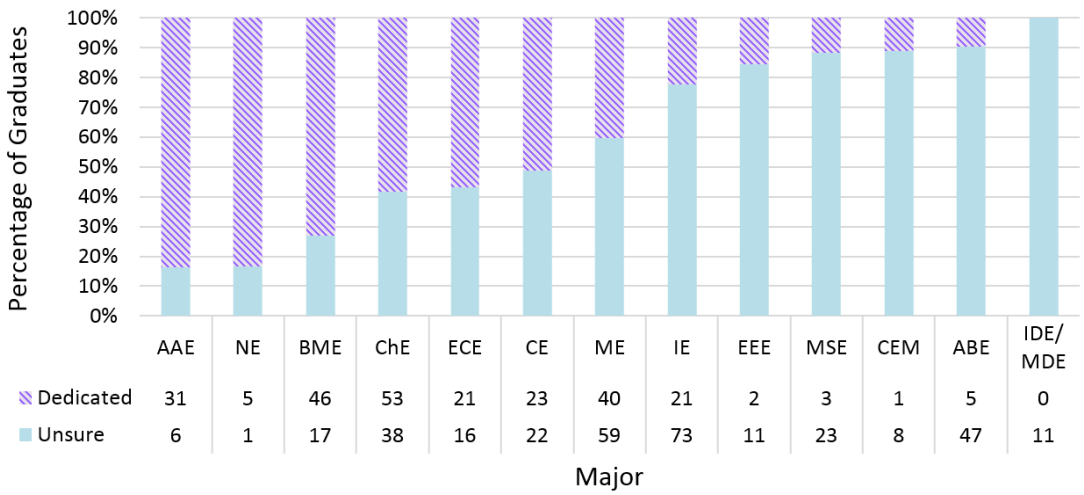

Figure 3: The percentage and number of graduates earning each major delineated by the student designations of Unsure and Dedicated.

IE, MSE, ABE, and CEM see a 65% or higher December DEIP. Also interesting to note is that four of the Unknown majors, IE (85.1%), ABE (88.5%), EEE (46.2%), and IDE/MDE (63.6%), have the lowest First Declare Major DEIP (Figure 2) indicating that students are finding these majors after they have matriculated into their First Declared Major.

Of the 583 students who earned engineering degrees, only 35 (6.0%) were "migrators", or students who move from their first declared major to another. All 35 of these students earned degrees from the second major they declared. A total of 91.4% migrated into a major from the Unknown group, either IE (40.0%), EEE (20.0%), ABE (14.3%), IDE/MDE (14.3%), or MSE (2.9%) (see Table 5). There is no discernible pattern to the majors they migrated from but it is interesting to note that 48.6% migrated from the group of Middle Ground majors.

Ricco et al.[3] found interesting migration patterns in two of what we have categorized as Middle Ground majors (note that Ricco et al. separated Electrical Engineering and Computer Engineering). They found that Electrical Engineering students tended to switch to IE, ME and Computer Engineering while ME students went to IE, EE, and CE. While we did not find patterns in our small number of migrators, it is interesting to note that 14 of the 19 (78.9%) students who initially showed interest in (but did not earn a degree in) ECE earned degrees in IE or ME . Similarly, 32 of the 46 (69.6%) students who initially showed interest in ME earned degrees in either IE, EE, or CE (see Table 3).

The Interesting Case of Industrial Engineering

Industrial Engineering has been found to have an unusual relationship with women studying engineering. Lord et al.[16] found IE as having the greatest success of attracting and graduating "migrating" (students who move from one declared major to another) women. Foor and Walden[17] suggest that this may be caused by weakened boundaries of gendered norms due to its marginalization as "imaginary" engineering. They found that both male and female students are

Table 5: Number and Percentage of Degree Earners who were Migrators by Major

Degree Earned	# Earned	% of all Migrators
IE	14	40.0%
EEE	7	20.0%
ABE	5	14.3%
IDE/MDE	5	14.3%
ChE	1	2.9%
ECE	1	2.9%
ME	1	2.9%
MSE	1	2.9%
Total Count	35	

able to find role-models, and find IE to be more "inviteful" than other engineering majors. Even though it has been marginalized as such, it was found that IE students were quantitatively not inferior in any way to other students regarding academics (that is to say it is not any "easier" than other engineering majors)[18]. Students who selected IE did so because it was inviting and the coursework provided flexibility, they did not lose their sense of self in their engineering courses compared to other majors. And similarly, when compared to another large and well-established major, it was found that women in IE seemed to remain in the discipline *because* of the environment while women in ChE seem to remain in the discipline *in spite* of it[19].

This study found that students initially have a moderate AMR in IE which results in more than 75% of IE degree earners coming from the group of Unsure students. As such, IE attracts the migrators with 40% of students who changed disciplines graduating from IE (Table 5) and half of those coming from Middle Ground majors. This pattern is also seen at the study institution where IE receives up to 45% of all (male and female) engineering migrators (unpublished institutional data).

The August DEIP of 33% (Figure 2) clearly puts IE inside the Unknown group of majors indicating that incoming students may not know about or have interest in the discipline. We postulate that it may be possible for a major to transition from one category to another. For example, if IE became more well-known or appealing to the entering first-year students, it could transition from the Unknown category to the Middle Ground category.

Conclusions

This study explored the major pathways of female engineering students to aid in the development of appropriate and timely interventions that help ensure persistence to degree. Two types of students: Dedicated and Unsure, and three categories of majors: Confident, Middle Ground, and Unknown were identified (see Table 6 for overview).

An examination of female engineering degree-earning students showed that 43.1% were Dedicated students with regard to their major pathway and 56.9% were, at some point, unsure of their major. The majority of Unsure students earned degrees in either IE, ME, ABE, or ChE, which were identified as either Middle Ground or Unknown majors. The majority of Dedicated students earned degrees in ChE, BME, ME and AAE, which were classified as Middle Ground or Confident majors.

Table 6: Overview of Types of Students and Majors

Name	Type	Description	Characteristic
Unsure	Student	Were unsure of major along their pathway	Tend to earn Unknown majors
Dedicated	Student	Singular major along entire pathway	Tend to earn Confident majors
Confident	Major	High August DEIP	Specialized majors
Middle Ground	Major	Medium August DEIP; High to Moderate AMR	Well-established, broad majors
Unknown	Major	Low August DEIP; Moderate to Low AMR	Lesser-known, newer majors

Unsure students tend to earn Unknown majors, and Dedicated students tend to earn Confident majors, with some Middle Ground majors being common to both groups. However, the vast majority of these students earned degrees in their First Declared Major. This is similar to Orr et al.[1] who found that students in FYE programs are likely to earn degrees in their first declared major.

The Confident majors (NE, BME, AAE) were seen to be high profile, specialized majors that many students expressed interest in, but mainly students who were confident in these majors early in their first-year went on to earn those degrees. The Middle Ground majors (ChE, ECE, CE, ME) were the typically long-standing, well-established, and broad engineering majors. More than 60% of the students who earned degrees in these Middle Ground fields had mentioned them as prospective majors. The other roughly 40% showed interest in the Confident majors but matriculated to a Middle Ground major. Students who indicated an Undecided prospective major were more likely to end up in Middle Ground majors as well. For both of these groupings of majors, the vast majority of students started in these majors as their First Declared Major. The Unknown group of majors (IE, MSE, EEE, ABE, CEM, IDE/MDE) are characterized by fields that many incoming students are initially unaware of or not interested in as indicated by low percentages of mentions at the first pathway point. Also, the majority of students who either transferred from one discipline to another or who were Unsure along their pathway graduated from an Unknown major. Research shows that students choose to pursue STEM degrees while in high school, from their growing interests in science and mathematics[20]. Therefore, it seems imperative that the group of Unknown majors be introduced to high school students through various outreach channels.

This overview study of the major pathways of female engineering students helps to identify points where students become confident about their choice of major. While these major pathways have been generated and examined, student intent was not collected, which raises questions as to *why* a student may be unsure of their major or may switch majors. A qualitative study could further explore these attitudes and is an interesting avenue for future work. A focused study into each individual major would also provide a better understanding behind the type of student who pursues each field. It would also be interesting to incorporate pre-college or other demographic factors, since these have been shown to relate to chosen college majors[21]. Finally, since the female first-year students who enrolled in the one credit Women in Engineering seminar course are seen to graduate with engineering degrees at a higher rate and leave the institution at lower rate than their peers, it would be pertinent to ensure that future students enroll in such a course.

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