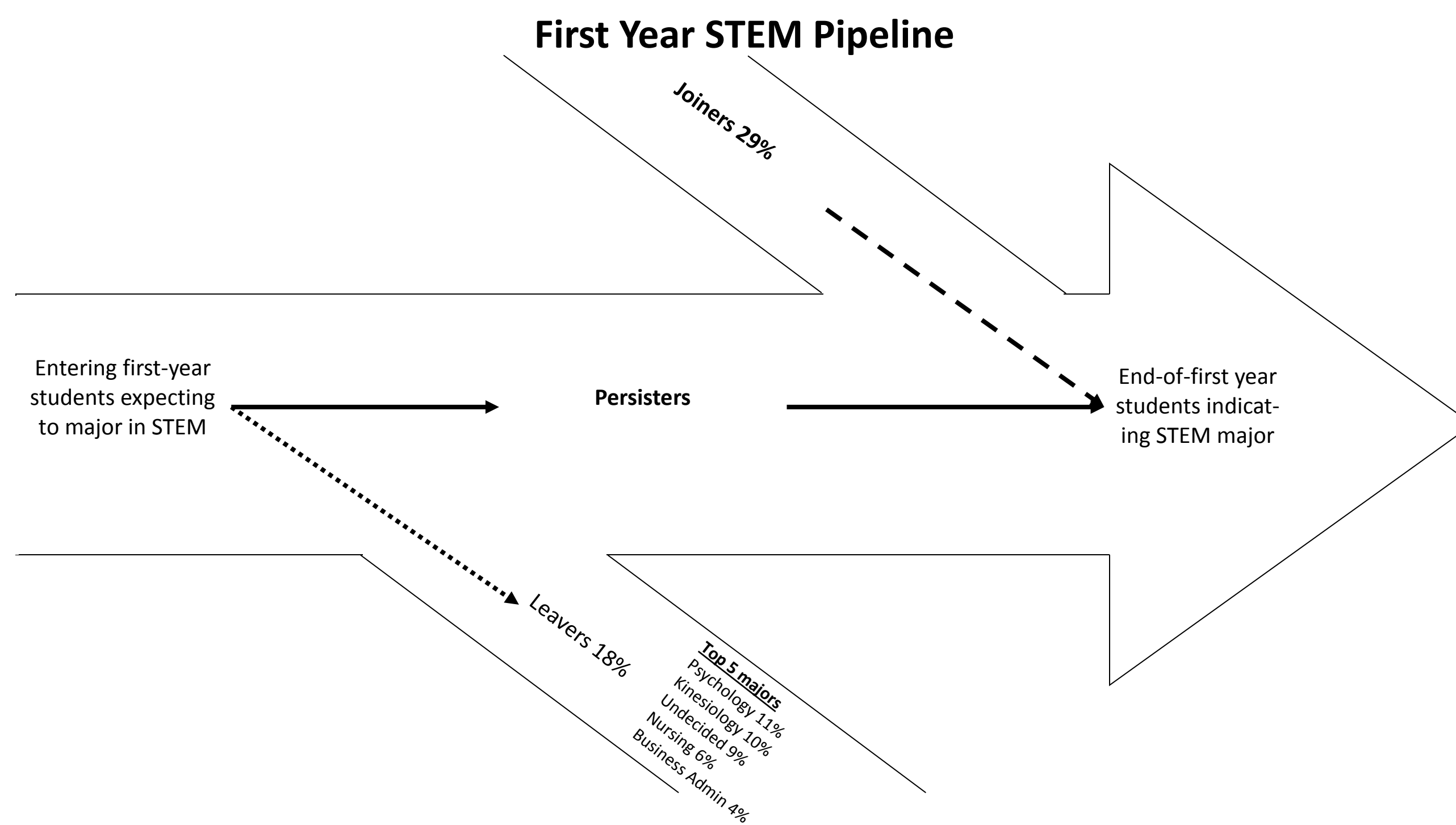


First-Year Persistence in STEM

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Introduction

Every fall, thousands of entering first-year students enroll on our campuses with the expectation that they will major in a STEM field. Of course, the reality is that many of these students (particularly students of color and females) will not persist to graduation in a STEM field (AAAS, 2001; Brown et al, 2009; Seymour & Hewitt, 2000). Though it is common for students to change majors often during their undergraduate careers (Pascarella & Terenzini, 2005), it is disheartening when STEM students who are academically qualified, choose to not persist in a STEM field. Persistence within a major beyond the first-year is an important predictor of persistence to graduation in that major (Pascarella & Terenzini, 2005).

This session will focus on three groups of important factors related to persistence: student background, student expectations, and student experiences through the course of their first-year. Research questions include:

1. What are the entering characteristics of first-year persisters, leavers, and joiners?
2. How do expectations and perceived academic preparation differ between the three groups?
3. How do first year experiences differ between the three groups?
4. What are important predictors of STEM persistence through the first year of college?

Data Source

This study used longitudinal data from the Beginning College Survey of Student Engagement (BCSSE) and the National Survey of Student Engagement (NSSE). Every year, BCSSE collects data from tens of thousands of entering first-year students regarding their high school academic experiences and their expected experiences during their first year of college. Every year, NSSE collects data from hundreds of thousands of first year and senior students from across the country near the end of the academic year regarding their levels of academic engagement and involvement. Many of the items on these surveys are used to create scales. The BCSSE scales range from zero to ten and include high school academic engagement, expected first year engagement, expected perseverance, expected academic difficulty, perceived academic preparation, and importance of campus support. NSSE scales (aka, benchmarks) range from 1 to 100 and include engagement in Academic Challenge (LAC), Active and Collaborative Learning (ACL), and Student Faculty Interaction (SFI). In addition, two other scales used in this study include student report of Supportive Campus Environment (SCE) and overall satisfaction.

Since 2007, BCSSE has been administered to students enrolled at 258 four-year institutions and since 2000 NSSE has been administered to students enrolled at more than 1,400 four-year institution across the United States and Canada. The longitudinal data used for this presentation are from 45,703 first-year students that completed both the BCSSE survey prior to the start of the fall semester and the NSSE survey near the end of their first year. Of these 45,703 students, more than **7,700** identified their major in a STEM field. Approximately 18% of these students who entered their first year of college as a STEM major, but by the end of their first-year did not identify their major in a STEM field. For this session, these students are categorized as “Leavers”. The other 82% that did persist for one year as a STEM major are categorized as “Persisters”. By the end of the first year, approximately 29% of all STEM majors were students from non-STEM majors at the beginning of the academic year.

Results

What are the entering characteristics of STEM persisters, leavers, and joiners?

As indicated in Table 1, persisters generally have higher test scores, more likely to complete calculus in high school, and get mostly A's. Not surprisingly, leavers generally score lower in all these categories, whereas joiners scored in between the leavers and persisters. Unfortunately though, first generation and female students were proportionately more likely to be in the leavers groups than the persisters. There were no large discrepancies in ethnic composition between the three groups. In addition, they were not major differences between institutions types.

How do expectations and perceived academic preparation differ between the three groups?

Though 89% of the persisters entered college with the intention to graduate from that institution (Table 2), leavers were not far behind at 86%. Joiners were least likely to indicated an intention to graduate from the institution at 81%. It is interesting and

Results, continued

How do first year experiences differ between the three groups?

Academic Challenge, Active and Collaborative Learning, and Student-Faculty Interaction are all indicators of student engagement in their academic environment. As expected, the persisters were significantly more engaged in academically challenging activities and active and collaborative learning. However, surprisingly there was no significant difference between any of these groups regarding student-faculty interaction. In addition, persisters reported significantly higher levels of support from their campus than leavers, and persisters reported significantly more overall satisfaction than leavers and joiners.

Table 3. Hours Spent Studying and Preparing for Class

		Leavers	Persisters	Joiners	
Academic Challenge	Mean	54.6	56.0	55.2	<i>Significant difference between persisters and joiners (p<.01) and leavers (p<.001)</i>
Active and Collaborative Learning	Mean	43.0	44.6	43.4	<i>Significant difference between persisters and both groups (p<.01)</i>
Student-Faculty Interaction	Mean	35.1	34.7	34.7	<i>No significant difference between persisters and other two groups</i>
Supportive Campus Environment	Mean	63.5	64.8	64.4	<i>Significant difference between persisters and leavers (p<.05). No significant difference with joiners</i>
Overall Satisfaction	Mean	73.8	78.2	75.4	<i>Significant difference between persisters and both groups (p<.001)</i>

What are important predictors of STEM persistence through the first year of college?

Logistic regression was used to determine how well the data can predict first-year persistence in STEM (Table 4). In the final step, several variables significantly predicted persistence in STEM. The variables with the largest predictive value (in order) are participation or planned participation in undergraduate research, completion of calculus in high school, SAT/ACT scores, hours spent studying during the first year, and student-faculty interaction. However, a closer look at student-faculty interaction reveals a significant interaction with gender. Males who left STEM by the end of their first year reported the highest levels of student-faculty interaction, whereas males that persisted reported overall lowest levels of interaction. Female leavers and persisters reported similar levels of interaction. Overall, the model explains approximately 9% of the variance in persistence.

Table 4. Predicting end-of-year persistence in STEM major

	Step-1				Step-2				Step-3						
	B	S.E.	Wald	Exp (B)	B	S.E.	Wald	Sig.	Exp (B)	B	S.E.	Wald	Sig.	Exp (B)	
Constant	-.45	.26	2.98	.084	.64	-.92	.40	5.34	.021	.40	-.86	.44	3.71	.054	.42
First Generation	-.22	.07	8.89	.003	.81	-.19	.07	6.59	.010	.83	-.16	.07	4.98	.026	.85
Female	-.48	.07	42.70	.000	.62	.76	.47	2.63	.105	2.13	.18	.51	.12	.725	1.20
Minority	.30	.09	10.82	.001	1.35	.27	.09	8.67	.003	1.31	.26	.09	7.54	.006	1.29
SAT_ACT	.00	.00	95.04	.000	1.00	.00	.00	36.92	.000	1.00	.00	.00	27.58	.000	1.00
Calculus						.48	.08	38.89	.000	1.62	.45	.08	33.28	.000	1.57
Female by SAT_ACT						.00	.00	7.28	.007	1.00	.00	.00	6.84	.009	1.00
HS Hours Study/Week						.02	.00	10.29	.001	1.02	.00	.01	.67	.414	1.00
Undergraduate Research						.47	.07	52.30	.000	1.61	.02	.00	26.37	.000	1.02
FY Hours Study/Week						-.02	.00	26.14	.000	.98	-.01	.00	8.55	.003	1.01
Student Faculty Interaction						.01	.00	8.55	.003	1.01	.01	.00	11.52	.001	1.01
Supportive Campus Env						.07	.00	11.52	.001	1.01	.01	.00	11.52	.001	1.01
SFI by Female						.01	.00	11.52	.001	1.01	.01	.00	11.52	.001	1.01
Cox & Snell R-square						.031					.041				.057
Nagelkerke R-Square						.051					.067				.094

Discussion

Given these results, some important findings are noted.

1. Not only is the importance of undergraduate research important for student success, but also the expectation to participate in research. Expectations influence the upcoming choices (major, course selection, etc) students make as their first year of college progresses. As Konings, et al (2008) claimed, “Expectations affect students’ motivation, engagement, and investment of effort in learning” (p. 536). Institutions should strive to provide as many undergraduate research opportunities STEM students.
2. Years of research has shown that student-faculty interaction is important for student success. However, this study found that males who interacted more with faculty were more likely to leave STEM. Though purely speculative, this may suggest not so much a dissatisfaction with STEM, as it does the fact the first year of college is exploratory for many students who may find other majors more appealing. Keep in mind that during the first year of college students are taking classes with a wide range of faculty representing many disciplines. Certainly additional study is warranted regarding this scenario.

Results, continued

Table 1. Student and Institution characteristics.

Student Characteristics		Leavers	Persisters	Joiners
SAT/ACT¹	1000 or less	11%	8%	10%
	1001 to 1200	40%	29%	33%
	1201 to 1400	40%	47%	43%
	1401 to 1600	8%	15%	14%
Completed calculus in high school	Yes	38%	57%	50%
High school grades (mostly or all A's)	Yes	63%	71%	65%
First Generation	Yes	38%	31%	31%
Gender Ethnicity	Female	68%	55%	60%
	Black/Afr. Am	10%	8%	7%
	Hispanic	5%	6%	6%
	Asian	5%	7%	8%
	White	71%	68%	70%
Institution characteristics	Other	9%	11%	9%
	Baccalaureate	20%	21%	24%
	Master's	46%	40%	42%
	Doctorate	34%	40%	34%
	Public	52%	48%	51%

¹ SAT V-M (min 400 and max 1600); ACT composite converted to SAT scale

Continued from column 1

important to note that persisters were much more likely to have participated in (or plan to participate in) undergraduate research with faculty. Though the mean differences is small, persisters also indicated a significantly higher level of self-reported academic preparation to be successful during their first of year of college.

Table 2. First Year Expectations

		Leavers	Persisters	Joiners
Intention to graduate from this institution	Yes	86%	89%	81%
Undergraduate research by end of FY	Done or Plan to do	41%	56%	50%
Perceived academic preparation (aka, confidence)	Mean¹	7.2	7.4	7.1

¹ Persisters scored significantly higher than leavers and joiners (p<.001)