

## Listen to the Students: Exploring Undergraduates' Reasons for Science Persistence Using E-V Theory

Yannan Gao, Anna-Lena Dicke, Nayssan Safavian & Jacquelynne Eccles

### Abstract:

As the first impressions, introductory courses in college play an influential role in students' decision to persist in science majors. We use students' open-ended explanations to understand how students make persistence decisions at the end of their introductory courses, based on Eccles' Expectancy-Value (E-V) Theory. Participants (N = 2737; 45.6% women; 16.4% European American, 22.6% Latino, 46.5% Asian, 14.5% other racial/ethnic groups) indicated the change in their certainty about their original major. In addition, a subset of the students (n=361) provided explanations for why their certainty in their major changed. Overall, the introductory course changed students' certainty about their major in nearly half of the cases. In the open-ended explanations, E-V constructs were frequently identified in students' responses, along with other themes. Overall, values were mentioned more frequently than expectancy in students' explanations. Students who became less certain about their major plan attributed the change to values more often than expectancy, whereas students who became more certain about their major plan did not cite E-V constructs differentially. The findings provide direct evidence for the prevalence of E-V beliefs in achievement choices and the effectiveness of the E-V theory. The result also indicates the need to understand students' experience and reasoning for the intention to leave science majors.

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For more information, please contact: [yannang@uci.edu](mailto:yannang@uci.edu)

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Extensive research has been devoted to understanding student persistence in science during college years. Persistence decisions can be explained using the Eccles Expectancy-Value (E-V) theory<sup>1</sup>. E-V beliefs, namely one's belief about their ability to do well and one's belief about the value of the field, directly relate to the person's persistence in the career path. Students are more likely to persist in science majors, if they consider the major meaningful, useful and interesting to them and if they believe they can succeed in the future<sup>2</sup>. Specifically, value beliefs consist of several components: interest, utility value (instrumental value of major), attainment value (personal importance of major to the student), and cost (everything the student has to give up to pursue the major). Research shows that subjective task values are a stronger predictor of career choices than expectancy<sup>3</sup>.

Introductory courses are often students' first impressions of their major in college. Thus, they can considerably influence students' attitudes towards their science majors and persistence. In introductory courses, students gain knowledge about the content and pace of learning, the classroom climate, interpersonal interactions with the instructors and other students and many more aspects of the major<sup>4,5</sup>. This affects students' certainty about the major they intend to study upon entering college<sup>6</sup>. However, previous quantitative studies have mostly focused on the finalized decisions of major choice over a longer period of time (such as the declared majors or course enrollment at the end of freshman year). This overlooks the process through which the decision unfolds over time, especially the important time points that changes in the decisions occur. Furthermore, existing literature is mainly based on the association between persistence and E-V beliefs measured by Likert scale items. More direct evidence for the ways in which E-V beliefs are involved in students' decision process is needed.

In this study, we address these gaps in the literature by investigating three research questions:

1. How does the participation in introductory science courses affect students' persistence decisions, indicated by students' certainty about their intended major?
2. What are the reasons for the change in students' choice of major, based on students' own explanations?
3. Do students provide different reasons depending on their certainty about their intended major?

Participants are 2737 college students in a large public university in the U.S. They completed a course survey at the end of their introductory Chemistry or Physics course in years 2018 and 2019 (45.6% women, 16.4% European American, 22.6% Latino, 46.5% Asian, 14.5% other racial/ethnic groups; average age is 18.84 years old [SD = 0.91]). In a multiple-choice question, students indicated how the course affected their major choices ("It made me less certain about my original major", "It had no effect", "It made me less certain about my original major"). In a separate open-ended question, students wrote down how and why their major plans had changed. Two research assistants coded explanations to identify emerging themes, particularly focusing on E-V constructs. Research assistants were trained by a graduate student based on a coding scheme.

Nearly half of the students reported that the introductory class affected their certainty about their major plan, with 25.6% (623 students) feeling less certain about their choice and 20.4% (498 students) feeling more certain about their major. A subset of students (n = 361) provided open-ended explanations (Table 1). E-V constructs spontaneously emerge in students' explanations with subjective task value constructs mentioned more often than expectancy. Interest was mentioned the most frequently among five E-V constructs, followed by expectancy and utility value (Table 2). A small number of students mentioned other reasons, such as gaining new information about

different majors. Overall, students becoming less certain about their original major were more likely to mention values than expectancy in their explanations. Students becoming more certain were equally likely to mention expectancy and values.

Our finding supports that introductory science courses play an important role in students' science persistence by influencing students' certainty about the major plan. When making persistence decisions, college students spontaneously think about factors aligning with the E-V theory. E-V constructs were identified in a large proportion of the responses. Subjective values were mentioned more often than expectancy, indicating that values might play a bigger role than expectancy in the decision process. In addition, interest was mentioned most frequently, a finding reflecting the expectation of "finding and pursuing your passion" during college in American culture. The finding that values were mentioned more often than expectancy among students who became less certain about their original major highlights the role of values for science majors. Although STEM majors were considered academically challenging, expectancy did not seem to be the primary reason students became hesitant to persist. In other words, the intention to leave science fields is justified by students' values in many cases. This finding could have useful implications for efforts to retain students in science majors.

#### References

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Table 1  
 Students' Reasons of Change in Major Plans

Reason	Frequency	Percentage
E-V Constructs	156	
Expectancy Only	33	9.14%
Values only	111	30.75%
Expectancy and value both increase	11	3.05%
Expectancy increase, value decrease	1	0.28%
Other reasons	22	6.09%
Reason unclear/unspecified	171	47.37%
"Don't know"	12	3.32%
Total	361	100.00%

Table 2  
Frequency of E-V Constructs Mentioned

Construct	Frequency
Expectancy	45
Interest	67
Utility value	35
Attainment value	31
Cost	10

*Note.* One response might be identified on more than one constructs.