Analysis of Physics Students' Subfield Career Decision-Making

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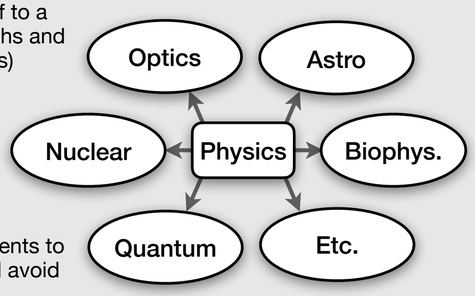
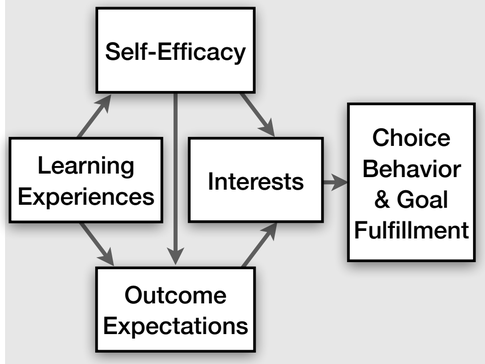
Introduction

- A degree in physics lends itself to a multitude of diverse career paths and subfields (e.g., Nuclear Physics)
- **RQ1:** What factors cause students students to develop positive interests in their most preferred subfields of physics?
- **RQ2:** What factors cause students to develop negative interests and avoid other subfields of physics?



Theory/Background

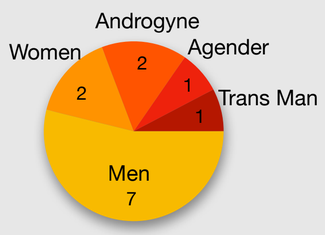
- Used Social Cognitive Career Theory (SCCT)[1] with a focus on the following main constructs:



- **Outcome Expectations:** What we think a career will look like
- **Self Efficacy:** Belief you can succeed at a task
- **Learning Experiences:** Classes, research, labs, books, videos…etc.
- **Interests:** The things we want out of a career

Methodology

- Initial protocol was developed around SCCT constructs with a focus on students most preferred subfields, and least preferred subfields
- Conducted **N = 13** interviews with physics majors from all years of study (3 in year one, 2 in year two, 3 in year three, 5 in year four)
- During interviews students were provided with a card ranking activity in which they could sort cards labeled with physics subfields
- Interviews were then cleaned manually and then coded based on SCCT constructs using Dedoose[2]
- We present a series of major themes from across the data



Gender Identity Breakdown

Results

"By the time I even heard about biophysics I had kind of made up my mind."

"[Chem] is all a lot of rote memorization. Versus in physics there are patterns and you can learn about how stuff works."

Theme 1: Subfield Unfamiliarity

All students interviewed expressed some degree of unfamiliarity with one or more subfields of physics. These students lacked learning experiences that introduced them to specific subfields. Generally this led to low interest and reduced choice behavior.

Theme 2: High School Learning Experiences Affect Collegiate Decision-Making

Students would frequently link the prefix of a subfield (e.g., the 'bio' in biophysics) to an outcome expectation they had formed through an introductory class they had taken in high school or college (e.g., AP biology).

Theme 5: Traditional vs. Altruistic Science Identity and Outcome Expectation Formation

With regards to subfield choice, students would settle into groups (altruistic, traditional, and mixed) based on their science identity. These groups bare resemblance to the science identity framework outlined by Carlone and Johnson[3].

"I feel like astro lacks that 'helping people' aspect, which is why I don't have interest in it." (Altruistic Identity)

Theme 3: Learning Experiences in Popular Science Limit Subfield Exposure and Create Limited Outcome Expectations:

Popular science disproportionately represents scientific results from only a few subfields such as astronomy, astrophysics, and quantum physics. Students in high school or earlier may have a limited and somewhat distorted view of what physicists or astronomers do.

"…learning about space through, like Popular Science, I absolutely adore it, it's loads of fun. I don't have to worry so much about equations."

Theme 4: College Undoes Outcome Expectations Formed by Popular Science and High School Learning Experiences

Learning experiences in high school and popular culture often fostered appealing outcome expectations about careers. However, college learning experiences may have significantly changed students' outcome expectations about what work in a particular subfield of physics would be like.

"I grew up looking at the planets and stars…then I get to college and take my first astronomy class, and I hated it. We had an astro speaker…all I heard was 'I sat at a computer and looked at data from a telescope'…that sucks."

Why Does This Matter?

Theme 1:
If students have **little awareness of the diverse subfields of physics, they may pursue fewer options for elective courses** or for research opportunities. Which could **limit growth of physics programs**.

Theme 2:
Being able to consistently provide good science education experiences is important for **fostering interdisciplinary research.** Yet, this data suggests a **sharp divide between physics and the other major science disciplines.**

Theme 3:
As a result of **exposure through pop culture**, not only are students **entering college with inaccurate outcome expectations**, they are **making decisions** with inaccurate outcome expectations.

Theme 4:
There may be a need for more early encounters for students to do science**, not just be exposed to the big ideas of science**. Presenting physics as a field with diverse options could **improve diversity and interest**.

Theme 5:
Physics programs offer plenty of ways for students of the traditional identity to **satisfy their interest** with science. Yet, the **altruistic identity is often left out** as many see the only way to help others as through teaching (i.e. LA & TA).

[1] Lent, Robert W., Steven D. Brown, and Gail Hackett. "Toward a Unifying Social Cognitive Theory of Career and Academic Interest, Choice, and Performance." *Journal of Vocational Behavior* 45, no. 1 (1994): 79–122. https://doi.org/10.1006/jvbe.1994.1027

[2] J. Saldaña, in "*Coding Manual for Qualitative Researchers*" (SAGE Publications Ltd, 2013) 2nd ed.

[3] H. B. Carlone and A. Johnson, "Understanding the science experiences of successful women of color: Science identity as an analytic lens." Journal of Research in Science Teaching 44 ,1187 (2007) https://onlinelibrary.wiley.com/doi/10.1002/tea.20237