Examining Doctoral Degree Attrition Rates: Using Expectancy-Value Theory to Compare Student Values and Faculty Supports*

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US degree completion data show that historically underrepresented students and women are less likely to complete doctorate degrees, particularly in engineering. While there are many studies on persistence, few compare student and faculty perspectives especially in engineering. The purpose of this case study is to compare what experiences motivate doctoral students and what experiences faculty aim to provide based on what faculty believe motivates students, particularly for women and historically underrepresented students in the United States. Drawing on Eccles' Expectancy Value Theory, we answer the questions: What relationships exist between ability beliefs and subjective task values for underrepresented students persisting in earning a doctorate in engineering? How do student and faculty beliefs compare? Our findings show that while both students and faculty agree on ability beliefs to remain motivated, they showed differences in the value they assigned to doctoral experiences; students focus on attainment value and faculty on utility value. Our findings suggest that both advisors and students should prioritize clear communication in their needs and intentions to better support student motivation in the doctoral degree process. While the context of this study is in the US, practitioners can find parallels in our findings to other contexts and their respective underrepresented populations. Our findings have the indirect impact that supporting the motivation of underrepresented students in particular can contribute to increasing diversity in doctorate degree completion rates.

Keywords: motivation; graduate students; doctoral education; minorities

1. Introduction

Data show that in the United States, women and racial/ethnic minorities underrepresented in engineering (e.g., African American/Black, Hispanic, Native American, Pacific Islanders) are less likely to complete doctorate degrees. This problem is exacerbated in the field of engineering as women and minorities have been long underrepresented in the US [1]. For example, data from 2014 shows that approximately 5% of doctorate degrees awarded in engineering were earned by underrepresented students and 22% by women of all races and ethnicities ([1]. As few women and minority students start engineering doctorate degrees and then even fewer finish [2], doctoral attrition is disproportionately affecting populations already underrepresented in doctoral education. This underrepresentation is simply not acceptable as we need diversity to achieve excellence in a diverse society [3]. However, failure to improve retention is not for a lack of research.

The process and factors contributing to doctoral degree persistence have been thoroughly examined, particularly from the student perspective, for both majoritized and minoritized students. For example, in reviewing current literature Spaulding and Rock-inson-Szapkiw [4] identified three overarching categories (personal factors, institutional factors, and

university integration factors) and their associated subgroupings that are associated with research on doctoral persistence. Personal factors include demographic variables, personal attributes, motivation, responsibilities, and coping skills. Institutional factors include program type and structure, curriculum and program, and expectations and communication. Finally, university integration factors include academic, social, and economic integration. The majority of studies included here, and across doctoral student research more broadly, represent the student perspective despite the clearly interactional nature between the student and the academic environment and system.

Interactions with advisors is one such doctoral attrition/persistence-related factor that warrants further investigation, particularly from multiple and comparative perspectives and using motivation theoretical frameworks. Many studies have already pointed to the importance of the advising relationship in doctoral students' success [5–9]. Fewer studies have examined the faculty perspective and fewer still have comparatively examined the student and faculty perspectives. One notable exception is work from Gardner [10] that comparatively examined student and faculty attributions in high-and low-completing doctoral programs in the United States. One important outcome from Gardner [10] is the recognition that the student

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must have motivation to succeed but that it helps to have the advisor acting in ways that support the student's motivation.

Considering all of this background, our study advances research and contributes to current literature by comparing what experiences motivate doctoral students and what experiences faculty aim to provide based on what faculty believe motivates students, particularly for women and historically underrepresented students in the United States. We used Eccles' Expectancy Value Theory of Achievement Motivation (EVT) [11] and focused on engineering students, as this is a discipline with particular disparities in completion rates by demographics. Using a case study approach, we first examined student motivation to answer the research question: What relationships exist between ability beliefs and subjective task values for underrepresented students persisting in earning a doctorate in engineering? We then examined the faculty perspective on students to answer the question: What experiences do faculty aim to provide with regard to student motivation? We found matches and mismatches between student and faculty perspectives that suggest potential leverages that could be used in future efforts to support doctoral degree completion.

2. Literature Review

The journey through completion of the doctorate degree is comprised of multiple phases [12]. These phases require of students increasingly complex skills and abilities which can be cumbersome and weary over time [13]. Through these phases, the advisor acts as a student's principal socializer into conducting research and becoming a member of the discipline [8]. The advisor can support a student's progress by sustaining their motivation [14].

By examining motivation-related constructs such as self-efficacy, autonomy, belonging, etc., existing studies provide some insight into student motivation and the critical role of the advisor. For example, in a 5-year quantitative longitudinal study of 130 students across 24 programs in the midwestern region of the United States that examined the impact of advising on students' research productivity, career commitment, and self-efficacy, Paglis, Green, and Bauer [15] obtained "preliminary evidence [...] that perceived self-efficacy, an important determinant of motivation and performance, may be positively influenced by the psychosocial mentoring function" [15, p. 470]. In a quantitative study with counseling psychology students across multiple stages of the doctorate degree, Schlosser and Gelso [16] found through survey data that an early advising relationship enhanced the student's development as a researcher and ultimately led students to a higher research self-efficacy. This establishment of a 'working alliance' with the advisor early in the process of doctoral research also led to higher student research productivity. Overall, Deane, and Peterson [17] used an online survey of 359 doctoral students in a university in New Zealand that aimed to assess students' academic, personal, and autonomy support as well as their research self-efficacy. The results showed that students with a high research autonomy had a higher research self-efficacy when advisor support and availability were also high. However, a high autonomy did not lead to a high research self-efficacy when the advisor support and availability were low. The authors found that student satisfaction with the advisory relationship was not consistent with the degree to which advisors allowed for students' autonomy, thus proving that students need a balance of both support and autonomy on their path to becoming independent scholars. These findings mirror a more recent quantitative study by Litalien and Guay [18] that demonstrated how students with a high perceived competence or research self-efficacy supported by the advisor were less likely to drop out of the doctoral pursuit.

Advisor support and availability were characterized beyond research assistance to a friendly and emotionally supportive advisor in the face of research adversities. Curtin, Stewart, and Ostrove [19] used a climate survey of over 300 domestic and international graduate students at a large public institution in the midwestern United States to examine the role of the advisor in doctoral students' sense of belonging. The results showed that doctoral students' relationships with the advisor had a strong influence on their sense of belonging and academic self-concept. This finding was particularly true for the domestic students who showed a stronger relationship between belonging and their academic selfconcept. A more recent study conducted by Devos et al. [20] took a qualitative approach into comparing completing and departing doctoral students. Interviews with 21 former doctoral students showed that while support from doctoral peers played a positive role in the doctoral process for all students, it was not enough to sustain a sense of belonging and by consequence persistence towards degree completion. Students described doctoral advisor support, particularly as they increased student's self-efficacy and belongingness, as the distinguishing factor that kept departing students from degree completion. The authors argue the motivational role of the advisor is complex and that further investigation should look into the mechanisms that enable it.

In comparison to the wealth of research on

graduate students, research on faculty beliefs about doctoral student motivation has been scarce and has typically been a secondary finding rather than an intentional element of the study. Again, the study by Gardner [10] is an exception. In this qualitative study, the faculty interviewed believed that students who 'lack motivation', or students who did not enjoy research or had trouble focusing on a specific topic, were likely to depart from doctoral studies. In the same study, faculty describe motivated students as those who have research initiative and are 'selfdriven' in their work. These studies did not address how faculty help students transition from lacking motivation to having initiative. However, the consensus across this study was that doctoral students who are productive without much outside intervention are considered motivated students.

Women and underrepresented students in engineering are a particular subgroup needing further research. While the experiences of domestic and international students have been compared [21-24], literature on women and other racial/ethnic groups typically underrepresented in engineering or STEM fields more broadly is scarce. Research at the undergraduate level has shown that the experiences of women and underrepresented students are significantly different from their majority peers [25] and caused minorities to not persist in their studies at higher rates than majority students [26]. At the doctoral level, both the entry and completion rates of minority students differ vastly from majority and international students [1], [2]. To this effect, much work has shown that the experience for minority students pursuing doctoral degrees in engineering is differently than their majority peers [27-29]. Specifically with regard to motivation, research has shown that underrepresented engineering students have specific self-efficacy needs [30] to help them overcome impostor syndrome and they tend to lean on their community for support more than majority students throughout their doctorate degrees [27, 31, 32]. At the same time, the majority of faculty advising graduate students in engineering are white, and this racial/ethnic difference matters in advising relationships [33].

In summary, this sampling of current research shows that the advisor-advisee relationship plays an important role in developing student motivation, such as ability beliefs with regard to research capacity and doctorate degree completion, and sense of belonging. While these studies offer insight into ways through which advisors can help motivate students, they do not address faculty knowledge of student motivation or the specific context of students pursuing doctorate degrees in programs where they are heavily underrepresented. Our research begins filling this gap by interpreting students doctoral experience and the faculty advising practices through a framework-specific motivational lens.

3. Theoretical Framework

Our study is grounded in Eccles' expectancy value theory [11, 34]. EVT is appropriate for this study for two reasons: (1) EVT was originally developed as a framework to explain the underrepresentation of women in fields such as science, technology, engineering, and math (STEM) fields [34, 35], and (2) EVT considers the psychological, social, and cultural factors contributing to choices to engage in specific tasks or activities [35]. These reasons are relevant to our study as we are examining persistence of women and underrepresented students toward doctorate degree completion and we recognize that pursuit of a doctorate degree is not a solo endeavor but rather that it is situated in cultures created by universities, departments, and doctoral advisors.

In simplified form, EVT suggests that people engage in tasks or activities that are valued (subjective task values, STV) and in which they believe they have a high likelihood of success [34, 35]. STV include four subcategories: interest, attainment, cost, and utility [36, 37]. Interest refers to the individual's enjoyment in the task. Attainment is the importance the individual assigns to the task and how their performance on such will reflect on them as an individual. Cost is the price of success or failure in terms of what the individual has to give up. Utility is how useful the task is to the individual. It is important to note that the STV categories are not inherently hierarchal but rather that relative prominence is task specific.

Expectancy of success is an individual's belief in the likelihood of success in an upcoming task or activity [11]. Although a distinct construct from other measures of ability beliefs, researchers have noted a similarity in how expectancy of success and beliefs such as self-efficacy are measured (e.g., Bong et al. [38]). For purposes of this analysis, we embrace that similarity and use the richness of research in self-efficacy to inform our study as similar research on expectancy of success is lacking. Therefore, we used EVT as an overarching framework to examine ability beliefs and STV relative to completion of doctorate degrees. To add detail to our analysis of ability beliefs, we drew on the construct of selfefficacy and the four ways it is built (see Fig. 1). Self-efficacy, a construct in Bandura's Social Cognitive Theory [39], is posited to develop in four ways: mastery experiences, vicarious experiences, verbal persuasions, and physiological reactions [39, 40]. Mastery experiences are successful attempts at



Fig. 1. Intersection of self-efficacy and subjective task values.

the given task or closely related task. Vicarious experiences encompass evaluating self-capability based upon the success or failure of someone judged to be at the same capability level. Verbal persuasion is encouragement from a valued other. Physiological reactions are how a person feels while engaging in the task.

Few studies have directly used EVT to examine the on-going experiences of graduate students though we noted several studies in our literature review that draw on self-efficacy. The findings from those studies were consistent with the verbal persuasion element of self-efficacy, or in this case, words of encouragement from an advisor, that can play a fundamental role in increasing students' expectations of succeeding [41]. However, we also see a bigger picture of researcher self-concept playing out in the results of prior works as the advisor is a person of esteem to the student, which enhances the verbal persuasion component to come from someone whose opinion matters to the student [42]. Existing studies also cite constructs that are akin to the value constructs. For example, a sense of belonging or fit is related to personal identity and importance and thus attainment value. Using this combination of EVT and selfefficacy allows us to holistically examine motivation-related variables that have previously been considered separately.

4. Methods

To answer our research questions, we adopted a case study approach. Yin [43] defines a case study as an "empirical enquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between the phenomenon and context are not clearly evident; in which multi-

ple sources of evidence are used" (p. 23). We classify our case study as exploratory because there is little prior literature focuses on the comparison of student and advisor motivation, particularly for students underrepresented in their field of study. Further, because of the underlying phenomenon of underrepresentation, we can't separate student's motivation from the context in which it is occurring. Therefore, the goal of this work was to explore how motivation manifested through the lens of EVT in the context of pursuing an engineering doctorate.

Our study also meets Yin's criteria for the three conditions that merit case study research [41]: (1) the nature of the research question is typically explanatory, exploratory, or descriptive; (2) the investigator lacks methods to control the site and participants; and (3) the phenomenon being studied is contemporary and the context is real life. We met these criteria as we explored the relationships between expectancy of success and STV associated with doctorate degree completion, particularly as related to underrepresented engineering graduate students. Therefore, our study is contemporary, the context is real life, and the setting is uncontrolled.

The primary data sources for our study are a single focus group with six students of underrepresented groups in engineering and from multiple institutions across the US, and three individual interviews with faculty at a single institution that are currently advising or have advised underrepresented students.

4.1 Participant Recruitment and Selection

Our focus group, conducted at a large multidisciplinary engineering conference during summer 2016, included six graduate students. The faculty members were recruited from a large Research 1 Land Grant University in the eastern United States

during Spring 2016. In both instances (faculty and students), we identified gatekeepers with access to mailing lists that forwarded our recruitment email. In accordance with the targeted student population of this project, our intent was to purposefully select student participants using the following criteria: (1) belonging to an underrepresented group in engineering, (2) being enrolled in a doctoral engineering program, and (3) being currently in the proposal or dissertation writing phase of their degree. We selected faculty who currently advise or have advised underrepresented students. Although we did not limit our faculty sample based on demographics, it is perhaps not surprising that our final sample included all men and that two of them are Caucasian as white men are the most prevalent demographic in engineering (Table 1). We recognize our faculty sample is not diverse, but given what we know about doctoral completion in the US it is representative of most advising relationships in doctoral engineering programs [1, 33].

4.2 Data Collection

The three interviews with faculty advisors occurred in one-on-one settings, whereas the students participated in a focus group. The student focus group was an intentional choice as we anticipated that the nature of the conversation might be sensitive and a focus group strategy can help create a 'safe space' for minority and marginalized groups [44]. The interview and focus group protocols were both semi-structured to allow flexibility [45].

Focus group questions salient to this analysis included:

- 1. What factors have helped you or hindered you in your progression toward your degree?
- 2. What things have you observed amongst your peers that it takes in order to be successful in completing a doctorate in your individual fields? Are there characteristics or things you need to improve?
- 3. What kind of advice and support does/has your advisor give/given you throughout your doctoral process?

We asked similar questions in the faculty advisor interviews to seek advisor perspectives:

- What has been your experience in advising and mentoring doctoral students from underrepresented racial minorities?
- When students who are in their dissertation writing stages come to you for advice, what is their most common concern?
- What would you say are different characteristics that define those students who take less time to finish versus the ones who take more time?

4.3 Analysis

We audio recorded the focus group and interviews and then transcribed the recordings to yield verbatim textual transcripts. For analysis, we started with *a priori* coding [46] using the four constructs of selfefficacy [39, 47] and the four STV [36, 37]. As shown in Table 2, we operationalized the codes for our context. Recall that we did not examine the faculty beliefs about themselves but rather their perceptions of graduate students and their experiences advising students. Their perceptions give us direct insight into faculty beliefs about students and from their descriptions of advising (behaviors) we inferred beliefs; EVT suggests a direct connection between beliefs and behaviors [48].

Although examples are not shown, faculty interviews were analyzed in the same way. Following the coding for individual constructs, we analyzed each of the instances where STV statements coincided with competency statements. Specifically, we examined (1) the context of each coincidence and (2) the relationships between the described constructs. We accomplished this task through the use of 'codeweaving'. Codeweaving is the actual integration of key code words and phrases into a narrative form to see how the puzzle pieces fit together [46]. Through the codeweaving technique, we created broader categories by integrating our first round codes into a narrative form, thus creating a generic statement that explains the relationships between the codes. Determining these relationships helped us understand how ability beliefs are linked with an individual's value of the task. This practice of codeweaving allows for the student's motivations to be examined directly through the interactions of the two frameworks proposed while remaining embedded in the context in which they take place.

Venue	Data Collection	Organizational Role	Sex	Race/Ethnicity
Large Conference	Focus group	Graduate Student	1 Male 5 Females	2 Black/African American 2 Latino/Hispanic 1 Asian American 1 Caucasian
Large R1 Land Grant University	Individual Interviews	Faculty	3 Males	2 Caucasian 1 Latino

Table 1. Study participants and data collection methods

Construct / Code	Operationalized Definition	Sample Excerpts from Student Focus Group			
Self-Efficacy					
Mastery Experiences	Past experiences similar to the task that enhance self- efficacy towards pursuing a doctorate.	"I participated in a summer undergraduate research experience, so I had an idea of what graduate school would be like."			
Vicarious Experiences	Comparisons to experiences of their peers that enhance self-efficacy towards degree completion.	"Seeing my peers graduating makes me think – if they can do it, I can do it too."			
Verbal Persuasion	Verbal arguments from another person that enhance self-efficacy towards completing the dissertation.	"Having my advisor acknowledging the quality of my work really boosts my confidence."			
Physiological Reactions	Physical responses that enhance self-efficacy.	"Thinking about my dissertation causes me great anxiety."			
Subjective Task Values (STV)					
Utility Value	The individual finds completing the Ph.D. useful.	"I need the Ph.D. to obtain the type of employment I want."			
Interest	The individual finds enjoyment in writing the dissertation.	"I enjoy my research topic so writing does not feel like work to me."			
Attainment	The individual's perception of how completing the dissertation is important to them.	"It is important for me to do a quality job in the dissertation because this will reflect who I am as a Ph.D."			
Cost	The price of success or failure, generally in terms of effort, time, and/or psychological impact to complete the dissertation.	"Sometimes I have to sacrifice time with my family in order to be productive."			

Table 2. Theoretical constructs, operationalized definitions, and sample excerpts from the student perspective

Table 3 shows an example outcome of how coded excerpts can be explored for code relationships. When all excerpts were examined, we grouped together similar assertions.

4.4 Role of the Researcher

The first author identifies as a Latina and at the time of data collection, analysis, and drafting this document was pursuing a doctorate degree in Engineering Education. These identities helped in understanding both the disciplinary jargon participants discussed in the data collection as well as interpreting the data with a perspective representative of the student participants. The second author identifies as a white female holding a doctorate degree in Engineering Education. Her detachment from an underrepresented identity helped to reduce bias in the analysis and explore in depth parts of the data that were a mutual understanding between the first author and the participants given their common background. Finally, the data collection was completed by a student also identifying as a Latina pursuing a doctorate degree in engineering, which helped in establishing a climate of mutual understanding between peers within the focus group.

Table 3. Codeweaving samples

Sample Excerpt	SVT Code	Competency Code	Resulting Assertion
"Hearing my advisor tell me I did a good job reinforces my fit in this program." – Student	Attainment Value	Verbal Persuasion	Verbal persuasion reinforces the student's attainment value for the doctoral pursuit.
"At this point obtaining this Ph.D. is very important. It's a goal that I've been striving for a very long time and the opportunities it will give me is why I wanted to do it. It is very important for me." - Student	Attainment Value Utility Value		Obtaining the doctorate degree has a utility value that meets the needs of the original attainment value the student had assigned to it.
"I take on opportunities that challenge me. If I'm going to benefit in the long run, I might as well just do it." – Student	Utility Value	Enactive Mastery Experiences	There is utility value for students to pursue activities that help develop mastery .
"I try to have my students work on grant writing. I think it's one of the most important things for someone when they get their Ph.D." – Faculty	Utility Value	Enactive Mastery Experiences	Advisors help students to engage in enactive mastery experiences that have a utility value .

4.5 Research Quality

In order to ensure the quality of the research, we took multiple actions during the making and handling of the data [49] to enhance the trustworthiness [50]. In generating the data, the data collection instruments were grounded in the theoretical framework for the study and were peer reviewed before deployment of the data collection. In handling the data, we relied on researcher triangulation through which we verified our reported findings were observed multiple times in our data and across a majority of the participants (Creswell, 2013). We also held weekly meetings that enabled peer debriefing as the results emerged [51]. The final output was audited by researchers external to the analysis team.

5. Results

In answer to our research questions, our results demonstrated clear patterns in student responses, faculty responses, and importantly a mismatch between the two. For students, we found the most connections between ability beliefs and attainment value. At the same time, we found evidence that faculty focused on ability beliefs and utility value. Therefore, while both groups focused on ability beliefs, students focused on attainment value and faculty on utility value.

5.1 Students' Self-Efficacy and Attainment Value

Attainment value is the personal importance of engaging in a task and it is associated with a personal sense of identity. Our data revealed that students rely on mastery experiences, vicarious experiences, and verbal persuasion to support a developing sense of identity as a doctoral student and/or member of a specific department or degree (i.e., attainment value). We did not find evidence of physiological reactions in our data. However, this may be due to the wording and questions used in our protocol as previous studies have shown students experiencing physiological reactions during the doctoral pursuit [52]. As an example of mastery experiences, one student said:

"Celebrating my small victories helps me to believe that I'm on the right path to my end goal and this is where I'm supposed to be. That's one of the ways that I'm in the process of overcoming impostor syndrome." [Student 1, African American Female]

Here, the student describes how mastery experiences, regardless of their size, work for her as a way to help reinforce her identity as a graduate student and future doctorate holder and help her feel like she belongs in the pursuit of the doctorate degree. Verbal persuasion connected to attainment value similar to mastery experiences. For example, one of the students said, "Hearing my advisor tell me I did a good job reinforces my fit in this program." The verbal persuasion, in this case praise and positive feedback, helps the participant feel a sense of fit with the program (identity). Vicarious experiences also connected to attainment value. For example, a participant said,

"I went into [my institution] as a coursework only Master's student. My goal is to finish up my degree in industrial engineering and go back into the industry, but in the black graduate student association I saw a lot of young black students going for Ph.D.'s and they really encouraged me to start thinking about it and by the last semester of my Master's I decided to go ahead and transition into the Ph.D. program. We have been instrumental in keeping each other on track." [Student 2, African American Female]

While this excerpt also has elements of verbal persuasion (encouragement), the participant specifically mentions seeing a lot of people like her (young black students) and that was a reason for her transition into the doctoral program.

In fact, most the participant's statements showed multiple of the self-efficacy constructs acting together to strengthen participant's attainment value. Here we see a participant discuss both vicarious experiences and verbal persuasion acting in combination to strengthen self-efficacy:

"One of the other ways which I think I help mitigate that feeling is having a really good peer support group. I mean [Student 3] is like one of my best buddies in my program, fist bump, but being able to like come to her and say I really don't know if I could do this. I can't. I don't think I can do this. Having her say yes you totally can do this [increases my confidence]." [Student 4, Asian Female]

Here we see how this student takes the word of a peer who she considered similar to herself and used her verbal encouragement to increase her confidence. From a self-efficacy lens, we observe a combination of vicarious experiences and verbal persuasion increasing her self-efficacy and reinforcing the belief that she belonged in the program.

Another example comes from a student who described the buildup of small tasks along with praise from colleagues as a self-efficacy builder:

"I think impostor syndrome hit the nail on the head. [...] I think you build that confidence by doing the baby steps. Finishing a paper, getting the results of whatever project you're working on, reporting out and people being like yes that was good. That positive reinforcement really helps." [Student 4, Asian Female]

Here we see how this student builds her self-efficacy through a combination of mastery experiences and verbal persuasion. She takes small steps in completing her tasks which makes her feel able to complete the larger tasks and this self-efficacy is reinforced when her peers value her work. This increase in her self-efficacy help her feel like she belongs and calm her impostor syndrome.

5.2 Faculty Support of Mastery Experiences and Utility Value

The most prevalent connection between beliefs and values in the faculty data are between mastery experiences and utility value. Often, the faculty describe providing an experience that is designed to be useful to the student by successfully building a skill (mastery experience). In comparison, there were very few mentions of scenarios designed to bolster attainment value.

As an example of mastery experiences and utility value, one faculty member participant said:

"I try to have each one of my students lead [grant proposals]. You know, we're co-leading, but we're basically like, 'this proposal's kind of going to be on your PhD,' thing. Whether it gets funded or not is another thing but I do want them each to have that responsibility and I think they really dive into it and if you can do it early enough, it helps them ..." [Faculty 1, White Male]

Although not directly stated, it is implied that "diving into it" means being successful. Having this success is useful to them. This quote exemplifies how faculty describe their advising style as exposing students to mastery experiences that have a strong utility value toward the pursuit of the doctorate degree.

As another example, a faculty participant described a practice defense scenario he runs with students:

"Well a typical case is to do a dry run, or let's say a proposal defense, and then the students would ask the types of questions a faculty member will ask in the real thing, so it is a nice simulation for the students. Their questions are usually insightful and quite challenging, because they are dealing with some of the same issues in many cases. They'll ask hard statistics questions, for example, that maybe a faculty member wouldn't even ask. It is a great proving ground before they get into the real defense." [Faculty Participant 2, White Male]

This faculty member provides a mastery experience that is similar to what students will face so that students can build confidence for the actual event. It is implied that being successful at the harder questions will be useful to students as a mastery experience for the actual event.

Sometimes faculty paired these mastery experiences in useful activities to vicarious experiences by making students work alongside older more advanced peers in the lab. Here we see how this faculty believe this strategy helps students learn to overcome hurdles themselves: "I also, one of the things I try to do, is I have a more senior graduate student in the lab, I also try to pair them up with somebody so that way, because you do get writer's block, so it's good for the more senior graduate student to kind of throw it over to the more junior one, then the junior starts to see, like, 'Oh, okay, this is what happens.' Then it's less intimidating because they get their A paper done, maybe they're second or third offer but then they kind of see, 'Okay, this is actually doable.' It's not like impossible." [Faculty 1, White Male]

While mastery experiences is the primary mechanism employed as shown by the student doing their own writing, this arrangement combines an intentional vicarious experience of seeing the advanced peer overcoming hurdles. These two activities of writing and observing someone else write are believed to develop confidence in the junior student. The faculty describes this activity being useful because writing a core component of the doctoral experience.

Some faculty take on a more collective approach to the writing process. Here we see a faculty describe how students learn from each other about the writing process when deadlines for conference papers are due:

"All of my students author pretty much every year, or maybe twice a year, a conference paper or whatever, or they are lead author, and then they get this panic when it comes time for them to be due, and this is a traumatic experience that also teaches everybody about, everybody else, and also how to ... A student starts to get a feel of how to write." [Faculty 3, Latino Male]

Once again, we see how the quote above demonstrates how a combination of both mastery and vicarious experiences are useful for students to be exposed and learn about the writing process.

6. Discussion

Our results demonstrate that both students and faculty advisors place a strong focus on students' ability beliefs, yet they differ on the values associated with these beliefs. Students focused on experiences related to attainment value, while faculty focused on offering experiences related to utility value. From a research perspective, our findings result in implications for future use of EVT and further study of doctoral advising relationships. From a practice standpoint, we make recommendations to both students and faculty drawn from comparing across groups.

Understanding connections between ability beliefs and STV has theoretical and practical merit. From a theoretical standpoint, our findings expand knowledge on the motivating experiences specific to underrepresented students and how traditional advising may not be meeting their motivational needs. Our study found that underrepresented students in engineering strongly value experiences that affirm their belonging, even over the utility value-related experiences faculty are aiming to provide. While EVT does not suggest STVs hold a fixed hierarchy relative to each other [37], the theory does support varying importance of STVs across contexts. Our results demonstrate that for the context of underrepresented students pursuing a doctorate degree, attainment value holds a higher importance than utility value with regard to motivating experiences.

Notably, the predominance of attainment value for students is similar to findings from research on persistence in undergraduate students earning an engineering degree [53] as engineering students' attainment value was the strongest predictor of them choosing to pursue engineering. This attainment predominance also aligns with the theory on graduate student socialization [13] where students strengthen their researcher identity as they progress in the doctoral process [54]. Likewise, the finding that advisors aim to provide experiences that are useful for their students is consistent with research on faculty motivation relative to designing learning experiences [55]. The patterns in the current study are similar even though the sample of undergraduate students was predominantly white and race/ ethnicity was not addressed in the study on faculty motivation. It is possible that our findings for doctoral students are not specific to underrepresented students, but our study was not designed to make this comparison.

From the standpoint of further research on doctoral education, our findings show that both faculty and students value different experiences in doctoral education. The difference confirms the need to include both viewpoints in research addressing the advising relationship. We established in the literature review that much of the work in doctoral education has focused on single viewpoints and rarely compares the perspectives of both groups, with some exceptions as noted. Therefore, as the advising relationship is composed of two people and understanding both is necessary to understand the whole, we recommend future research to address comparative perspectives on the dynamics of advisors and doctoral students.

From a practical standpoint, our findings presented a feasible way through which doctoral advisors could frame the tasks they set forth to students so as to further encourage them, particularly those who are underrepresented in their program. The mismatch between students and faculty could be contributing to high rates of doctoral students leaving degree programs and should be an area of focus in the future for research on graduate education. By advisors considering the attainment value of the doctoral experiences and purposely framing these experiences in attainment value to students, students can be more motivated to engage in and complete their doctoral studies. Framing experiences as attainment-related does not diminish the utility value, but rather adds a layer of understanding of overall value. At the same time, if students understood that faculty aimed to provide utility value [56, 57] and why such value is important, they might also be able to better embrace the utility value of the experiences. As recommended by much of the previous research [10, 58], having open conversations about expectations and struggles are crucial in the advising relationship. Having clarity about the values between students and advisors being brought into the relationship and discussing such in an open conversation between both parties can help establish explicit guidelines on the student's degree progress, the advisor's responsibilities, the merit of the work, and the expectations of performance. Having such conversations about the value of doctoral tasks, students and advisors may be able to communicate more clearly and overcome the common hurdles faced in managing the advisoradvisee relationship.

7. Conclusions

This study sought to explore faculty and underrepresented students' perspectives on student's ability beliefs and subjective task values in the completion of the doctorate in engineering. We found that underrepresented students described activities that strengthened their attainment value and sense of belonging in the program as those most useful to them. Faculty described employing experiences that they considered to have utility value as those used to motivate students. This mismatch of task values can create a communication discrepancy in the advising relationship and could be contributing to high attrition rates in underrepresented populations pursuing an engineering doctorate. We recommend students and advisors to have candid conversations about their expectations and struggles in the doctoral pursuit. These conversations can help in establishing trust between both parties and help develop guidelines to sustain degree progress.

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