“It was awkward to leave, and I wish it wasn’t”: Physics PhD students’ perceptions about switching research groups

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When physics PhD students struggle in their research group, one option is to switch advisors. However, the way physics students approach changing groups is not well understood. Using interview data from 19 physics PhD students who considered switching research groups, we explore the experiences that motivated them to think about switching and the factors that influenced their ability to switch. About half of interviewees were motivated to switch by negative group experiences, while others considered changing if they believed another group could offer them a better research experience. However, students were commonly discouraged from switching due to feelings of obligation to their advisor, a sense of security in their current group, and a lack of clear expectations and procedures. Minimizing these barriers is important for supporting graduate students who wish to change into a group that improves their chance to persist and thrive in their programs.

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I. INTRODUCTION AND BACKGROUND

Finding the right research group is a critical endeavor for first-year physics graduate students. The quality of the advisor-advisee relationship influences nearly all aspects of the doctoral experience, and physics PhD students consider selecting an advisor to be one of the most important decisions they make during graduate school [1]. Upon joining a group, some students find that their new environment provides the right blend of interesting research, supportive peers, and a good mentor. Such positive research experiences support students' socialization into their departments and the field of physics as a whole [2–7]. However, not all students find the right group on their first try. Many students join a lab only to discover that their research is not as interesting as they anticipated, or that their advisor or lab group environment is not a good match. Unsatisfactory experiences in a research group, particularly a negative advisor-advisee relationship, are often cited as reasons that students leave PhD programs [6, 8–12]. One option for students who find themselves in a sub-optimal research environment is to switch groups, as switching may offer them the best way to change their situation while remaining in their graduate program.

The exact count of physics PhD students who switch research groups is hard to estimate, but interviews with faculty indicate they believe the number to be around 20% [13]. This broadly aligns with results of a survey of 4,114 STEM and non-STEM PhD students in which 25% reported that they had switched advisors during their graduate careers [14]. Although prior research has not focused specifically on the phenomenon of switching research groups, several broader studies on advisor-advisee relationships have suggested that switching groups can be challenging for students. For instance, one multidisciplinary study exploring mismatched advising relationships found that students perceived switching groups to be too public, and believed it would not reflect well on them while looking for another group [15]. Other studies indicated that students feared retaliation by their advisors if they left, believing that the advisor could damage their future career [6, 16, 17]. These challenges made students more likely to either stick with their current group or simply leave their program altogether, as the burden of switching seemed too great. Approximately 40% of physics PhD students leave their programs, most commonly during the first two years [18, 19]. Moreover, data shows that numerous students persevere through an unsatisfactory situation. According to a 2017 survey of STEM graduate students conducted by *Nature*, 36% of third-year doctoral students in the US wished they had chosen a different advisor or a different area of study (a percentage that increases as students move later in the program) [20].

Characterizing the experiences that drive students to think about switching groups, as well as the factors they consider when evaluating their decision, will allow departments to more effectively support students during this process. Helping students change from an unsatisfactory group to a more fulfilling research environment is pivotal for providing them with an improved graduate experience. Moreover, if students feel like switching is a viable option, they may be less likely to leave. Yet little research in graduate education has focused on the process of switching research groups, and none has been done in the context of physics graduate education.

To fill this gap, we extend the results of our previous study exploring how physics PhD students searched for a research group in order to examine how students think about the prospect of changing groups [7]. In that study, 19 of 40 first and second year graduate students in the sample considered switching to a different research group. This work focuses on those 19 students in order to answer the following research questions: 1) What experiences motivated physics PhD students to consider leaving their research groups? and 2) What factors influenced students' ability to switch (or not)?

II. METHOD

This study is part of an ongoing set of analyses aimed at characterizing the process by which PhD physics students search for a research group [1, 7, 21]. Study participants were recruited by emailing physics graduate program directors and asking them to forward our recruitment letter to their first and second year graduate students. A $25 Amazon gift card was offered as incentive. We targeted these years of study because they were either in the process of or had recently completed searching for a research group. We intentionally emailed programs of varying size and research activity to ensure a variety of institutional contexts were represented. In total, we interviewed 40 students from 13 institutions.

Data was collected using semi-structured interviews. Our protocol was inspired by cognitive task analysis (CTA) methods [22, 23] and Dervin's sense-making method [24, 25]. Both methodologies are designed to elicit detailed descriptions of interviewees' thoughts and actions as they recount how they progressed toward a goal. The interview protocol asked students to construct a timeline of steps they took while searching for a research group (Stage 1). Students were free to start their timeline at any point, but most commonly began during their junior or senior years of undergraduate study. For each step, we asked students about any major questions and concerns they had at each step of their timeline (Stage 2). This included anything they wanted to find out, were confused about, worried about, or were just curious about. Lastly, we asked students to identify any sources of help that allowed them to resolve their question or concern, as well as any obstacles that hurt their ability to move forward (Stage 3). Interviews were conducted over Zoom, and audio transcripts were then edited for grammar and clarity.

We did not explicitly ask students whether they considered switching research groups, and the 19 of 40 students who brought up the topic did so independently during Stage 2 of the protocol. Then as part of Stage 3 of the protocol, these students were asked directly about which factors they felt helped or hindered their decision-making process regarding whether

to switch groups. These sections of the interview transcripts became the subject of thematic analysis [26].

Students most often brought up the topic of changing groups during Stage 2 of the interview protocol by describing the reasons they started to think about switching. These excerpts were coded under "Motivations for considering switching" and corresponded to RQ1. Stage 3 of the protocol then asked about students' experiences *after* they had already begun thinking about switching groups, and often highlighted students' perceptions about their ability to successfully change groups or not. Excerpts from this section of the interview were coded under "Factors influencing decision to switch (or not)" and addressed RQ2. Initial codes consisting of a short sentence describing why we thought an excerpt was important were also applied [27, 28], which supported development of the themes described in the results. Overall, one researcher (MV) was responsible for developing most of the codes and themes, which were refined through discussion between (MV) and (BZ) at weekly research meetings. A selection of excerpts were coded by a researcher external to the project to establish validity of the codebook; agreement was high, and the codebook was edited to resolve ambiguities.

Prior to each interview, a fixed-choice demographic survey was administered via Qualtrics. Based on the results of the survey, 10 interviewees identified as women and 9 identified as men. 9 identified as White/Caucasian, 5 as Asian, 4 as Hispanic/Latinx, and 1 as Black or African American. 9 institutions are represented. All names used throughout the paper are pseudonyms.

III. RESULTS

Motivations for considering switching: While the interview protocol did not specifically ask whether students considered switching, 19 students brought up the topic of switching on their own. Students often did so by describing their "Motivations for considering switching." We organized students' motivations for considering switching into two subthemes: "Poor group fit" and "Better prospects elsewhere." Statements coded under "Poor group fit" indicated that there were aspects of the student's current research group that were not meeting their expectations, which spurred them to consider leaving the research group. Statements coded as "Better prospects elsewhere" indicated that students were motivated to switch when they perceived other groups as potentially being better than their current group.

1) Poor group fit: 11 of 19 students considered switching groups because they felt their current lab may not be a good fit for them. Descriptions of poor group fits largely revolved around the group's research topic or the advisor-advisee relationship, aligning with prior literature on graduate students' unsatisfactory experiences in research groups (see Sec. I). For example, Wendy initially thought her first group's research topic was interesting, "But then, upon reflection, I was like this really isn't as computational as I want." She explored switching to another group entirely, but eventually was able arrange a collaboration that better suited her research interests. Similar to Wendy, Eric came to graduate school wanting to "do something that was computationally focused and preferably not experimental." In his first research group, he found that the advisor "encourages people to have their hands in a little bit of everything," including more experimental work, which he was willing to try. However, after working in the group for his first two semesters in graduate school, Eric recalled "[The advisor] didn't really change my perspective on experiment at all." Thus, Eric opted to change into a group that was entirely focused on computational physics.

Others described issues with the advisor-advisee relationship that drove them to think about switching. For instance, one concern raised by several students was a perceived lack of guidance from their advisor. Cole felt that he was not able to get enough help from his first advisor, saying "Every time I went to a meeting to clarify what I'd be doing, I ended up more confused." Cole suspected that "how [my advisor] liked teaching and working with people, it wasn't how I liked working with people." Hence, Cole left this group and joined a new one where "everything seems to make sense, and I have a plan for how things go forward. So we just work better together." Benjamin offered a similar appraisal of his first research advisor, saying that "I didn't have a lot of direction. It was kind of scary for me... I felt like I was in over my head." Meanwhile, Tabitha and Pauline, who both identified as women, reported that they were compelled to leave their groups after discovering that their advisors had been investigated for misconduct allegations related to their treatment of graduate students (see [1] for a more detailed description of these cases).

2) Better prospects elsewhere: 13 of 19 students said that they considered switching out of their group when they discovered other groups that might offer more interesting research or a more fitting work environment. 5 of the 13 had also indicated that they were in a group that did not fit them well. For these 5 students, the availability of an alternative was a positive influence that served to strengthen their motivation to leave. One example is Benjamin, who was not enjoying his first lab experience and was contemplating a switch due to the benefits he believed a new group would offer him. Its research topic made him "way more excited," and he suspected he would enjoy the working environment more too: "What kind of swayed me in the end was, there was two people I knew personally [in the group]... I have the opportunity to like, be around people that I've known for years." Thus, it was not only Benjamin's poor experience in his first group that motivated him to consider switching, but also his belief that there was something better available. Similarly, Brianna did not enjoy the research in her first group and worried that changing would result in "the same thing where I don't like what I'm researching again, and just having to suffer through it." Her worry was alleviated when a prospective new advisor indicated that he would "work with me to make sure that I'm doing something that I like, and that's really important." Hence, for Benjamin and Brianna, the prospect of having a

better opportunity elsewhere strengthened their motivation to explore other groups.

On the other hand, for students who felt like they were in a good research group and were not motivated to leave by poor experiences, the possibility of better research elsewhere drove anxiety as they reassessed their initial decision. 8 students fell into this category. For example, Elena described entering graduate school "secure in the fact that [this research] is really what I want to do." Despite this, she found herself second-guessing her decision when she started attending department colloquia and hearing about different kinds of research: "For students who already have a group... Like, I know what I'm doing, and I know what I like. But then I'm hearing about this really cool thing and that really cool thing. Oh, maybe it would be good to like, reach out." Elena said that although she enjoyed working with her advisor, "I wasn't expecting it to be as difficult once you're in a group... [you hear] people talking about their groups and their work ethic or like how they do one on one meetings, maybe like three times a week versus you're doing it once a month. And so you you can't help but compare." This illustrates how the availability of other groups can motivate students to second-guess their initial advisor choice, even when satisfied with their current group. Still, none of the 8 students who reported this anxiety actually ended up switching. Those who switched were all categorized as being motivated by a poor group fit as well, which indicates that having an unsatisfactory group experience may more strongly compel students to change labs.

Factors influencing decision to switch (or not): Once students began to consider switching groups, we identified five factors that influenced whether those students eventually switched groups or not. Students discussed these factors *after* they had already indicated that they had some motivation to switch, and these excerpts related to whether students perceived switching as a viable option. The overarching theme of this section is that students commonly felt dissuaded from switching groups, and generally felt that changing groups was not a well-supported process.

1) Fear of inability to find a new group: Aligning with prior literature (see Sec. I), students feared that they would struggle to find a new group if they left, oftentimes due to fear of reprisal from their current advisor. Benjamin, whose advisor held a more powerful position in the lab than the advisor he sought to join, similarly feared that he would "have problems down the road with lab politics, because you don't want the person who's in charge to not like you." Meanwhile, Dev wanted to explore the possibility of switching to another research group, but hesitated to reach out to a new advisor "Because I know for a fact that these two professors talk to each other." Dev did not want his current advisor to feel jilted because he was looking at another group. However, he also recognized that his lab was not fitting him well, which left him in a bind regarding how to move forward.

Other prior literature indicated that students felt like switching was a public spectacle, and would reflect poorly on them if they switched. Pauline expressed this concern, noting that prospective faculty would know she was switching and want to know why. In this case Pauline was was leaving her group due to misconduct allegations against her advisor and was afraid of explaining her situation to prospective advisors. "I was scared that they would ask like, well, why are you switching groups? And I didn't want to say like, well, there's this whole list of things about [my former advisor] that you probably know but that we don't talk about in the department." Furthermore, as a student participating in a bridge program, Pauline was especially concerned about how other faculty would perceive her research ability. Bridge programs are transitional post-baccalaureate programs designed to increase the number of graduate degrees earned by underrepresented students in physics [29]. "I wasn't sure if there was a kind of like stigma against bridge students. And I wasn't sure how PIs saw us. Like if they saw us as a handicap or not." Pauline's comment illustrates how in the absence of clear structure and guidance, students are only able to speculate about how their search for a new group might unfold.

2) Obligation to current advisor: Many students made comments about feeling an obligation to remain with their current advisor. Students often felt like advisors had invested in them by giving them a spot in the group, and therefore said they would feel guilty leaving. For instance, Nina said that switching "would be a very difficult thing to do for me. To say to this person, you put so much effort and time into talking to me... And now I'm just like, you know what, on the second thought, I might like this group better? I would feel very bad for doing that." Indicating that she was content with her research and not strongly motivated to leave, this was a major reason Nina opted to stay. However, for students in a poor research environment, this feeling of obligation toward an advisor can be a significant barrier to leaving. For instance, Tabitha recalled feeling that her advisor "made me believe I was here because of him. Like 'oh I owe him so much. I could never switch advisors.'" She said that she began to doubt herself as a researcher, thinking that she could never join a new group because "the only reason I'm publishing something great is because of my old advisor."

3) Inertia of similarity: Students were also reluctant to leave their group due to what one student dubbed the "inertia of similarity." Even in cases where students expressed dissatisfaction with their lab, its familiarity remained attractive. Hassan, who worked in a research group throughout his first semester in graduate school, said he originally intended to explore different research options but never did: "It was like, you know, being in a comfort zone, right? I have this sure position in this one lab that has decent funding... it kind of demotivated me to still pursue some other groups." Elena said moving to a new group would be "uncharted" and make her feel "insecure." Similarly, Benjamin felt "safe" in his first research group, and described switching as "like jumping ship... it's like leaving a relationship that you've been in a long time. That's why I keep saying it's like a breakup. You know, you're in a relationship that's like safety for a long time. And you don't want to leave it." He lamented, "It was

awkward to leave, and I wish it wasn't." In fact, four students likened the experience of switching to a breakup or divorce.

4) Lack of information to decide: Several students felt unprepared to decide whether switching was the right option for them. For example, Melody had considered switching groups after hearing about "intense arguments between the professor and [another graduate student in the lab], including really bad words like the f-word and that stuff. It was really intense." Despite this experience, she did not feel that she had been in her group long enough to determine whether her research topic would make it worthwhile to stay. Hence, Melody intended to wait and see "if the project that he gives me is like, if I don't want to do that and it feels unimportant to me, then there's a chance I would consider different groups." Cole offered a similar concern, saying that amidst classes he "didn't have enough time to go down and actually work in the lab with [the older graduate student]." This made it difficult for him to assess whether the research was a good fit, or if he should change labs.

5) Normalization of switching: Many of the items listed thus far tended to dissuade students from switching research groups. However, students described feeling more secure about switching when they perceived it as a normal practice. Students cited several sources that helped normalize the process of switching, including current advisors, other graduate students, and messaging from the department. Brianna reported feeling "more confident" about leaving her group when her advisor at the time told her switching was "totally fine, you know, that's what these years are for." Similarly, Nina said "I also appreciated my professor saying... please don't feel guilty, I know you came here as a member of my group, but don't feel obliged to stay." Her advisor said if she was unhappy it "would not create a good environment for either of us. You would suffer through your PhD, and I would not have a student excited about what they're working on."

Normalization of switching groups was not always related to explicit comments, but to a recognition that other students were thinking about it too or were still searching for a group. Cole felt like changing research groups would make him fall behind other students who were already settled in research groups, which was another commonly cited concern among interviewees. However, his fear was assuaged when he realized that there were many other graduate students in his cohort who still did not have an advisor or were also planning to switch. He recalled, "I knew a lot of people in [our] office took awhile to actually get real research groups. So that made me feel better when I was like, maybe I'm not going to work with [my first advisor]... it was kinda reassuring." Explicit messaging from the department about the normalcy of switching also helped. Nathan noted that his department placed a strong emphasis on letting students switch groups during their orientation. He said, "I was glad that at [my school] they made it clear that you're not locked in immediately. And switching is common... it seems fairly accepted." This helped Nathan get into a research group sooner, knowing that he could change at a later date if needed.

IV. DISCUSSION

When PhD students find themselves in an unsatisfactory research group, switching advisors may be their best option for staying in their program. While it was known that students were motivated to switch due to poor experiences in their group, our results show that students also feel motivated to think about switching if they feel they are missing out on something better. Physics PhD students often enter graduate school unsure of exactly what research topic they want to pursue or what their advisor-advisee relationship should look like [1, 7]; thus, many physics graduate students may think about switching research groups at some point during their graduate careers. Departments must recognize that this is likely a common consideration among graduate students and provide support for those thinking about making a change.

For students who want to switch groups, our results show that students are dissuaded from doing so by feelings of obligation to their advisor, feeling secure in their group ("inertia of similarity"), and lacking enough information to decide whether to leave. Research groups are "sticky" in this regard; once students join a research group, they tend to feel attached to them. If a student is in a poorly fitting lab, this stickiness makes them less likely to have a satisfying graduate experience and increases their likelihood of leaving the program altogether. Departments must therefore work to provide these students with more support during such a critical transition. Although it is outside the scope of this paper to determine the most effective ways of lowering the barriers to switching, our results suggest several possibilities.

Clear and consistent messaging from departments and faculty that switching groups is common among physics graduate students would be one step in the right direction. This would help to normalize the practice, which students cited as helpful when trying to switch. Program handbooks, websites, and orientation material should explicate that students are allowed to change advisors in order to find the right fit. One idea is for the graduate cohort's academic advisor to act as the first point of contact for students considering changing groups. This individual could help students evaluate their choices and support discussion of switching with their current research advisor. Another example would be to create a system for students to try several labs during their first year, which would make switching an inherent part of their program. If changing groups is a scheduled activity, it could help address several obstacles that students encountered (e.g., obligation to an advisor).

Finding a research group is not an easy task, and some PhD students will inevitably find themselves in a lab that does not provide them with their best chance to succeed. This study provides insight into how to support students who want to switch groups, but more work is needed to assure all students are given an opportunity to thrive in their research environment. We thank the PhD students in this study and hope their stories contribute to on-going improvements to PhD programs in physics. This work is supported by NSF Award 1834516.

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