The powerful impact of positive and negative interactions with STEM faculty on undergraduates, especially underrepresented and transfer students

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Abstract

Despite clear links to improving college outcomes, descriptive details about the kinds of student-faculty interactions that are most helpful for STEM students are less well understood. In this qualitative interview study, we investigate what micro interactions are most helpful – and consequential – for STEM students' persistence and success, especially transfer students. We found that students who experienced positive, caring interactions with at least one faculty member in their major tended to feel more connected to their discipline, had greater confidence in their abilities in STEM, and often put forth more effort in their studies. Transfer students were especially impacted by the quality of care they received from faculty; those who had negative experiences with faculty were often left feeling less capable and discouraged to continue in their STEM discipline. STEM faculty should show interest in students' learning and long-term academic and career goals and provide sufficient availability for one-on-one help.

Key words: STEM education, student-faculty interactions, transfer students

Introduction

Numerous studies have found that positive faculty interactions help improve college outcomes for students (Seymour and Hunter 2019; Harper, Weston, and Seymour 2019b; McCoy, Luedke, and Winkle-Wagner 2017; Jackson and Laanan 2015; Packard et al. 2011). This study not only reinforces the strong impact of positive student-faculty interactions, but also provides a detailed account of the kinds of faculty-student interactions in science, technology, engineering and mathematics (STEM) that are helpful for increasing enjoyment of science class material and perception of ability in STEM, and how those variables in turn can affect persistence and success

in STEM. Furthermore, the results of this study illustrate the importance of micro-interactions with faculty on students' success, especially for STEM transfer students (students who transferred from community colleges) who often come from diverse and underrepresented backgrounds.

This study builds upon the *Talking About Leaving Revisited* findings on impactful STEM teaching practices, which found that the most frequently reported characteristic of good STEM teaching – according to students – was when the teacher seemed friendly and approachable, and showed concern about the students' learning (Harper, Weston, and Seymour 2019b); that is, 40 percent of students defined good teaching in this way. Correspondingly, one of the leading ways that students defined poor quality teaching was when faculty exhibited intimidation and distancing behavior, with one-third of students reporting experiencing this type of behavior (Harper, Weston, and Seymour 2019a). In the *TALR* study, friendly interactions were the most frequently reported characteristic of good STEM teaching; and this study delves deeper into what makes those interactions seem more friendly and more supportive than other types, and how those interactions can affect students' enjoyment of their learning and perception of ability in their STEM disciplines.

Literature review

Student-faculty interaction is perhaps one of the most widely accepted college experiences that is thought to improve college outcomes. According to Astin's involvement theory (Astin 1993), frequent faculty interactions are more strongly linked to student's satisfaction in college over any other institutional characteristic. Other studies have confirmed the strong impact of positive student-faculty interactions on students' satisfaction of their college

experience (Fries-Britt and White-Lewis 2020; Kim and Sax 2009; Vogt 2008); their engagement in their academic discipline (Wilson, Summers, and Wright 2020); self-efficacy (Vogt 2008); educational aspirations (Fries-Britt and White-Lewis 2020; Kim and Sax 2009), and academic performance (Micari and Pazos 2012; Wilson, Summers, and Wright 2020).

Researchers have found that interactions with faculty are an important part of higher education socialization for students – contributing heavily to students' academic adjustment, especially for transfer students (Jackson and Laanan 2015). The more that community college transfer students can view faculty at the university as easy to approach and communicate with, the more likely they are to have a positive academic adjustment to their university. But for all students, especially when new to a program or university, being able to socialize organizationally and professionally can help them feel a better sense of belonging to the discipline and within the department (Holland-Zahner and Harper 2022).

STEM-specific faculty interactions

Student-faculty interactions in STEM are especially important for students' academic and professional success in their disciplines. Students often learn the norms and culture of their STEM discipline through faculty interactions and mentoring (McCoy, Luedke, and Winkle-Wagner 2017). Faculty can also serve as the gatekeepers to future opportunities and advancement, as they are the ones students often go to for letters of recommendation and for information about internships, research assistantships, and employment possibilities (Park et al. 2019).

In particularly difficult STEM courses, students – especially transfer and racially and ethnically underrepresented students – rely on their relationship with their instructors for support,

motivation, and help; they often have few personal outside resources they can depend upon (Micari and Pazos 2012). Supportive and inspirational STEM faculty are one of the key elements that influence students' perseverance to continue pursuing a STEM degree (Packard et al. 2011; Seymour and Hunter 2019). Faculty-student relationships also significantly predict grades in STEM – that is, good relationships tend to predict higher grades, and poor interactions tend to predict lower grades (Micari and Pazos 2012; Muenks et al. 2020).

Frequency of interactions is not enough

Just the frequency of interactions is not enough; past research shows that the quality of those interactions is very important (Endo and Harpel 1982; Vogt 2008). Scholars have found that students appreciate sensitivity to their unique situations, concern for their academic struggles, and friendliness in their interactions with STEM faculty (Buttner 2004; Gasiewski et al. 2012; Harper, Weston, and Seymour 2019b; Vogt 2008; Wilson, Summers, and Wright 2020; Harper and Thiry 2023). The quality of care seems to be more important than number of interactions. In addition, a few studies have found that students' perception of how much faculty care about them is heavily linked to students' academic performance and commitment (Buskirk-Cohen and Plants 2019; Kim and Sax 2018). Students who perceive their faculty don't care about them tend not to perform as well as their peers who believe that faculty do care (Buskirk-Cohen and Plants 2019).

Underrepresented students' interactions with faculty

For students of color, interactions with faculty are especially important for their ability to navigate higher education systems that have historically excluded them. Unfortunately,

researchers have found that students of color in STEM tend to have less interaction with STEM faculty, especially at predominately white institutions, and are also more likely to experience discrimination from faculty (McCoy, Luedke, and Winkle-Wagner 2017; Park et al. 2019).

In one study, underrepresented STEM students who attended predominately white institutions reported that they felt STEM faculty often tried to weed them out (more so than their White peers), and also often encouraged them to consider non-STEM disciplines (McCoy, Luedke, and Winkle-Wagner 2017). In contrast, the study found that STEM students of color who attended HBCUs reported faculty in their disciplines were warm and inviting. Other research has shown that students who experience racial discrimination from STEM faculty tend to get lower grades in their STEM courses (Park et al. 2022).

But the good news is that several studies have shown that historically underrepresented students do benefit significantly from positive faculty interactions, which often increases their perception of ability and their educational aspirations (Fries-Britt and White-Lewis 2020; Gasiewski et al. 2012; McCoy, Luedke, and Winkle-Wagner 2017; Wood and Palmer 2015; Harper, Weston, and Seymour 2019b).

Importance of faculty interactions for STEM transfer students

STEM transfer students are typically more racially, ethnically, and socioeconomically diverse than traditional first-time-in-college students, as community colleges provide a more accessible and affordable pathway for entering STEM majors (National Academies of Sciences 2016; National Academy of Engineering and National Research Council 2012). Universities can help diversify their STEM education programs – and the resulting workforce – by enrolling and retaining more transfer students. A successful academic adjustment and connection to the major

department is essential for transfer students' success, particularly in STEM programs, which typically require complex, sequential courses. This makes successful completion of every course critical for their already shortened timelines (Elliott and Lakin 2020). Some research shows that one of the key predictors for better academic adjustment and department connection for transfer students is positive faculty interactions (Lopez and Jones 2017).

Study aims

Despite clear links to improving college outcomes, descriptive details about the kinds of student-faculty interactions that are most helpful for STEM students are less well understood. In this qualitative interview study, we investigate specifically what kinds of micro interactions (small moments of impactful communication) are most helpful – and most consequential – for STEM students' persistence and success, especially transfer students.

Materials and methods

This work is part of a larger, five-year descriptive case study of STEM students' experiences starting at a community college and transferring into a four-year university in three different U.S. states. The larger study includes a) longitudinal interviews with students who started at a community college and transferred into a university; and b) interviews and surveys with graduating STEM seniors – including both transfer and first-time in college (entered from high school) students – about what helped them persist to bachelor's degree completion. Study sites included three universities and two community colleges in three different state contexts that are exemplars in successful transfer and retention.

This paper focuses on the findings from interviews with 112 graduating STEM seniors at the three university study sites. Interviews were conducted individually with students and typically lasted about 60 minutes. Interviews addressed classroom experiences, advising experiences, peer and faculty interactions, and involvement in co-curricular opportunities. We found that one of the key components to student persistence was the kinds of interactions students had with STEM faculty members. We asked all of the senior students the following questions about their experiences with faculty: (1) What was your experience like with the professors in your STEM department? (2) How did those experiences differ from your experiences with faculty at the community college? (3) What was the instructional quality like? (4) Outside classroom availability and support? (5) What is the climate or atmosphere like in your major/department?

Students were recruited from the larger pool of all graduating STEM majors at the three universities. The total population of STEM seniors at the three universities was 9,114 students (ranging from a low of 2,670 to a high of 3,571). Campus institutional research offices shared student contact and demographic information, including previous higher education attendance. From these records, we drew a stratified sample of students to represent a variety of STEM disciplines; racial/ethnic, gender, and socioeconomic diversity; and including representation of both transfer and first-time-in-college students for comparative purposes. This stratified sample comprised 456 students from the three universities who were invited to participate in an interview. Students were recruited via email invitations and were compensated with a gift card for their participation. In all, 112 seniors responded to the invitation and were interviewed. Interviews were conducted individually with students and typically lasted about 60 minutes. The interview protocol was developed by a team of four researchers.

We used Domain Analysis methods to analyze the interviews which were transcribed verbatim for text analysis (Spradley, 1980). A team of four researchers developed an analytic codebook and coded all interview data. Codes were generated inductively based on emerging themes in the interviews, as well as deductively based on our research questions and previous findings from the literature. Codes were then clustered into larger domains (e.g., student-faculty interactions, classroom experiences, etc.) and compared across disciplines and student demographics. Because this was strictly a qualitative study with textual data, we did not perform inferential statistics and rarely report frequencies of codes or participants' responses. Rather, when appropriate, we use descriptive terms, such as "a few" or "many" to reflect the weight of opinion in the study. In a few cases, we provide numeric data to illustrate the weight of opinion with the student interview sample. Overall, though, our focus is on providing qualitative, rather than quantitative, descriptions of the patterns of micro interactions that we identified from the analysis.

In all, we interviewed 112 graduating seniors in STEM majors, including 36 community college transfer students. Students majored in a variety of STEM disciplines: engineering (27%), CS/IT (22%), biology/life sciences (24%), physical sciences (14%), and mathematics (13%). More than half (57%) received a Pell grant, a marker of low-income background. Nearly half (42%) were the first in their families to attend college. About half (55%) were from underrepresented racial and ethnic groups (Black, Latinx, or Native American). Finally, although they are underrepresented in STEM majors, women comprised 55% of senior interview participants. Because we used stratified sampling procedures to ensure representation of transfer students, underrepresented racial/ethnic groups, and first-generation college students, the sample in this study did not perfectly reflect the demographic composition of the larger undergraduate

population at the three universities. Still, each university was diverse (ranging from 30-45% of students from underrepresented racial/ethnic groups) and we selected the study sites for this quality.

Institutional review

This study was approved by the University of Colorado Boulder's Institutional Review Board (Approval #18-0170). Each study site's institutional review board reviewed the human subjects research protocol and accepted the approval from the University of Colorado. Students were invited to participate via email which further explained the nature of the project and included a copy of the informed consent for their review. Participants were then able to review the letter of consent – away from the investigators – and consider whether they wished to participate in the study before participating in the interview.

Results

Of the 112 students that we interviewed, 106 of them commented on specific interactions they had with faculty members in their STEM major department. In the following, we share about the powerful effect that these faculty interactions had on both students' enjoyment of their learning and their perception of ability in their STEM discipline – that is, both the positive effects from supportive faculty as well as negative effects from unsupportive faculty.

We found that the most described types of effectual (and ineffectual) micro interactions with faculty that were experienced by the students fell into two themes: Supportive and caring (vs. unsupportive and discouraging); and available and approachable (vs. unavailable and unresponsive), as summarized in Table 1 [Table 1 near here].

The powerful impact of positive and negative interactions with faculty

Supportive and caring faculty

When students felt their professors genuinely cared about them, they responded by exerting greater effort. Nearly 60 percent (63 students) reported that they felt at least one teacher in their department cared about their learning. This care was usually in the form of professors showing they recognized, understood, and/or respected the unique needs and interests of the student, and were willing to spend one-on-one time with students. Students responded with boosted confidence and reported exerting more effort, particularly in the course taught by the caring teacher, but sometimes also in their other STEM courses.

Students' descriptions of caring micro interactions included comments about faculty encouraging students to persist and helping students believe they could succeed in their STEM discipline. For example, a biology student said that whenever she started to "feel down and lose motivation," she would talk to one of her biology professors, who would prompt her to set monthly goals and consistently check in with her to talk about those goals. The student explained that these frequent conversations "made all the difference" in her motivation.

Similarly, a biochemistry student, who was struggling in organic chemistry, reported that her organic chemistry professor told her "Don't worry so much about failing one test" because it would likely not make a big difference in her overall studies. The professor had shared that she had "failed many O-chem tests" and still succeeded all the way through to her Ph.D. in Chemistry. The student said this personal micro interaction helped her "feel better" so she "could keep going."

A transfer student reported that her university professors in computer science were more caring than those she had at her community college, and the support encouraged her to "stick it out" when she "thought about quitting." She said the caring micro interactions she experienced with computer science faculty helped her feel more comfortable with them, enabling her to ask questions both inside and outside of class, and motivated her to continue working hard in her studies.

Caring was also manifested in taking the extra time to discuss academic and career goals with students, beyond just answering questions about class material. For example, a mathematics student – who switched from engineering – shared that one of his professors in mechanical engineering recognized his keen interest in mathematics, along with talent, when the student was showing the professor how he came to an answer on a test by doing some complicated math. The professor said "Why are you studying mechanical engineering? You're doing this complicated proof and showing me stuff I would never do in a million years, and you're getting it right and obviously enjoying it – I think you should go to the math department and become a mathematician." The student worried there wouldn't be any employment opportunities in mathematics, but the engineering professor alleviated his concerns, "That's the farthest thing from the truth. You will have no problem finding work." It was because of this micro interaction that the student ended up switching from mechanical engineering to mathematics, and reported that he "loves his major," and is so glad he made the switch.

Similarly, a biology student reported talking to her microbiology professor about her hopes of getting into a physician assistant program, and the professor provided helpful tips for increasing the student's chances. The student said this simple micro interaction made her feel like

her professor genuinely cared about her and she felt like they "had a special connection." The helpful tips and connection boosted the student's confidence for "really getting into PA school."

One-on-one time with faculty – usually during office hours – invoked the strongest feeling of care from the students. Fifty-nine of the 63 students explained that the caring micro interactions they experienced took place one-on-one. For example, a first-generation mathematics major said he would spend "up to 60 minutes" at a time with his math professors during their office hours, which made him feel like "they really took us under their wing," and he said those one-on-ones were "some of the most important interactions" he had that helped him "want to work really hard" in the major. Similarly, another student studying information communication technology explained that she had several one-on-one conversations with a couple of professors in her major, and these interactions enabled her to "build some really great relationships" that helped her "feel supported" in her learning and encouraged her to persist through to graduation.

Whole department-level care was less commonly reported, with only four students noting that all – or most – of the faculty in their STEM majors showed care. But indeed, as this mechanical engineering student explains, it made a big difference:

> *I feel like the faculty here [in mechanical engineering] are all very understanding – they sympathize with us; they know what we're going through, and it makes a big difference. I feel like they're keeping an eye out for me, helping me get through.*

We found that students who experienced positive, caring micro interactions with at least one faculty member in their major tended to feel more connected to their discipline, had greater confidence in their abilities in their major, and often put forth more effort in their studies. One-

third of our sample who reported having positively impactful interactions with faculty were transfer students (21 students) – and nearly all these students noted that at least one professor in their major helped them feel more connected to the department, as well as confident in their abilities, which in turn contributed to their persistence.

Unsupportive and discouraging faculty

Unsupportive and discouraging interactions had an adverse impact on students' confidence, effort, and sense of connection with their majors. Forty percent of the participants (42 students) reported they experienced negative interactions with STEM faculty that left them feeling intimidated, demoralized, or made to feel too stupid to belong in a STEM major. Three students even believed the negative interactions contributed to their failure in courses, and two students reported the interactions made them consider leaving their STEM discipline altogether.

Thirteen students reported experiencing rejecting, hostile or other negative interactions with at least one STEM professor. The most common experience was being intimidated (often publicly), belittled, or discredited, usually when the student tried to ask a question. For example, a chemistry major shared:

> *This one particular professor, when I'd go in to talk to him during office hours with a question, and he'd be like, "Why don't you know this?" kind of thing. Which just felt demeaning.*

Similarly, a computer science student said his operating systems professor made him feel "stupid" and unsupported when he went to visit the professor during office hours, saying: "Did you not come to class? Were you not prepared? Do you know what's going on?" The professor

then turned his back to the student and resumed typing at his computer, ignoring the student and making him feel "brushed off."

Public humiliation happened too. A math student reported trying to ask a question during class, and his professor responded with, "That's a dumb question, [I'm] moving on …" and never answered the student's question. Unfortunately, most of these students said they stopped going to office hours and stopped asking questions during class, for fear of being shamed, criticized, or disregarded.

Some students believed the negative micro interactions they experienced with faculty were specifically because of their backgrounds. Four transfer students suspected their professors were uncaring towards them because they came from community colleges. For example, an electrical engineering transfer student reported his physics professor made him feel "like a moron" when the professor said: "How do you not understand? This is basic!" The student was convinced "he was treating me that way because I was a transfer student."

Four women reported feeling less confident with approaching faculty in their departments after experiencing at least one discouraging encounter with a teacher. For instance, a math student shared that one of her professors said: "I love your questions because of their simplicity." The student assumed he meant it was because she was a woman, and she stopped going to office hours.

Ten racially underrepresented students reported that unsupportive faculty contributed to their lack of confidence and/or feelings of isolation. An African American woman explained that she felt her experience was "especially difficult, because you don't see a lot of people that look like you, and that alone makes it hard to speak up in class. And there are some teachers who are

just not as supportive … You feel like you're by yourself and you can't say anything because you're not as intelligent as the person next to you."

Seven students surmised that the reason their STEM professors seemed so uncaring was because faculty treated teaching as a secondary concern and placed more value on their research work. For instance, a computer engineering student was convinced that "many of the professors in this program – they just don't care about their students; it seems like all they want to do is research. They're just pushed into teaching because the university forces them to."

Available and approachable faculty

Micro interactions happened when faculty made time in their schedules for student connections and communications. As noted in the Supportive and Caring section above, students highly valued one-on-one time with faculty. We include a separate section here on availability and accessibility for that one-on-one time because students distinctly reported on faculty's approachableness for getting that desired support. However, we acknowledge that there is naturally some overlap between care and availability.

Fifty-four students discussed how much faculty availability, approachableness, and responsiveness helped them feel more supported. Sixty percent of the transfer students in our sample (21 students) reported they felt more supported by their departments when faculty were more available to them for both their academic questions as well as discussing the students' personal concerns and future career plans.

Students felt more supported when office hours were at times that students could realistically attend and when they were long enough to accommodate multiple students' questions. As a chemical engineering student noted, "I feel supported by the faculty in my

department who move office hours around for me. I work two jobs, so it's hard to visit during standard office hours. Some faculty have been supportive of that aspect."

Students appreciated when faculty encouraged them to visit during office hours; meaning, not just holding time for the office hours, but also warmly inviting students to attend them. They also valued faculty taking the time for discussions about not just classwork, but also about personal concerns, such as the student's goals and future in STEM. When students felt like they could "stop by anytime," and the teachers had "time to talk about future plans, like hopes of getting into graduate school," they viewed their professors as more approachable, supportive, and friendly.

We found that students who attended office hours regularly tended to be the ones who felt more supported by their STEM departments in general, often because it gave them the opportunity to get to know faculty better, and to feel "seen" by their professors. Some students noted that they felt more comfortable asking questions in class after having the one-on-one connection time with professors during office hours. As a computer science student shared: "I visited my software engineering professor during his office hours a lot; he was always available for any questions. And now we're buddies and because of this I always feel comfortable raising my hand in class."

Unavailable and Unresponsive Faculty

When faculty seemed unavailable, or were unresponsive, these silent micro interactions negatively affected students. Seventeen students reported experiences where their teacher was either unavailable for help or would not respond to their queries for help.

Descriptions of unavailable faculty included offering too few office hours, or only offering hours at times that were unrealistic for the student to attend. As one working computer science student noted:

> *I had the hardest time in the classes where it was hard to find help because the TA or the professor were not available when I could come by. I always had to work when they held office hours. Those classes were always the most difficult because of that.*

Students expressed their frustration when faculty went completely silent on them with unanswered questions via email or taking an excessively long time to reply (which was too late to be helpful for the student, like after an exam had already passed). As a biology student shared:

> *There are some professors who you email, but they don't get back to you until like a week later, which was no longer helpful. It's like they don't want to help you.*

Students sensed that these unavailable and unresponsive teachers just "didn't care about helping" or were "unenthusiastic about teaching." The lack of opportunity for help, communication, and connection left some students feeling alone in their confusion, or unsupported by their departments. Most students reported succeeding despite their frustrations, but nevertheless these silent micro interactions contributed to loss of confidence and poor sense of belonging.

Discussion

We found that most STEM students who were impacted by interactions with their STEM faculty had positive experiences with at least one teacher in their department, which led them to

believe that at least one faculty member cared about their learning and their success in the major. These students attributed the care they felt to also feeling connected to their departments, more confident in their abilities in the major, more focused in their long-term academic and career goals, and more determined to put in hard effort in their courses (and not just those taught by the caring teacher, but often in their other STEM courses as well).

Unfortunately, 40 percent of the students in our sample reported experiencing unsupportive and unfriendly interactions with at least one professor in their STEM department, which usually took the form of belittling or intimidating behavior from the professor. Students said that they believed these negative interactions contributed to feeling less connected to their departments and less capable in their discipline. A few even felt strongly that the negative interactions they experienced with professors contributed heavily to their failure in those particular courses.

Transfer students have less time to become academically and social integrated to the university, so they were especially impacted by caring faculty in their STEM departments. One-third of the transfer students in our sample said that "feeling cared about" contributed to their confidence in the major, and one-fifth of the transfer students explained that "uncaring faculty" made them feel less capable and often discouraged. Availability of STEM faculty for one-on-one help was also particularly important to transfer students, with nearly two-thirds of our transfer sample noting this characteristic helped them feel more supported.

Conclusions and implications

Feeling cared about and supported by STEM faculty helped students feel more connected to the discipline, enjoy the course material more, and feel more capable in their majors. Many

students believed that these positive outcomes in turn contributed to their desire to keep working hard in their majors.

Our results confirm past findings that positive faculty interactions improve academic outcomes for students (Harper, Weston, and Seymour 2019b; Jackson and Laanan 2015; McCoy, Luedke, and Winkle-Wagner 2017; Packard et al. 2011; Seymour and Hunter 2019). Our findings showcase why positive interactions are particularly important in STEM disciplines, where persistence and success rates are significantly lower than other majors (National Academies of Sciences 2016), and therefore support that contributes to students' perseverance is essential for student success. Our findings also provide specific details about the kinds of micro interactions that provide the most support to students: That is, interactions that are one-on-one; include discussions about long-term academic and career goals; and that sometimes include conversations about more personal, non-academic issues, such as the unique challenges the student is undergoing.

In addition, ample availability for these kinds of micro-interactions is equally important; so that students can find time in their busy schedules to have these quality interactions with STEM faculty. Transfer students, especially, need sufficient time to meet with STEM faculty early on when they enter the major so that they have the opportunity for connection and positive academic adjustment as soon as possible. Students of color and those from low-income backgrounds are disproportionately impacted by this transfer challenge because many of these students began their studies in community college (Hagedorn et al. 2006; Witham et al. 2015).

Based on our findings on the strong impact of positive student-faculty interactions on STEM students' enjoyment of class material, perception of ability in STEM, and resulting persistence and success in STEM; in addition to previous research on the tremendous positive

effect of teachers showing care for students' learning (Harper, Weston, and Seymour 2019b), the following recommendations may be helpful: STEM faculty should provide sufficient availability for one-on-one help via office hours, so that students with busy academic and work schedules are able to visit outside of class time; show interest in students' learning and long-term academic and career goals, and provide assistance with attaining those goals when possible; and show concern for other aspects of students' lives, such as the personal and unique obstacles that students face while trying to pursue a STEM degree. Developers of faculty professional development training could highlight the significance of these seemingly mundane interactions on students' motivations and persistence so that faculty could consider them as integral to students' learning and retention. Leadership in STEM departments should support and encourage their faculty appropriately to enable them to have these one-on-one relationships with undergraduate students that provide meaningful connections, tailored academic support, and emotional support and affirmations.

Limitations and recommendations for further research

As explained in our methods, the student sample from which the interview data was drawn came from 112 graduating STEM seniors; that is, all the students in our sample persisted through to graduation, even those who experienced negative interactions with faculty or who lacked any interactions with faculty due to unavailability. Indeed, these students persisted despite the poor quality of support and/or lack of support they received. We believe a follow-up study that further examines how these students can persevere, especially in contrast with those who switch out of STEM or drop out, would be useful to gain more understanding of what students can draw upon when they lack faculty support.

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