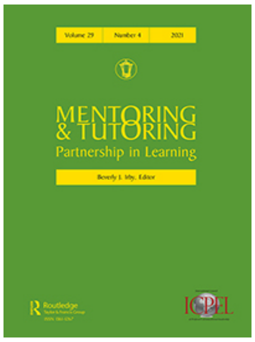

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The Motivations of STEM Mentors

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ABSTRACT
Little is known about why people decide to mentor in the context of science, technology, engineering, and math (STEM) learning. The purpose of this qualitative study was to identify the motivations of undergraduate student mentors working in an afterschool STEM program for underrepresented elementary schoolboys. We used self-determination theory (SDT) to explain why the undergraduate students decided to become mentors and, for some of them, to persist as mentors. We interviewed a sample of 16 mentors about their backgrounds and experiences over three semesters. The participants experienced intrinsic and extrinsic motivations to become and persist as mentors. Each mentor articulated more than one reason, suggesting their motivations are multifaceted. Some motivations did not fit well with SDT, which points to the underlying complexity of why people mentor and how mentors' backgrounds shape their motivations.

KEYWORDS
Mentoring; stem; undergraduate students; self-determination theory

School-Based mentoring (SBM) is currently the most widely available and fastest-growing form of mentoring in the United States (Herrera & Karcher, 2013; Karcher, 2008). Mentoring is 'a developmental experience or a type of support intended to advance students towards an important goal' (Kram, 1988, p. 5). Mentoring programs face the continual challenge of recruiting and retaining high-quality mentors (Drew, 2018; McMorris, Doty, Weiler, Beckman, & Garcia-Huidobro, 2018; Raposa, Dietz, & Rhodes, 2017). Why mentors decide to become involved and the conditions under which they persist as mentors are questions that require robust answers due to the importance of cultivating deep and positive relationships between mentors and mentees to obtain positive results (Bayer, Grossman, & DuBois, 2015; Lyons & McQuillin, 2019; McMorris et al., 2018).

Mentoring in STEM contexts has become a common strategy to get young students, particularly girls and racially and ethnically diverse students,

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interested in STEM areas (CITE). However, there are few researchers who have addressed the motivations of STEM mentors specifically (Carroll, 2014; Lewis et al., 2018; Nelson et al., 2017). Mentors who work in a STEM-focused context are unique because they are expected to play the psychosocial support role that most mentors are expected to perform (e.g. listening, offering advice, asking questions) while also helping their mentees develop a sense of belonging and content knowledge in STEM (Packard, 2016; Stevens, Andrade, & Page, 2016; Stoeger, Duan, Schirner, Greindl, & Ziegler, 2013). While many types of mentorship programs exist to encourage K-12 students from groups who historically have been marginalized within STEM to study, persist, and, eventually, work in STEM (Eagan, Hurtado, Figueroa, & Hughes, 2014; Estrada, Hernandez, & Schultz, 2018), a better understanding of the motivations of STEM mentors can help SBM programs recruit and retain high-quality mentors as well as foster more mutually beneficial mentor/mentee interactions. The purpose of this study was to understand the motivations of undergraduate STEM mentors working in an afterschool STEM program for underrepresented elementary schoolboys. The following questions guided the study:

(1) What motivates STEM undergraduate students to become mentors in an afterschool engineering program for elementary school boys?
(2) What motivates STEM undergraduate student mentors to persist?

The following study explores these questions qualitatively in the context of an intensive afterschool engineering program.

Literature Review

We begin our review of research by describing existing research on STEM-focused mentoring. Then, we review existing explanations for why individuals decide to become mentors. The literature review process we used was 'exhaustive,' which Hallinger (2014) describes as the reviewer combing through 'a wide range of possible sources in an attempt to identify all potentially relevant studies' (p. 545). We searched Google Scholar using the following key terms: 'STEM mentoring,' 'engineering mentoring,' 'science mentoring,' 'math mentoring,' and 'computer science mentoring.' For these searches, we imposed no time limit and searched articles' abstracts for the key terms and to identify whether their focus was on the mentors. Because the Google Scholar search using 'STEM' and 'Mentoring' yielded 75,000 citations, we move that search to EBSCO*host*, which allowed us to limit our results to those peer-reviewed articles (2000–2020) that included both terms in their abstracts. As a result of our searches, we identified eight peer-reviewed empirical studies, of which five presented elaborated results on the motivations of STEM mentors (the remaining three did not elaborate on the mentors' motivations). Table 1 summarizes our search results, and Appendix A presents the full results of each of our searches.

Why Focus on STEM?

STEM mentoring is unique because the nature of STEM areas themselves calls on mentors to go above and beyond the traditional psychosocial support that mentors offer their mentees. In this way, STEM mentoring is similar to mentoring that occurs in organizations and institutions with a mission to serve historically marginalized students (Crisp & Cruz, 2009). According to Crisp and Cruz (2009), mentors of marginalized students provide support in four areas: Academic work, psychological and social domains, goal setting and career choice, and role modeling.

We can apply this multi-dimensional conceptualization of mentoring to STEM specifically as a way to identify the multiple roles that STEM mentors play. First, many students consider STEM subjects, math, in particular, to be very challenging and often lack confidence in them (Hill, Corbett, & St. Rose, 2010; van Tuijl & van der Molen, 2016). Most STEM majors require advanced math, so low confidence and achievement can become barriers to pursuing a STEM career (Crisp, Nora, & Taggart, 2009; Geisinger & Raman, 2013; Tyson, Lee, Borman, & Hanson, 2007). For this reason, STEM mentors often help facilitate their mentees' acquisition of content and skills. Second, the vast majority of individuals in STEM majors and careers continue to be male and White or Asian, and women and people of color continue to be underrepresented (Estrada et al., 2016; National Science Foundation, National Center for Science and Engineering Statistics; 2019). STEM areas historically have marginalized women and people of color through exclusionary cultural norms and practices as well as through the stereotypes about people who work in STEM. Examples of norms and practices that drive women and people of color away from STEM include a chilly climate (Cheryan, Plaut, Davies, & Steele, 2009; Flam, 1991; Ireland et al., 2018; Johnson, 2007, 2012) and overt sexism (Logel et al., 2009) and racism (Brown et al., 2016; McGee, 2016; McGee & Martin, 2011). These challenges make women and people of color feel as though they do not belong. Younger students may lose interest in or may not consider STEM as they progress through grade school because they may have stereotypical notions of who works in STEM: 'Nerds' and White and Asian men (Aschbacher, Li, & Roth, 2010; Brickhouse, Lowery, & Schultz, 2000; DeWitt, Archer, & Osborne, 2013; Finson, 2002; Jenkins & Nelson, 2005; Miller, Nolla, Eagly, & Uttal, 2018). As a result, a common goal across STEM mentoring programs is for mentors to serve as role models who can help their mentees develop a sense of belonging and identity as well as attitudes and aspirations towards STEM careers (Piatt, Merolla, Pringle, & Serpe, 2019; Tytler & Osborne, 2012). Indeed, some researchers have found that many underrepresented

Table 1. Search Results.

	'STEM mentoring'	STEM mentoring (no quotes)*	'engineering mentoring'	'science mentoring'	'math mentor'**	'computer science mentoring'	Total (excluding duplicates)
Total number of hits	439	139	940	824	207	32	2581
Empirical studies (peer-reviewed) on mentoring ('STEM/science/math/engineering/technology' and 'mentoring' in the abstract)	50	57 (2 were duplicates)	34 (5 were duplicates)	69	3	2 (1 was a duplicate)	206
Focus on mentors/Report findings for mentors at K-12 or postsecondary levels (based on a review of abstract)	15	9 (2 were duplicates)	4 (1 was a duplicate)	15	0	0	40
Results relate to mentors' motivations (based on a review of abstract)	1	5	0	2	0	0	8

**"math mentoring" yielded only 89 studies
*Search conducted using EBSCOhost

students value being matched with a mentor who is similar to them (Blake-Beard, Bayne, Crosby, & Muller, 2011; Syed, Goza, Chemers, & Zurbriggen, 2012).

University- and School-Based STEM Mentoring

Research on mentors working in K-12 STEM school-based programs remains limited. Most researchers have focused primarily on the impact of programming on participating students and teachers to the exclusion of mentors (see Appendix C for the tables that detail the full results of our literature searches). There are, however, several exceptions in which the authors describe the benefits to STEM mentors of mentoring (Chelberg & Bosman, 2019; Estrada et al., 2018; Hernandez et al., 2018; Kendricks, Nedunuri, & Arment, 2013; Lewis et al., 2018; Nelson et al., 2017; Tenenbaum, Anderson, Jett, & Yourick, 2014) and explain what motivates STEM mentors (Adams & Hemingway, 2014; Carroll, 2014; Muller et al., 2007; Ross, Fletcher, Thamotharan, & Garcia, 2018).

Many scholars have investigated peer and faculty mentoring of undergraduate STEM majors; however, most of these studies focus on the benefits to the mentees. For example, researchers have addressed the effect of being a mentor on student retention (Chelberg & Bosman, 2019; Damkaci, Braun, & Gublo, 2017; Lisberg & Woods, 2018; Wilson et al., 2012), STEM efficacy (Estrada et al., 2018; Lewis et al., 2018), academic and career motivation (Griffin, Pérez, Holmes, & Mayo, 2010), STEM content knowledge (Nelson et al., 2017), goal setting and career planning (Chelberg & Bosman, 2019; Mondisa, 2015; Nelson et al., 2017), and cultural capital (Hernandez et al., 2018; Luedke, McCoy, Winkle-Wagner, & Lee-Johnson, 2019). Consistent with Crisp and Cruz (2009) mentoring model for marginalized students, these research findings reinforce the need for a multifaceted approach to mentoring, which includes both the acquisition of STEM knowledge and skills as well as social support and guidance as students become integrated into the field.

Researchers have found that STEM mentors have several motivations. For example, undergraduate engineering majors mentoring middle school students in a design thinking course explained that serving as mentors allowed them to 'pay it forward' (Carroll, 2014, p. 19). They shared their own experiences and struggles with the middle school students and served as role models who could show the students what was possible. Similarly, in their investigation of a summer camp that paired undergraduate mentors of color with middle school boys of color, Ross et al. (2018) reported that the mentors were motivated to get the younger students interested in STEM. STEM mentors likely have other motivators, such as becoming a better communicator and a financial need. For instance, in their study of an online mentoring community, Adams and Hemingway (2014) found that the mentors were motivated to become better science communicators. The mentors in Ross et al. (2018) study indicated that financial need was a motivator to become a mentor. Across mentoring research, and in research on STEM mentoring, specifically, mentors' perspectives continue to be overlooked. It is crucial to understand what motivates mentors to become engaged and then to persist. In the next section, we describe explanations that researchers have offered to explain why people mentor.

Existing Explanations of Mentor Motivations

In this section, we describe how previous researchers have explained why individuals more generally decide to become mentors.

Self-Efficacy

In social cognitive theory, Bandura (1982) defines self-efficacy as a belief in one's innate ability to accomplish specific tasks and goals. Self-efficacy relates to one's motivations in that higher self-efficacy tends to enhance one's intrinsic motivations, while lower self-efficacy can erode it (Ryan & Deci, 2000). High mentor self-efficacy is a belief in one's own ability to mentor youth protégés. It is associated with a higher number of interactions between the youth and mentor as well as more positive experiences (i.e. feelings of closeness and perceived value of mentoring) between the youth and mentor (Parra, DuBois, Neville, Pugh-Lilly, & Povinelli, 2002). On the contrary, when mentors do not believe that they are efficacious in the early stages of their mentor/mentee relationships (i.e. mentors believe their relationship with their mentee is weak, negative, or ineffective), they are less likely to persist as mentors and may end their commitment early (Rhodes, 2002). Program directors can improve mentors' self-efficacy, overall readiness to mentor, and understanding of mentorship expectations before mentoring through staff training and professional development (Kupersmidt, Stelter, Garringer, & Bourgoin, 2018).

Intrinsic and Extrinsic Motivations

The decision to engage in volunteering, and where to engage, lies partly in the specific program's ability to facilitate and maximize the volunteer's goal of achieving personal benefits (Cameron-Jones & O'Hara, 1995; van Tuijl & van der Molen, 2016). Benefits can be categorized either as intrinsic or extrinsic motivations (Geiser, Okun, & Grano, 2014). Intrinsic motivations encompass benefits accumulated from participation in the activity in and of itself (e.g. because the experience is rewarding). In contrast, extrinsic motivations manifest in external satisfaction from beyond the activity (e.g. receiving a stipend) (Ryan & Deci, 2000).

Social Interest. Social interest, or one's connection to others and sense of belonging to a community, is at the heart of mentoring. Social interest may lead to persisting relationships because mentors are driven by care and concern for their mentees (Herrera, Sipe, & McClanahan, 2000; Karcher & Lindwall, 2003). Moreover, mentoring involves relationships spanning beyond the mentor-mentee relationship, including relationships with the mentee's family and the mentoring organization. In a study of college student peer mentors, researchers found that the mentors gained a greater understanding of their university services and felt a stronger sense of belonging on campus (Marquez Kiyama, Guillen Luca, Raucci, & Crump-Owens, 2014). Positive relationships with each of these facets improve the mentor's overall satisfaction and, subsequently, their desire to persist as mentors (Suffrin, Todd, & Sanchez, 2016).

Altruism and Generativity. Research indicates that mentoring or volunteering behavior may be motivated by values grounded in altruism, or a general concern for others (Caldarella, Gomm, Shatzer, & Wall, 2010; Clary & Snyder, 1999; Clary et al., 1998). As such, mentoring provides a concrete avenue for individuals to express their values (Clary et al., 1998). Altruism is characterized by showing empathy and helpfulness, two traits that are strongly associated with active and sustained volunteering efforts (Penner, 2002; Unger, 1991).

Within altruism is a desire to give back to the community for the explicit purpose of shaping the next generation. This disposition – generativity – describes adults engaging in generative activities (e.g. teaching and mentoring) out of concern for younger, less experienced individuals (Erikson, 1950). Generativity can stem from purely altruistic values (Taylor, 2006), the need to satisfy cultural expectations of taking responsibility for the next generation (Son & Wilson, 2011), or from narcissistic desires to produce something that will outlive oneself (McAdams & Logan, 2004). Moreover, generativity partially moderates the effect of education level on volunteering (Son & Wilson, 2011). Given that mentoring in the STEM fields typically has a goal of combating under representation of certain groups, such as women, Black Americans, and Latinxs, in STEM studies and careers (Eagan et al., 2014; Estrada et al., 2018), generativity may be a particularly strong motivator for these types of mentoring programs. While this topic has not been studied extensively, one group of faculty mentors of Black American STEM undergraduates reported approaching and interacting with their mentees as if they were family (Mondisa, 2015). The faculty's experience supports the idea that generativity could be a strong motivator in STEM mentoring relationships.

Social Support and Pressures. College students who engage in mentoring may be motivated by an extrinsic desire to participate in supportive social communities and activities. As an example, Mondisa (2015) posit that mentoring programs facilitate social support through environments wherein like-minded individuals engage in dynamic, multidirectional interactions. Similarly, Clary et al. (1998) argue that volunteering behavior helps individuals engage in activities viewed favorably by others. It also serves as a social function in which individuals encounter others who share similar goals and values.

Alternatively, individuals may choose to mentor due to external social pressures. For example, in work environments, employees might mentor younger protégés because their supervisor asked them to do so or because it is socially expected to engage in mentorship. They also may seek to gain respect from their peers (Janssen, van Vuuren, & de Jong, 2014). When we apply this to a college setting, we see that students may choose to mentor or engage in volunteer experiences because an upperclassman or professor encouraged them to do so, or because it is socially expected for college students to volunteer (i.e. service-learning experiences).

Transactional Purposes. Finally, individuals may opt to engage in mentoring to receive direct, extrinsic benefits, such as enhancing individual egos (Ragins & Scandura, 1999), receiving payment (Janssen et al., 2014), gaining career-related experiences (Clary & Snyder, 1999), and developing leadership skills that can enhance their career opportunities (Gunn, Lee, & Steed, 2017). A study of Junior League volunteers found that 15% of volunteers did so to prepare for a new career or gain specific career skills (Jenner, 1982). Similarly, a study of volunteer motivations found that college students were more interested in volunteering to further their career paths than non-student volunteers (GageIII & Thapa, 2012). Despite the lack of research on motivations of STEM mentors, some limited work has looked at the benefits of mentoring on mentors. Undergraduate STEM mentors reported that participating in a mentoring program was 'beneficial to their education' due to increased content knowledge and organization skills, indicating there are transactional benefits to participating as a STEM mentor (Nelson et al., 2017).

Theoretical Framework

We drew on social exchange theory (SET) initially to guide the design of the study (Blau, 1968). Blau (1968) argued that much of human behavior could be explained by focusing on the associated costs and rewards from different behaviors. Once we began analyzing the data, however, we realized that SET was not as powerful a framework for sensemaking as self-determination theory (SDT; Ryan & Deci, 2000). In contrast to SET, SDT frames the decision to mentor in terms of mentors' motivations as they spread out along a continuum. This reframing allows for motivations such as a desire for human connectedness to explain mentoring behavior, as opposed to purely *quid pro quo* interactions (Janssen et al., 2014). In essence, SDT explores the various motivations, from intrinsic to extrinsic, that drive individual actions to achieve three basic human needs: Autonomy (embracing self-determination and volition), competence (experiencing feelings of success), and relatedness (experiencing social connectedness) (Ryan & Deci, 2000).

Intrinsic motivation is a 'natural inclination toward assimilation, mastery, spontaneous interest, and exploration' that manifests as behaviors driven by a genuine interest in the activity (Ryan & Deci, 2000, p. 70). In the case of mentoring, individuals intrinsically motivated to mentor would do so because they find joy in the act of mentoring. Humans naturally are inclined towards intrinsic motivation, but certain environments can bolster or suppress this inclination. For example, intrinsic motivation for an activity can be elicited from verbal affirmations of competence (i.e. someone tells a mentor that he or she is doing a great job) and when the action is self-determined (i.e. the mentor chooses to participate) (Ryan & Deci, 2000). On the other hand, external pressures and impending deadlines diminish levels of intrinsic motivation.

Extrinsic motivation for an activity emerges from the rewards and outcomes that accrue to the mentor. Four types of extrinsic motivations range in terms of the level of autonomy that the individual experiences when making a decision, from low self-determination to high self-determination. *External regulation*, the lowest in autonomy, stems from the need to comply (i.e. mentoring to maintain a quota on volunteer hours) or to avoid punishment. The second type of extrinsic motivation – *introjected regulation* – represents semi-compulsory actions wherein individuals participate but do not fully accept the action as their own. Examples include performance to avoid guilt (i.e. mentoring due to feelings of survivor guilt) or to bolster ego. Next, *identified regulation* represents a personally identified value of the action and acceptance of the behavior as one's regulation. In the case of mentoring, an extrinsically motivated individual with identified regulation would mentor to further personal growth or to gain valuable skillsets for their future career. Lastly, *integrated motivation* occurs when the actions are 'fully assimilated to the self' and are 'brought into congruence with one's other values and needs' (Ryan & Deci, 2000, p. 73). For mentoring, a person with integrated motivation would mentor because it aligns with their values and beliefs.

Methods

Research Design

We conducted a case study inclusive of undergraduate STEM mentors working in an afterschool engineering program in two elementary schools. As both a process and a unit of analysis (e.g. a single case) (Merriam, 1998), case studies allow for the in-depth examination of a phenomenon or process as they play out in 'real-life' (Merriam, 1988). Case studies also allow for the development and exploration of hypotheses (Gerring, 2006). Two critical assumptions of case study research are that what is studied can be bounded in its context (Miles & Huberman, 1994) and that the context in which the process or phenomenon plays out is essential to understanding its complex nature (Yin, 2017). In this study, the case is defined as the afterschool engineering program. As the case, the afterschool program provides an opportunity to explore hypotheses relating to STEM mentors' motivations (Merriam, 1998). Here, we report on findings from the first year of an ongoing, three-year study of an afterschool engineering program for fourth and fifth grade boys of color at two elementary schools in a large city in Texas.

Program and Setting

The afterschool engineering program was created in 2013 to teach young Black American and Latino boys engineering design through math and science content and increase the boys' interest in STEM studies and careers through the mentoring relationship. The mentors play three critical roles in the program. First, they facilitate the boys' learning by sitting at the tables with the boys, answering their questions, asking questions, providing content expertise, and helping them make engineering design decisions. Second, they provide psychosocial support by asking the boys about their day, listening to them, giving advice, and engaging with them playfully. Third and finally, the mentors act as role models by showing the boys that people who look like them and have similar backgrounds can go to college and major in STEM. Importantly, most of the teaching of the new content material is done by pre-service teachers who study at the same university.

The afterschool STEM program is designed to maximize the boys' exposure to STEM in a culturally responsive way, and the mentors play an essential role in achieving that goal. The program runs for eight weeks during the fall and spring semesters, with sessions occurring three times a week – twice after school for an hour and a half, and on Saturday mornings for two hours. The mentors, who beginning in the spring of 2018 were paid, are required to attend the three sessions as well as a weekly mentor meeting. In a typical weekday session, the mentors welcome the boys, have them sign in, and then sit at tables or grouped desks with the boys to help them with the math problem of the day. After that, if it is a Tuesday, the mentors introduce the STEM professional of the week, who almost always is Black American or Latino. Then, the pre-service teachers take over and introduce the design activity. Typical dialogue between the mentors and students includes reminders about the design process and first steps, questions about the potential uses of materials the students can use for the activity, and questions about proposed solutions. These STEM-specific conversations also are littered with informal exchanges in which the mentors talk to the students about their day and what might be bothering them. At one of the schools, the mentors also play basketball with the boys after the session ends as the students wait for their parents to pick them up or even drive or walk them home if parents cannot pick them up. In these tucked away moments, the mentors play a more traditional mentoring role, getting to know the boys beyond a STEM academic setting.

At the time these data were collected, the program was being implemented at two public schools in a large city in Texas. The two schools were selected for the program because their student demographics fit the program's mission to serve boys of color and their close distance to the university the mentors attend. That said, the schools were quite different. One of the participating schools was a traditional public school that was Title I and whose student population was 85% Black American, 14% Latinx, and 96% economically disadvantaged (Texas Education Agency, 2018). In contrast, the second school, which has participated in the afterschool program since the spring of 2017, is a university-affiliated K-5 public charter school. The charter school is a small learning community with fewer than 150 students in total. Of those students, approximately 35% are Black American, 42% are Latinx, 14% are White, and 32% are economically disadvantaged.

Mentor Training

The afterschool STEM program provides initial training and ongoing support for the mentors. At the beginning of each semester, the mentors are required to participate in a two-day training covering topics ranging from the program's history, program objectives and expectations, the purpose of mentoring, classroom management techniques, daily procedures, and culturally responsive mentoring. The training mixes direct instruction (e.g. describing procedures) with group discussion (e.g. what experience has had the most significant impact on your life?). The mentors also meet with the program manager every Wednesday afternoon to discuss ongoing challenges, potential solutions, and future sessions.

Participants

We recruited sixteen mentors from the 18 undergraduate and graduate students and alumni who signed up with the afterschool program during the spring and fall of 2018. Fifteen of the mentors were engineering majors, and one was a math major at a large research-intensive, minority-serving institution. The 16 participants included 14 undergraduate students, one graduate student, and one recent alumnus of the university (he graduated in spring 2017). Thirteen of the 16 mentors were male. Nine were Black, and five were Latino (See Table 2). Two participants served as site coordinators as well as mentors. Two participants returned for a second semester (fall 2018) as volunteer mentors (i.e. they were unpaid while the other mentors were paid) due to their inability to commit to every Tuesday, Thursday, and Saturday because of course schedule constraints. Eleven of the 16 mentors only served for one semester (i.e. the non-persisters). Finally, two of the participants volunteered as mentors in 2017 *before* the external funding allowed the

Table 2. Description of participants.

Mentor	Participation	Gender	Race/Ethnicity	Year	Major
1	Fall 2018	F	Black	Senior	Civil engineering
2	Fall 2018	M	Black	Alumnus	Chemical engineering
3	Fall 2018	M	Latino	Junior	Industrial engineering
4	Fall 2018	F	Black	Junior	Industrial engineering
5	Spring 2017, Fall 2018	M	Black	Junior	Mechanical engineering
6	Spring 2018, Fall 2018	M	Latino	Sophomore	Mechanical engineering
7	Spring 2018, Fall 2018	M	Latino	Sophomore	Mechanical engineering
8	Fall 2018	F	South Asian	Ph.D. student	Chemical engineering
9	Fall 2018	M	Latino	Junior	Mechanical engineering
10	Fall 2018	M	Black	Senior	Computer engineering
11	Spring 2017, Fall 2018	M	Black	Junior	Electrical engineering
12	Spring 2018	M	Black	Senior	Math
13	Spring 2018	M	Black	Freshman	Computer engineering technology
14	Spring 2018	M	White	Sophomore	Chemical engineering
15	Spring 2018	M	Latino	Senior	Mechanical engineering
16	Spring 2018	M	Black	Senior	Petroleum engineering

program director to provide a stipend. The students were recruited to be mentors by the program director through their engineering courses, through campus-based professional organizations such as the National Society of Black Engineers, and college-wide email blasts. Beginning in the spring of 2018, when the program received external grant funding (NSF Award #1,760,311), the participants were paid a stipend to serve as mentors for at least one semester during which the study took place.

Data Collection

We collected data on the mentors in four ways to enhance the trustworthiness of the findings (Morse, Barrett, Mayan, Olson, & Spiers, 2002). First, two of the authors observed a full week (three sessions) of the afterschool program twice during the semester, focusing on the interactions and conversations between the boys and the mentors. During the observations, we rotated from table to table (where groups of three to four students and one mentor were working together) every two to three minutes for approximately one hour during each session. We did not use a rubric or protocol to structure the observations, but instead kept detailed field notes that included the time, what activities were underway, and who was doing what or saying what. Second, we interviewed all of the participating mentors at the end of the 2018 spring and fall semesters. Two of the authors conducted interviews during the final two weeks of each semester, either in an office or a small conference room on the university campus. Two of the authors, in consultation with the program director (also an author), developed the interview protocol after reviewing the literature on mentoring and STEM mentoring. The protocol was piloted among mentors serving at a single school site in the spring and fall of 2017. The interview protocol is included in Appendix C. We were able to follow up by email with three of the 11 mentors who did not continue as mentors in the program to ask them about their decision to leave. Initially, we requested a short interview with all five undergraduate students who did not persist as mentors past one semester to debrief about their experience and decision to leave. All of the undergraduate students declined the invitation; three responded with their reasons via email.

Beginning in the fall of 2018, we administered a card sort to the mentors during their end of semester interviews. Card sorts are useful for investigating participants' beliefs (i.e. agreement) about the relative importance of a particular issue (Saunders, 2015; Whaley & Longoria, 2009). Moreover, combining the interviews with a card sort allows for triangulation (Saunders, 2015). We adapted the card sort from the *Person Values Card Sort* (Miller, C'de Vaca, Matthews, & Wilbourne, 2001) and followed recommendations regarding uniformity of card and font size (Rugg & McGeorge, 2005). In the card sort, we listed potential motivations on cards and asked the mentors to categorize each motivation as 'very important to me as a mentor,' 'important to me as a mentor,' and 'not important to me as a mentor.' Upon completion of the sorting, we asked the mentors to explain those motivations that were 'very important' and those that were hard to sort (Rugg & McGeorge, 2005). By following up with the mentors about their sorting decisions, we achieved complementarity or clarification and elaboration regarding their beliefs (Saunders, 2015). The card sort activity also is included in Appendix A.

Data Analysis

In this paper, we focus on the findings from the interviews, including the card sorts. All interviews, including the interviews at the end of the card sort activity, were audio-recorded and transcribed for clarity and ease of analysis. We analyzed our data in two phases to enhance the trustworthiness of the study (Miles & Huberman, 1994). First, two of the authors analyzed the interview transcripts using open coding (Bogdan & Biklen, 2007) in Atlas.ti. We read through the transcripts with no *a priori* codes and identified emergent themes. The two authors read through one transcript together as part of this first step, identifying and agreeing on definitions for the emergent codes. After we completed open coding, the same two authors generated a list of *a priori* codes based on the literature review and the competing explanations for mentors' motivation and persistence we identified. Drawing on SDT and our review of the literature, we created a set of *a priori* codes that fell along a continuum of extrinsic (e.g. transactional) to intrinsic (e.g. altruism) motivations. One author carried out the second round of coding using the *a priori* codes. Please see Appendix B for both sets of codes. After we completed the two rounds of coding, we re-organized the coded data according to whether they were better examples of intrinsic motivations, extrinsic motivations, or of motivations that did not fit on Ryan and Deci (2000) SDT continuum (i.e. emergent mentoring motivations).

Trustworthiness

In qualitative research, it is essential to ensure the trustworthiness of the results. According to Lincoln and Guba (1985), the purpose of trustworthiness is to ensure that a study's findings are worth reporting. They proposed five ways to assess a study's trustworthiness: Credibility, dependability, conformability, transferability (Lincoln & Guba, 1985), and authenticity (Lincoln & Guba, 1986). Credibility is achieved through an accurate description of the setting and the participants. Dependability essentially means that the data are reliable – the meaning will be consistent across time and under different conditions. Conformability or objectivity is achieved when two or more people agree on the meaning of the data. Transferability is the ability to generalize from the data. Finally, authenticity means that the researchers have depicted a range of experiences or realities (Lincoln & Guba, 1985, 1986).

Throughout the study, we sought to enhance trustworthiness in three ways: Triangulation, prolonged engagement in the field, and disconfirming evidence (Creswell & Miller, 2000). Triangulation is achieved when researchers leverage and search for agreement across more than one data source (Creswell & Miller, 2000; Denzin, 1978). In the present study, we triangulated across methods (mentor interviews, card sorts, and observations) and researchers. The two authors who conducted the observations met regularly throughout data collection to share and reflect on the observations. We also reflected on the observations as we identified the emergent codes through the first round of coding, and as we conducted the two rounds of coding. The two authors who collected and analyzed the data also engaged with the afterschool program for a prolonged time (Fetterman, 2019). Here, we report on data collected in the spring and fall of 2018; however, both researchers began attending and observing sessions and interviewing the mentors and mentees in the spring of 2017 when the afterschool program was piloted at one school. Specifically, we both observed six sessions per semester in 2017, conducted focus groups with approximately 15 mentees, and interviewed nine mentors. Finally, we sought disconfirming evidence (Miles & Huberman, 1994) through our application of a two-phase approach to data analysis. In this study, disconfirming evidence comprised examples of motivations that did not fit the SDT framework.

Results

In this section, we present the results. In response to the first research question, we found that the undergraduate students had more than one motivation to mentor and that those motivations spanned from intrinsic to extrinsic. For those mentors who persisted beyond a single semester in the program, we found that self-efficacy helped explain that decision. We begin by describing participants' intrinsic motivations to become mentors: Enjoyment and altruism. Then, we outline their extrinsic reasons, which we organized according to Ryan and Deci (2000) continuum: External regulation, introjected regulation, and integrated regulation. We conclude the section by describing two sources of motivation that emerged from the open coding process, which did not fit well with Ryan and Deci (2000) framework: Self-efficacy and survivor's guilt. In response to the second research question, self-efficacy may also explain why some mentors persisted, and others did not. In the following sections, we provide additional detail as well as the mentors' responses.

Intrinsic Motivations

The vast majority of reasons offered for deciding to mentor and persisting as a mentor can be considered intrinsic. Specifically, the mentors were motivated by their social interest and altruism. We discuss each as follows.

Enjoyment

Several of the mentors expressed enjoyment as a reason for becoming a mentor. One reason the participants cited as a reason to mentor was that they enjoyed working with kids, whom they found to be playful and fun. Several of them expressed this enjoyment to us, saying, 'I love working with children' (Mentor 12, S18), 'Working with kids is fun' (Mentor 5, F18), and 'I really like helping out kids' (Mentor 13, S18). Two of the mentors elaborated on why they enjoyed working with kids. One noted that kids are interesting because they are different as individuals. He explained,

> I love kids, man. I love to be around kids. I think kids, they're so dynamic. Each different kid is such a different package, and you can unravel them in so many different ways, and you can test them, and you can push them to so many different directions, and they will respond so differently. Each time you go up there, each kid will be a different test case. (Mentor 7, F18)

Finally, one mentor told us that he had decided to mentor because 'It's just really fun to talk to [kids] because they're so unfiltered' (Mentor 9, F18).

A second source of enjoyment that three of the mentors mentioned was the low-stress environment of mentoring in the program. The low-stress environment appeared to be a motivation to *persist* as a mentor. One mentor explained that,

> I'll be wound up all day [from class], but when I go hang out with the kids, I get to work with what I know, STEM, but I also get to just hang out with the kids, just hang out with the kids, maybe goof around with them a little bit. (Mentor 6, F18)

Another mentor concurred, reporting that 'It's really fun working with [the kids]. It's also really nice because it's like a break in my day, it's just constantly schoolwork and talking with people about technical stuff' (Mentor 9, F18).

Altruism

The most common reasons participants shared for their decision to become mentors were related to altruism – the participants gained personal satisfaction by doing something that would benefit others. We found three strands of altruism consistent with the literature. The first might be considered *pure altruism*, where the mentors described wanting to *make a difference* or *have an impact*. The second we describe as empathy-driven altruism, in which the participants knew how vital mentors could be based on their own experiences in school and STEM. Finally, the most common reason offered for mentoring was a desire to ensure that more underrepresented students, particularly males, were becoming interested in STEM.

We heard from seven of the participants that their interest in mentoring emerged from a desire to help and to have a positive impact on the elementary students. One of the mentors explained that he wanted 'to give back to the community by helping others . . . I mean, it's very rewarding to give back and then also to see that you're making a difference' (Mentor 12, S18). Another echoed this sentiment, telling us that, 'I just want to continue making an impact, that's my biggest thing. I want to make a difference in people's lives' (Mentor 13, S18). A third participant described mentoring as an opportunity to make a difference, recounting what he would tell other STEM undergraduates potentially interested in becoming a mentor. He explained,

> I would say, 'Look, man, here's a program where you can get involved and make a difference in a lot of other kids' lives and also make a difference in your life, and see what you're learning here today on campus can go and help somebody, and actually be applicable in life, and make a difference.' (Mentor 7, F18)

The mentors' desire to have a positive impact on their mentees was directly connected to the program's STEM focus. In particular, the mentors saw themselves as helping their mentees develop a STEM identity. One mentor described his experience in the program as 'very positive,' and then went on to explain that,

> I think it was very positive. Kids came in not knowing what engineering was. They had heard of it, but they didn't know. And leaving, now I can ask them, "What would type engineer would you be?" And they could tell me. And that's the overall goal of the program – having them identify a certain area of STEM maybe they didn't know of before. (Mentor 11, F18)

Another mentor reflected on the importance of putting his strong content knowledge to work. He recounted, 'I think that you get a lot out of it. I think it's important to give back since you've been studying STEM and you have all this knowledge. I think it's important to pass it on in one way or another' (Mentor 1, F18).

We also heard from six participants about becoming mentors out of empathy with the younger students. In other words, the mentors reflected on their own experiences and struggles in school and STEM and concluded that they would have benefited from having a mentor. One student reflected on his struggles in school, explaining that,

> I decided to participate in this program because as I was growing up, I really didn't have a person to teach me stuff. I know my parents did teach me certain stuff, but there were certain things I had trouble with, and I wanted a mentor to help me with it . . . . I had to overcome [my challenge] by helping myself, and so I want to be a part of this program to be a mentor to people. (Mentor 12, S18)

A second participant described her desire to have had STEM experiences as a younger child saying that, 'I really wanted that and should have gotten something like this, but there wasn't any program' (Mentor 8, F18). Similarly, another mentor described a similar feeling, stating that, 'I didn't know about engineering until I was in 11th grade, and yeah, I feel like that's my way of giving back to the community and getting kids involved in engineering' (Mentor 15, S17). Another participant who was motivated to mentor by his own experiences explained that,

> I realized that society really didn't view me as someone that could succeed in life. You're just someone that's going to probably get your high school education. Get some college or technical certificate and then be given back to the community by their technical skill and not really by having that degree . . . I always see it as like a diamond in the rough. You have to polish it. There's a lot of diamonds. You just don't know because it's covered in a lot of dirt. You just have to find them. That's what I mean. If you can't help all of them, maybe you can find a few diamonds in the rough, you could polish them. They will succeed in life. That's how I saw my life and how I got here to this point. Someone gave me an opportunity, and I did the best I could for that. (Mentor 3, F18)

Finally, a mentor explained that he wanted the students to have the inspiration to explore STEM studies that he did. He recounted,

> It just makes me so happy to be able to inspire these kids to pursue an opportunity, because like I said, for me, I knew I wanted to do it, but I didn't really have any, I guess, inspiration outside of my family and these kids probably don't have any inspiration in their family, so it really makes me feel good that I might be the reason that they're pursuing STEM and it really just makes me feel good that I, as a STEM major, as a kid in college, am able to inspire that they're worth this much. (Mentor 6, F18)

Extrinsic Motivations

Many of the mentors also articulated extrinsically-motivated reasons they chose to mentor and why they would persist. These included being part of a supportive and structured community, preparing for their future as a professional, external pressures, and other transactional reasons. We offer examples from the mentors to describe each.

External Regulation

While all except for two of the participants were receiving a monetary stipend for their involvement with the mentoring program, only three participants mentioned the monetary compensation as a motivation for becoming a mentor. Compensation falls into the least autonomous category because it emerges from a completely external reward system (Ryan & Deci, 2000). As one of the mentors pointed out to us, ‘Of course, you know college students they need money’ (Mentor 3, F18). Another mentor joked that he joined in part because the program director had told him the funding for the afterschool program would last four years. He quipped,

> I told [the director], as long as the money keeps coming in, you keep getting this grant, I’m going to be here. [Laughter] He told me, I remember he said in the intro, he was like, ‘We’re planning for this to be four years,’ and I was like, ‘I’ve got four years here. [Laughter] I need a job for four years. I’m definitely signing up.’ (Mentor 7, F18)

A third mentor explained that the stipend made him more motivated to participate. He said, ‘I didn’t actually realize this position was paid, but then once I realized it was paid, it was like, “I’m very on board [with] that”’ (Mentor 14, S18). This mentor added that, without the stipend, he would not have remained so committed to the program. He said,

> It [would have] been harder for me to get myself to care more or less, especially with the science fair and everything. It would have been like, ‘If you guys aren’t going to do anything, I’m not getting paid for this. I’m not getting paid to really help you, like if you’re not going to do anything, I don’t see any reason to push you too hard, like I don’t want to fight you over it.’ (Mentor 14, S18)

Introjected Regulation

Introjected regulation describes those motivations that involve the ego as well as internal rewards and punishments (Ryan & Deci, 2000). The first of these motivations that four participants described for deciding to become a mentor was the belief that it would help ‘bolster’ their résumés. One of the mentors captured this sentiment, telling us that,

> I decided to try [mentoring] because, well, I mean, I needed some volunteer hours on my resume … I started seeing that I needed volunteer hours and stuff like that, like leadership, something to stand out on my résumé. (Mentor 6, F18)

Another mentor echoed this reason for his initial interest in the program, explaining,

> It all began with me just thinking I need to get something on my resume, and I thought this would be a better opportunity then because, originally, I thought it was volunteer work. So, I thought it would be a better opportunity than anything else I could do, like it’s better than just working in a fast-food restaurant or something. (Mentor 14, S18)

A second, related reason that three of the mentors became involved was to develop or improve skills they would need as engineers. The mentors expressed this motivation when they described what they would tell other undergraduates considering becoming mentors. One mentor described what he would tell others, saying,

> I'd tell them, 'It'll teach you a lot of things. It'll teach you how to be more patient. It'll teach you how to communicate.' If you're going to explain something to an 11-year-old, you can do it to pretty much anybody. (Mentor 11, F18)

Another mentor agreed with this reason, explaining to us that,

> There's way more than just the physical aspect of engineering. There's communication. There's presentation. There's talking to people. They talk about that soft skill all the time, that soft skill is really important and, again - and it also has been – it's really funny because whenever it comes to something new, I learn, it's almost always reflected in every other thing that I'm doing in my engineering career. (Mentor 9, F18)

A third and final form of introjected regulation that we identified in our data was the desire to satisfy external pressures. Specifically, two of the mentors described how they wanted to please the director of the afterschool program. To be clear, the participants did not view this pressure negatively; quite to the contrary, they all spoke very highly of the director. As an example, one of the mentors recounted how he heard about the program and decided to join after getting to know the director. He explained, 'I just randomly started talking to [the director] one day, and ever since then, he's been like a mentor me. So, he personally reached out to me, and from there, we just went on to the application process and everything' (Mentor 13, S18). A second mentor told us about how the director also got him involved in the afterschool program by personally inviting him to join. The mentor told us,

> That dude [the director] is awesome. Yes, he's awesome. I might be going on a trip with him. This dude, he's unbelievable. He handles so much. I was in Engineering with Dr. [Name], and then Dr. [Name] got asked to do computing, and so [the director] came in, and he was just a down-to-earth guy, and I just started talking to him, got a good relationship seeing him in office hours. He sent out an email, and he had mentioned in class, I think there was a good program, and he told me, 'I think this would be a good program for you. You could really help me out.' (Mentor 7, F18)

Integrated Regulation

Integrated regulation refers to those motivations that deeply reflect and align with the participant's values (Ryan & Deci, 2000). We found in our conversations with almost all of the participants (11 mentors mentioned this reason at least once) that they were strongly motivated by their belief that they had a responsibility to help diversify the STEM pipeline by supporting the next generation of STEM professionals. One mentor captured this sentiment clearly, telling us, 'I love working with students . . . Specifically, the minority students because I believe that they're the future. They're holding the future for us' (Mentor 12, S18). Similarly, another mentor said, 'Seeing an older version of you like a Black of Latino college student do engineer[*sic*], that could really provide a sense that it can really happen. I don't just have to be what I might see on the streets. It's cliché, but it's real' (Mentor 16, S17). One mentor explained that mentoring in a STEM program was important because he could show them 'there's other career paths that you can pursue, I think it's really important overall especially for minority males' (Mentor 11, F18).

The mentors recognized that they were role models for the students they were mentoring and that for many of those students, potentially the only STEM mentor they might have who looked like them. One mentor stated this very clearly, saying, 'I think it's very important for underrepresented students to see people that look like them in these roles as engineering majors and ultimately, professionals' (Mentor 1, F18). Another mentor recognized that many of the kids they were working with did not have many opportunities outside of the afterschool program to have hands-on STEM learning experiences. He told us that, 'It's just good to go out there and help all these kids and really educate them on what it's all about because these kids, they don't really have the opportunity' (Mentor 6, S18). A second mentor explained his decision to mentor was grounded in his values to help open doors to STEM studies for younger students, telling us, 'You can inspire people there that are younger me, and so they would know what they want to do as they get older' (Mentor 12, S18).

Self-efficacy

The first of two findings that did not fit well within the SDT framework was self-efficacy. Enhanced self-efficacy as a mentor was offered as a reason the participants thought they would continue to mentor in the future. In response to our questions, eight of the participants described that they felt more confident interacting with the elementary school boys, managing the class setting, and explaining engineering content to the boys as a result of their participation in the program. A participant who began as a mentor in the fall of 2018 reflected on his experience, recognizing he had struggled in the beginning because he was unsure how to interact with the elementary boys. But, as he describes, over time, this improved and he felt more self-efficacious:

> . . . [mentoring] was a little daunting at first just for the fact that I didn't know the line between – I didn't know the line between being an authoritative figure and then just also being friendly with them. I've definitely drawn that line now. It also helps because,

> like I said, I didn't know the kids at the beginning, and now I do, so just building that relationship and them knowing what to expect from not only them but from me has helped a lot as well (Mentor 9, F18).

We found self-efficacy to be particularly salient among those participants who were returning for their second semester as mentors in the fall of 2018. For example, one such participant explained, 'I've been able to get – when I'm in there, I'm able to have a lot more one-on-one with the kids rather than teaching the whole class in the sense. I would say the adjustment's been good' (Mentor 11, F18). A second returning participant agreed that having mentored in the elementary setting enhanced his self-efficacy. He said that,

> I definitely have a lot more experience. It's definitely easier to interact with the kids, and I know I think there were five to six returners. I don't know the exact headcount, but it was easier to interact with the newer ones because I actually know how to interact with them. I know how to handle situations where if one starts crying or something like that or when one's getting all hyperactive, I know how to deal with it now, so I was much more comfortable with what I was doing. (Mentor 6, F18)

In contrast, one of the mentors who did not continue in the program after one semester described how he did not feel efficacious working with the students. He explained how he had felt frustrated that the students did not always listen to him and were not continuously engaged in the work. He recounted that,

> The problem was just making sure that they would actually do the project. Sometimes they just wouldn't listen to you, and it's like, 'I'm in the position to power only so much.' I can tell them what to do, and they should respect me, but I can't threaten them. It could be like, "Oh, I'm going to call [the director] or something,' but I don't have any real control over them, so they would not just listen to me sometimes. And it's like, 'What can I do?' I'm not going to do anything. You just have to sit here and tell them, and they eventually do listen to me, so that can be really challenging getting them to listen to you. (Mentor 14, S18)

Survivor's Guilt

One participant articulated the second motivation to mentor that also did not fit well into the SDT framework. He reflected on how different his circumstances as a college student were relative to his peers' conditions from high school. He sensed that he had 'made it' when others did not, and this guilt was a motivator for him to mentor. The mentor explained his sense of guilt by describing how different his life is from some of his high school friends, telling us that,

> . . . Some of [my high school friends] didn't even go to college, and they started out to have families. That was very weird for me because I'm going to college, and they're already realizing their goals in their life, started to work, having kids. I'm just going to college. (Mentor 3, F18)

He added that 'a lot of my sister's childhood friends, they are no longer with us, and that's because of drugs or gang-related activities. I realized it just sucks' (Mentor 3, F18).

Discussion

Our study of undergraduate STEM students' motivations to mentor elementary school boys in an afterschool STEM program uncovered multiple motivations for becoming a mentor, and a potential explanation for mentor persistence. Specifically, we found that it was a combination of intrinsic, extrinsic, and other motivational factors that attracted the mentors to the afterschool STEM program and kept them engaged across multiple semesters. Importantly, intrinsic rewards were cited by participants more often than the monetary stipend, which is promising given that many school-based mentoring programs are unable to pay mentors. Indeed, receiving a monetary stipend could undermine the mentors' intrinsic motivation to engage in mentorship (Geiser et al., 2014). The one exception to that trend was a mentor who felt inefficacious with the mentees and left the program after one semester; this student admitted that the stipend kept him motivated in a way that he likely would not have been otherwise.

Mentoring in the STEM Context

Was to understand the motivations of undergraduate STEM mentors working in an afterschool STEM program for underrepresented elementary schoolboys. More specifically, our case study allowed us to explore existing explanations for why young people become STEM mentors and to identify a hypothesis for why those STEM mentors persist. As we outlined, mentoring in the STEM context is unique because it calls on mentors to focus on developing the mentees' content knowledge, providing psycho-social supports, exposing them to STEM careers, and serving as role models (Crisp & Cruz, 2009). These roles are even more important when considering a STEM mentoring program for underrepresented students, as were most of the students who participated in the afterschool program that is the focus of this study. Previously, researchers identified that STEM mentors were motivated to help younger students (Carroll, 2014), to give back to the community (Adams & Hemingway, 2014), to get younger students interested in STEM (Ross et al., 2018), to become better science communicators (Adams & Hemingway, 2014), and to receive the financial incentive (Ross et al., 2018).

We contribute to this literature and the field's understanding of undergraduate STEM mentors' motivations in four ways. First, we by grounding our research in existing motivational theories, we were able to situate the undergraduate STEM mentors' motivations within the field's broader understanding of motivations and mentoring and to uncover and characterize a greater range of motivations. By using theory as a guide, we can identify where along the continuum of intrinsic to extrinsic motivations (Ryan & Deci, 2000) researchers' existing findings lie, and where our findings help fill out the continuum further. For example, researchers had identified multiple intrinsic motivations (giving back, paying it forward, getting younger students interested in STEM) and two extrinsic motivations (external regulation: financial incentives and introjected regulation: becoming a better science communicator). To these, we add new examples: Enjoying working with young kids (intrinsic), and improving their résumé and satisfying external pressures (introjected regulation). We also add a new category of motivations to the existing understanding of STEM motivations: Integrated regulation in the form of the mentors' specific desire to get more underrepresented students into the STEM pipeline.

Second, by rooting our study in theory, we also are able to point to those motivations that are crucial for STEM mentors. We argue that generativity and sharing content knowledge may be particularly salient for STEM mentors. Generativity as a motivation is consistent with Crisp and Cruz (2009) framework for mentoring marginalized students in higher education, which points to the importance of role models. The persistent under representation of certain students in STEM studies and careers (Estrada et al., 2016) means that STEM mentors continue to have an important generative role to play, showing younger marginalized students that STEM *is* for them. The desire to share content knowledge also is consistent with Crisp and Cruz (2009) notion of mentors providing academic support. Helping boost math and science achievement among these students is essential to move and keep more underrepresented students in the STEM pipeline.

The third contribution we make to our understanding of STEM mentors' motivations is our identification of survivor's guilt as a motivation to become a mentor in a STEM setting. Though we heard from only one mentor regarding survivor's guilt and therefore must characterize this finding as very preliminary, its presence points to the potential relationship between STEM mentors' motivations and their background. In other words, motivations may not vary only in instrumental (i.e. due to requirements) or value-driven ways (i.e. identified or integrated regulation), but also in ways rooted in the mentors' own experiences and even trauma. Future research should seek to understand the extent to which this relationship exists, and how prevalent survivor's guilt is among mentors who have experienced challenging childhoods or some form of trauma.

A final contribution to our understanding of STEM mentors is our finding that self-efficacy may be a potential motivator for retaining STEM mentors over time. Previously, researchers have not offered explanations for why STEM mentors persist over time. Because STEM mentoring calls on mentors to provide multiple forms of support to their mentees, the mentors must develop self-efficacy, defined as the mentors' belief that they can connect and communicate with their mentees, in each of those areas to feel successful. Based on our preliminary findings relating to self-efficacy, we contend that self-efficacy may be essential to their decisions to persist over time. Given the preliminary nature of the finding, researchers should examine the hypothesis more closely.

Mentoring Motivations and Self-determination Theory

Our study also contributes more generally to our understanding of mentors' motivations. Many, but not all, of our findings were consistent with the basic tenets of SDT. For example, we identified motivations that could be categorized as *introjected regulation* (Ryan & Deci, 2000). These included external social pressure, where the participants explained that they were partially motivated to mentor because the director of the program had suggested it, and they wanted to work with him. Mentoring could improve one's résumé, thereby demonstrating one's worth (Ryan & Deci, 2000). Many of the mentors had been told that adding engineering-related volunteer activities would help them in the job market eventually.

Similarly, we found motivations that could be categorized as *integrated regulation*, which Ryan and Deci (2000) described as a motivation that emerges voluntarily from one's values. The example we saw of this type of motivation was the mentors' desire to get more students like themselves – underrepresented students – interested in STEM. This motivation is particularly important in the STEM context because of the persistent under representation of students of color and the role that having mentors with the same or similar backgrounds may play in keeping students' interest (Blake-Beard et al., 2011; Syed et al., 2012) as they advance through school. Our study, therefore, offers evidence that the desire to serve as that matched mentor helps motivate undergraduate STEM students to become mentors in a STEM context.

Our findings did not align perfectly with SDT, however. First, the theory predicts an additional motivation, external regulation, which explains motivation as a need to be in compliance or avoid punishment (Ryan & Deci, 2000). We did not hear any of the participants articulate this as a motivation; that may be because the program purposefully recruits mentors who are interested in mentoring and volunteering. Second, SDT implies that individuals fall somewhere along the spectrum of motivations and therefore have single motivations. We found that the participants had multiple, often complex motivations that brought them to mentoring. In this way, our findings raise questions about how the SDT framework may need to be revised to study mentoring, particularly in STEM contexts.

Considerations

We examined mentor motivations in a small group of mentors in one STEM mentoring program. All of these mentors were current or former college students at the time we collected the data, limiting the applicability of these findings to other groups of mentors who may be at different places in their lives and have other competing responsibilities. Only five of the participants were returning mentors; most participated for one semester and did not return. We spoke to three of the 11 mentors who did *not* persist about their reasons for leaving the program when they did, and most of them stopped mentoring either because they graduated from the university or their course schedule made their continued participation challenging or impossible; only one spoke to low self-efficacy.

A second consideration is that we considered all of the data as a single case, and not as two cases to be compared. For this reason, we did not investigate differences across the school sites to see whether the mentors' motivations or reasons for persisting differed across schools. The two schools, however, were very different, and the mentors had different experiences depending on where they were assigned. In future analyses of data from the project, we will define each case as a single school and compare across the cases.

A third consideration is that we did not compare the mentors serving in this particular afterschool STEM program with mentors serving in non-STEM programs. Thus, it is difficult to state conclusively just how different the motivations might be depending on the focus of the mentoring program. Instead, we relied on existing research to provide a reference point to draw inferences about those motivations crucial to the STEM context.

A final consideration of this study stems from our data. First, we only report on one year of data. Within that year, we interviewed the mentors each semester they worked with the program, but only at the end of each semester. As a result, the participants were reflecting on an entire semester of mentoring and may have forgotten crucial information, or their experiences at the end of the semester may overshadow their motivations at the beginning of the semester when they were deciding to mentor. As we continue to collect data on the afterschool program, we will include the following additional opportunities to collect data from the mentors: Short surveys that will be administered twice a semester and that ask the mentors to reflect on the most recent week, and two observations of the weekly mentor meetings.

Implications for Future Research

Given the study's limitations as well as some of the interesting findings, there are several avenues for future research. First and as mentioned above, we have not yet compared the mentors' experiences and motivations across school sites. We aim to do this going forward and also encourage other researchers engaged in similar work to examine how the mentoring setting itself shapes the mentors' motivations to begin and then persist. In particular, it is important to consider how the mentees' needs – both academic and social-emotional – as well as how the mentors perceive those needs shape the mentors' experiences, their motivations, and their reasons for persisting (or not).

Second, in our interviews with the mentors, we saw hints of reflection on the university and engineering more generally. More research is needed to understand how the mentoring experience benefits and changes the mentors themselves, including their sense of belonging in the community of engineers as well as their institutional community (here, the university), and how the experience changes their perceptions of the university and engineering more generally. Future research should explore the role that self-efficacy plays in mentors' retention as our findings were only suggestive. Finally, our conclusion that mentors have multiple motivations leads us to highlight the need for a person-centered approach in which different constellations of mentor motivations can be modeled across a group of individual mentors (e.g. Geiser et al., 2014; Hayenga & Corpus, 2010; Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009). Similarly, future research should compare constellations of mentor motivations across settings, such as STEM vs. other mentoring programs.

Implications for Practice

While our findings are descriptive, they may shed some light on the recruitment and retention of mentors in STEM contexts. Given that many of the mentors in our sample indicated intrinsic or internalized motivations, program directors may want to consider how to highlight these motivations in the marketing of mentoring and to allow mentors opportunities to articulate their motivations. Similarly, it may be helpful for program managers to explore the characteristics and backgrounds that will most likely tie into a mentor's sense of generativity.

Based on our findings, we also speculate that having shared experiences or a certain level of cultural proficiency may increase a mentor's ability to empathize with and connect to their mentees in meaningful ways (Mijares, Baxley, & Bond, 2013). This is particularly important for STEM mentors working with underrepresented youth, given that traditional ways of 'knowing' and 'doing' STEM can be alienating for them (Archer et al., 2010, 2012a, 2012b; Barton, Tan, & Rivet, 2008; Calabrese Barton & Berchini, 2013; Calabrese Barton et al., 2013; Tan & Barton, 2010). What is more, a focus on cultural relevance may be motivating to mentors as well.

Finally, our findings point to the potential importance of mentors' self-efficacy for their retention. Programs should carefully consider how to enhance mentors' sense of self-efficacy throughout their experience by providing vicarious learning experiences, mastery experiences, and frequent, relevant feedback (Bandura, 1982). Opportunities to provide vicarious learning experiences could take place during pre-session training and observations. In contrast, mastery experiences would emerge from the actual mentoring with sufficient supports so that mentors can improve. Finally, supervisors may wish to provide frequent and constructive feedback to mentors to reflect on their actions and take steps to improve.

Conclusion

The purpose of this study was to understand the motivations of undergraduate STEM mentors in an afterschool STEM program for underrepresented elementary schoolboys. Guided by self-determination theory, our findings suggested that the mentors were motivated primarily by introjected regulation and integrated regulation – motivations that fall on the autonomous end of Ryan and Deci (2000) continuum. We also found that mentors' self-efficacy is related to their persistence and that mentors who have similar backgrounds as the mentees may be motivated by a sense of survivor's guilt. Future research should extend our findings and address the limitations of the study.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendix A: Data Collection Protocols

Interview Protocol: Mentors

My name is _______ and I am helping with the research component of the afterschool program. In this interview, I am going to ask you about your experience as a mentor in the afterschool program. As we talk, I'd like you to think about your experiences, the students you worked with, and how the experience made you feel as a mentor, engineering student, and future professional. If at any time, you would like to stop the interview or you would like me to stop recording, please let me know. This interview should take about 30 minutes.

(1) Background questions:
   (a) You mentioned in your survey that you have done volunteering/mentoring before. Can you tell me more about what you did?
      i. Why did you get into volunteering/mentoring?
      ii. What do you think you got out of that experience?
(2) STEM background and identity: Questions about high school experiences:
   (a) Tell me about your high school and your friends in high school – did you have other friends who were good at school and into STEM?
   (b) How would you say you got into STEM? When did you decide that STEM was for you?
      i. Was there an 'a-ha' moment?
   (c) Can you tell me about a time in high school when you struggled in a science or math class, and how addressed it?
(3) Questions about your experience as a mentor this semester
   (a) How well are you adjusting to the role of a mentor?
   (b) How well, do you believe, your mentees are responding to you as a mentor?
      i. Can you provide an example of how you successfully helped a mentee (meet and overcome a challenging obstacle) this past semester?
   (c) How confident do you feel in your abilities to mentor in the future?
   (d) After your experiences, are you more or less likely to mentor in the future?

(e) Reflecting back on your major here at the university, in what ways has being a mentor changed how you think about the university, your major, and your career interests? Please sure to explain.

(f) Do you think you would want to serve as a mentor again with this or a similar program? Why or why not?

(g) Would you recommend the program to other engineering students? What would you tell them?

(4) Is there anything else you would like to add?

That concludes the interview. Thanks so much for your time today and for helping us improve the program

Appendix B: Closed Card Sort

Instructions (This should be done after the option questioning is complete.)

(1) Lay the three label cards on the table to create a 3 column chart.

Not Important to Me	Important to Me	Very Important to Me

(2) Shuffle the motivation cards and give them to the participant. Say:
We have listed several possible motivations that one might have for participating in a mentoring program. Think about why you became a mentor. Please review the motivations and place each under one of the three headings. If you feel that we have left off any key reasons that you became a mentor, please include them on the cards labeled "other".

(3) If the participants ask for clarification on a card, try not to expand past what is written. Just tell them:
You should rate the card in whatever way you interpret it. (follow up on their interpretation at the end)

(4) Have the participant rank their "Very Important" column. Say:
Focusing only on the "Very Important to Me" column, please rank the cards from your strongest motivation for being a mentor to your least important motivation.

(5) Record the answers (Taking a photo is the simplest way to do this during the interview. If that is not an option, jot down the order as they are listed.)

(6) Follow Up Questions:
   (a) *What does ____________ card mean to you? (especially if they asked for clarification on a card)*
   (b) *What card was the most difficult to categorize? Why?*
   (c) *Are there additional reasons that you mentor that were not listed on the cards?*

(7) *Optional Sort*- Move one of the "Very Important" motivation to "Important" and move an "Important" motivation to "Not Important" column. Follow up as to why they chose to move those cards.

Very Important to Me as a Mentor	**Important to Me as a Mentor**
Not Important to Me as a Mentor	Personal Enjoyment
Working with Students Like Me	Money/Pay
Gaining Respect from my Peers	Gaining Respect from my Professors
Gaining Experience as a Mentor	Working with Children
Competence as an Engineer	Introducing Others to My Profession
Giving Back to the Community	Experience to put on a Resume
Working with my Friends/Classmates	Pressure from Family
Pressure from School	Connection to Other Students in my Program
Connection to the University	Helping Others
Gaining Respect from my Family	To meet New People
Becoming more integrated with the Engineering community	Learning from my Peers
Learning from my Mentees	Gaining Experience on a Grant-funded Project
Other: ______________________	Other: ______________________
Other: ______________________	Other: ______________________

Appendix C: Codes

Open Coding:

- background
- challenge
- change
- change career thinking
- Connection
- family
- goal
- major reason
- mentor experience
- mentor reason
- path into program
- prior mentoring
- prior volunteering
- university reason
- Impostor syndrome
- Survivor's guilt
- Mentoring persistence: Relationships
- Mentoring persistence: Fulfillment
- Mentoring persistence: Altruism
- Mentoring persistence: Learn about self
- Mentoring persistence: Preparation for future

A priori codes based on self-determination theory:

- Mentoring reason: Altruism
- Mentoring reason: Community
- Mentoring reason: Empathy
- Mentoring reason: Extroversion
- Mentoring reason: Transactional
- Mentoring reason: Likes working with kids
- Mentoring reason: Preparation for future
- Mentoring reason: Fulfilled