STEM Engagement through Mentoring: Motivations of STEM Mentors

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Dr. Jerrod A. Henderson ("Dr. J") is an Instructional Assistant Professor in the Cullen College of Engineering at the University of Houston. He joined the University of Houston after six years as a chemical engineering faculty member at the University of Illinois. He has dedicated his career to increasing the number of students who are in the pipeline to pursue STEM careers. He believes that exposing students to STEM early will have a lasting impact upon their lives and academic pursuits. He is the co-founder of the St. Elmo Brady STEM Academy (SEBA). SEBA is an educational intervention aimed at exposing underrepresented fourth and fifth grade boys to hands-on, inquiry based STEM experiments and activities.

Henderson is a part of the first year engineering experience team and he was recently appointed by the Dean of the College as the Director of the Program for Mastery in Engineering Studies (PROMES), a program aimed at increasing engineering student achievement, engagement, and graduation rates. His research interests are in engineering identity formation and persistence among underrepresented students, especially African American males. He was most recently recognized by INSIGHT Into Diversity Magazine as an Inspiring STEM Leader Award recipient.

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Rick Greer graduated from Tuskegee University with a bachelor's in History. He began his professional career at the University of Illinois at Urbana-Champaign where he earned distinction as Dr. Bruce D. Nesbitt Campus-Community Collaborator Awardee in 2016. Rick is also a co-founder of St. Elmo Brady STEM Academy (SEBA). SEBA is an educational intervention aimed at exposing underrepresented 4th and 5th-grade boys to hands-on, inquiry-based STEM activities. SEBA accomplishes its goals through an innovative educational curriculum and by engaging students' fathers and/or male mentors who learn STEM alongside them. This project has been recognized and funded by local organizations, the University of Illinois and most recently, the National Science Foundation. Currently, Rick is the Program Manager for St. Elmo Brady STEM Academy in the Cullen College of Engineering at the University of Houston. Further, Mr. Greer has enrolled in the Higher Education M. Ed program at the University of Houston. He has worked as a Graduate Assistant for the Urban Experience Program (UEP) in the Student Affairs Department. UEP provides opportunities for the university's diverse student population by preventing minor obstacles from becoming major setbacks to degree attainment. Rick has always had a passion for helping students succeed at navigating the college experience. He strives to promote academic awareness, academic excellence and the development of leadership skills in students. Rick believes that anything is possible if you have faith and work hard to obtain your dreams. He believes that Dr. Martin Luther King Jr. said it best, "The function of education is to teach one to think intensively and to think critically. Intelligence plus character - that is the goal of true education."

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Mariam Manuel is a graduate of the University of Houston's teachHOUSTON program and the UTeach Engineering Master's program at the University of Texas at Austin. In Spring 2016, Mariam returned to the University of Houston to serve as an Instructional Assistant Professor / Master Teacher for teachHOUSTON. In this role, Mariam is charged with teaching and inspiring the next generation of high-quality math and science teachers through inquiry-based instruction and ongoing field experiences. Mariam also teaches Physics 4345 (Physics for Pre-Service Teachers), a course that connects middle school physics state standards with content knowledge and instructional strategies that are designed to enhance student

learning. Mariam is also the one of the writers and instructors for the Preparing for AP Physics I Massive Open Online Course (MOOC), offered through the University of Houston. The MOOC has served over 10,000 students in more than 110 different countries.

Mariam previously served as the Instructional Specialist for the Robert Shaw Center for STEAM in the Katy Independent School District (KISD). She was responsible for implementing STEAM curriculum, instruction, and projects appropriate for K-12 students. Additionally, Mariam has taught both on-level and AP Physics I (formerly known as Pre-AP Physics) and played an integral role in writing the district physics curriculum consisting of rigorous labs, activities, and projects.

Mariam fills the role of Alumni Representative on the UTeach STEM Educators Association (USEA) Board and was also elected Secretary-Treasurer. She is also currently pursuing a Ph.D. in STEM education at Texas Tech University.

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The Motivations of STEM Mentors

Introduction

School-Based mentoring (SBM) currently is the most widely available and fastest-growing form of mentoring in the United States [1]. One challenge limiting mentoring programs is their ability to attract and retain mentors. 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 relationships between mentors and mentees in order to obtain positive results [2], [3], [4]. While we know some demographics about individuals who mentor, we know less about why mentors decide to become mentors and why they persist. Existing research points to several potential explanations for why individuals decide to mentor, including self-enhancement [5], [6] or the fulfillment of personal values [7], [8] such as altruism [9]. Self-efficacy and confidence also have been related to whether mentors persisted in their relationships [10]. Furthermore, mentoring also has been described as having improved mentors' personal (e.g., organization) and leadership skills [11]. However, this research is limited and often specific to particular mentoring programs.

We know relatively little about why people decide to mentor in the context of science, technology, engineering, and math (STEM) learning specifically. While many diverse types of mentorship programs exist to encourage students in underrepresented groups to study, persist, and work in STEM [12], [13], [14], a better understanding of the motivations of STEM mentors can help SBM programs recruit and retain mentors as well as foster more mutually beneficial mentor/mentee interactions. The purpose of this study, then, is to understand the motivations of undergraduate student mentors working in an afterschool engineering program for underrepresented elementary school boys. The study was guided by the following questions:

1. What motivates STEM undergraduate students to become mentors in an intensive afterschool engineering program?
2. What motivates the mentors to persist?

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

Literature Review

Recruiting and retaining qualified mentors is key to cultivating strong and effective mentoring relationships. For this reason, researchers have sought to understand the factors that influence volunteers' and mentors' decisions to engage in volunteering and mentoring activities, focusing on specific individual characteristics and traits. These include self-efficacy, social interest, altruism, generativity, social support and pressures, and transactional motivations.

Self-Efficacy

Bandura's [15] social cognitive theory 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 [16]. High mentor self-efficacy is a belief in one's own ability to mentor youth protégés, and is

associated with a greater 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 [17]. 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 terminate their commitment early [10]. Mentor self-efficacy is not a static mindset; programs can facilitate higher levels of mentor self-efficacy through ongoing and frequent training focused on building and sustaining positive mentor relationships [18].

Intrinsic and Extrinsic Motivations

Mentors and volunteers decide to get involved in mentoring and volunteering programs because these programs provide certain benefits to the individual [6]. As such, 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 [19]. Benefits can be categorized either as intrinsic or extrinsic motivations. Intrinsic motivations encompass benefits accumulated from participation in the activity in and of itself (e.g., because the experience is rewarding), whereas extrinsic motivations manifests in external satisfaction from beyond the activity (e.g., receiving a stipend) [16].

Social Interest

Social interest, or one's connection to other human beings and sense of belonging to a community, is at the heart of mentoring, where the relationship is between a mentor and a mentee. Social interest may lead to persisting relationships because mentors are driven by care and concern for their mentees [8]. As such, mentors who engage in social activities (e.g., hanging out and eating lunch together) as opposed to academic activities (e.g., tutoring) with their mentee report having stronger feelings of closeness, emotional connectedness, and instrumental supportiveness [20]. These positive feelings feedback into the mentors' perceived value of mentoring, ultimately bolstering the mentor's decision to persist [20]. Studying social interest and mentor persistence among high school student mentors, Karcher and Lindwall [8] found that high school mentors who reported higher levels of social interest persisted longer in mentoring relationships than those with lower levels of social interest.

Altruism & Generativity

Research indicates that mentoring or volunteering behavior may be motivated by values grounded in altruism, or a general concern for others [21], [6], [9]. As such, mentoring provides a concrete avenue for individuals to express their values [6]. Altruism is characterized by expressing empathy and helpfulness, two traits that are strongly associated with active and sustained volunteering efforts [22], [23]. Indeed, Caldarella and colleagues' [21] study of school-based mentoring volunteers found that altruistic values (coded as "values" in the study) were the primary motivation for mentorship.

Within altruism is a desire to give back to the community for the explicit purpose of shaping the next generation. This disposition – generativity – was first theorized in Erikson's [24]

Psychosocial Theory of Human Development as a way to describe adults engaging in generative activities (e.g., teaching and mentoring) out of concern for younger, less experienced individuals. Generativity can stem from purely altruistic values [25], the need to satisfy cultural expectations of taking responsibility for the next generation [26], or from narcissistic desires to produce something that will outlive oneself [27]. Generative concerns have yielded generative behaviors for both older and younger adults [28], [29], [30]. Moreover, generativity partially moderates the effect of education level on volunteering [26]. Given that purpose of mentoring in the STEM fields typically has a goal of combatting underrepresentation of certain groups, such as women, African Americans, and Latinos, in STEM studies and careers [12], [13], generativity may be a particularly strong motivator for these types of mentoring programs.

Social Support and Pressures

College students who engage in mentoring may be motivated by an extrinsic desire to actively engage in supportive social communities and activities. Mondisa and McComb [31] posit that mentoring programs facilitate social support through environments wherein like-minded individuals engage in dynamic, multidirectional interactions. Similarly, Clary and colleagues [6] posit that volunteering behavior helps individuals engage in activities viewed favorably by others and serves as a social function in which individuals encounter others who share similar goals and values. Indeed, Wilson [32] found that individuals who are extroverted and are embedded in extensive social networks were more likely to volunteer. This was due, in part, to an increased probability of direct and indirect invitations to join social causes [32].

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, because it is socially expected to engage in mentorship (i.e., to avoid feelings of guilt), or to gain respect from their peers [33]. In a college setting, students may choose to mentor or engage in volunteer experiences because an upperclassmen 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 [34], receiving payment [33], and gaining career-related experiences [9]. Jenner's [35] study of Junior League volunteers found that 15% of volunteers did so in order to prepare for a new career or maintain specific career skills. Similarly, Gage and Thapa's [36] study of volunteer motivations found that college students were more interested in volunteering to further their career paths than non-student volunteers.

Mentoring in STEM Fields

Research on STEM school-based mentoring programs has focused primarily on the impact of programming on participating students and teachers [37], [38], [39]. However, recent studies have examined the role of mentors and the benefits they receive as mentors. As an example, Nelson and colleagues [11] studied how STEM undergraduate mentors reflected on their

experiences working with K-8 low-SES youth. These undergraduates noted that the participating as mentors benefitted their own education. The mentors also reported feeling more confident in specific STEM content, improving organization and communication skills, and considering a potential career change to education in the future [11]. The authors noted that these improvements in student personal attributes were all significant skillsets needed to gain employment in the STEM fields. However, the mechanisms as to why these undergraduate mentors chose to get involved was not expanded upon.

Theoretical Framework

We drew on social exchange theory originally to guide the design of the study (SET [40]). Blau [40] argued that much of human behavior can be explained by focusing on the costs associated with and the rewards derived from different behaviors. However, once we began analyzing the data, we realized that SET was not as powerful of a tool for sensemaking as Self-Determination Theory (SDT; [16]). In contrast to SET, SDT frames the decision to mentor in terms of mentors' motivations, which are spread out along a continuum (see Figure 1 below). This reframing allows for motivations such as a desire for human connectedness to explain mentoring behavior, as opposed to purely *quid pro quo* interactions [33]. 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 human connectedness) [16].

Intrinsic motivation is a "natural inclination toward assimilation, mastery, spontaneous interest, and exploration" that manifests as behaviors driven by pure interest in the activity [16]. In the case of mentoring, individuals intrinsically motivated to mentor would do so because they find joy in the act of mentoring in and of itself. Humans are naturally inclined towards intrinsic motivation, but certain environments can bolster or suppress this inclination. For example, individual 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 choses to participate) [16]. 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. In the case of mentoring, extrinsically motivated mentors may opt to mentor in order to gain social status or to advance their career, both of which provide rewards beyond the mentoring experience. There are four types of extrinsic motivations that 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 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 own regulation. In the case of mentoring, an extrinsically motivated individual with identified regulation would mentor in order 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” [16]. For mentoring, a person with integrated motivation would mentor because it aligns with their personal values and beliefs.

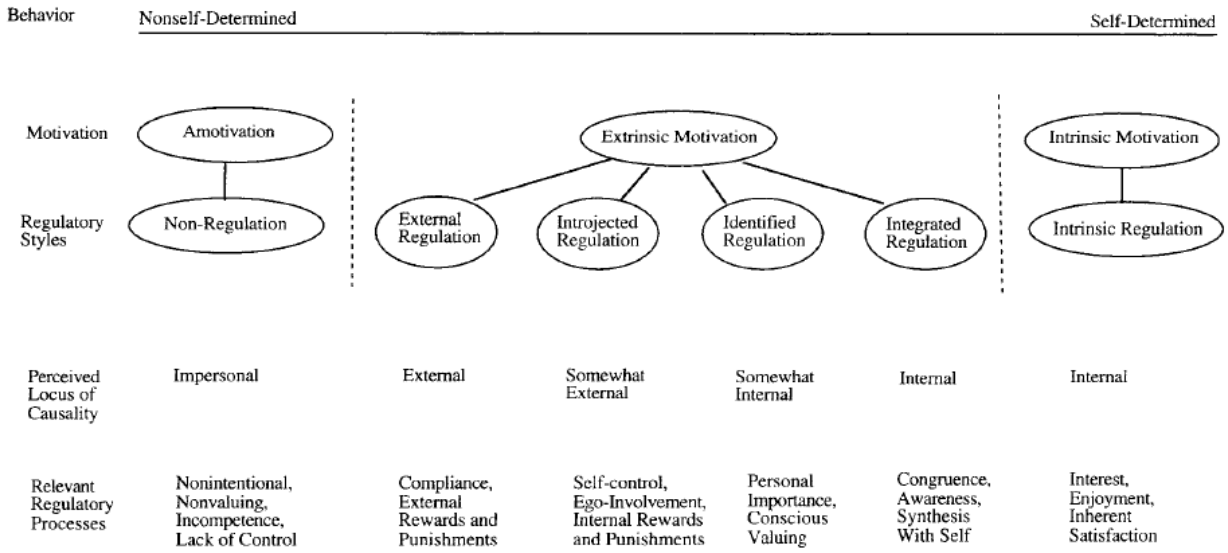

Figure 1. Continuum of motivations to mentor (from [16])

Research Design and Methods

This study comprises a comparative case study of undergraduate STEM mentors working in two elementary schools. Case studies allow for the in-depth examination of a phenomenon or process, and comparative case studies allow for the identification of differences and similarities across more than one case [41]. The two cases are the two elementary schools where the undergraduate mentors have been working for the past year.

In this paper, 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. The afterschool 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. One of the participating schools is a traditional public school that is Title I, and whose student population is 85% African American, 14% Latino, and 96% economically disadvantaged according to the state. 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 African American, 42% are Latino, 14% are White, and 32% are economically disadvantaged. What’s more, many of the students have parents who work at the affiliated university as faculty or staff. For this reason, many, but not all, of the students at the charter school have high levels of exposure to STEM outside of the school setting.

Participants

The participants were recruited from the 18 undergraduate and graduate students and alumni who are majoring primarily in engineering at a large research-intensive, minority-serving institution and who served as mentors to the elementary students in the fall of 2018, spring of 2018, or in the spring of 2017. Two mentors of the mentors serving in the afterschool program declined to participate in the interviews, leaving us with a sample of 16 mentors. The mentors wear multiple hats as they alternately help teach and model activities, and also sit with the elementary school boys to facilitate conversations and work. As such, they serve as STEM content role models as well as role models in the more traditional way that mentors do.

The 16 participants included 14 undergraduate students and one graduate student as well as one alumnus of the university (See Table 4.1). They 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 through college-wide email blasts. Of the participants, all were paid a stipend to serve as mentors during at least one semester during which the study took place, two served as site coordinators at the two school sites, and two of the mentors returned for a second semester as unpaid mentors.

Table 4.1. Description of participants

Mentor	Participation	Gender	Race/Ethnicity	Year	Major
1	Fall 2018	F	Black	Senior	Civil engineering
2	Fall 2018	M	Black	Graduated	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

Data Collection and Analysis

We collected data on the mentors in two ways to enhance the trustworthiness of the findings [42]. First, we 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 sat with a dyad (one mentee and one mentor) for three to five minutes while taking detailed field notes, and then we rotated to the next dyad. This continued for an hour during a total of six sessions per semester for three semesters. Second, we interviewed all of the participating mentors at the end of the 2018 spring and fall semesters and the 2017 spring semester. In this paper, we focus on the findings from the interviews.

We began our analysis of the interviews by using open coding [43] in which we read through the transcripts with no *a priori* codes to identify emergent themes. Then, we re-read the transcripts using a set of *a priori* codes we developed based on the literature review and the competing explanations for mentors' motivation and persistence we identified (see Appendix A).

Results

Though we began collecting data from the participating mentors guided by Social Exchange Theory, we found that many of the mentors' motivations are better understood through the lens of Social Determination Theory (SDT). In other words, participants' reasons to become and persist as mentors generally fell into two categories—intrinsic and extrinsic motivation. That said, we also found that each mentor articulated more than one reason, suggesting that their motivations are multi-faceted and may include an internal costs and benefits analysis, as suggested by SET. Finally, there also were motivations that did not fit well with SDT, pointing both to the underlying complexity of why people mentor as well as to the influence of mentors' own backgrounds in shaping their motivations. We begin by describing participants' intrinsic motivations and then we outline the extrinsic reasons.

Intrinsic motivations

The vast majority of reasons offered deciding to mentor and persisting as a mentor can be considered intrinsic. Within this larger set, we found that most of the mentors' responses cohered into the subcategories outlined in the theory. Specifically, the mentors were motivated by their own self-efficacy, social interest, and altruism. We discuss each in turn.

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. Unlike working with kids, which was a reason to begin mentoring, the low stress environment was 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 expressed a similar sentiment, telling us that, "I feel like I'm a kid at heart, so this is a good opportunity for me to go take an hour and 30 minutes out of my day of stressful college engineering degree and go and hang out with some kids and be a kid and make an impact on kids" (Mentor 7, S18). A third 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 school work 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. Specifically, we found three strains of altruism, which were consistent with the literature. The first might be considered a 'pure' altruism, where the mentors described wanting to 'make a difference' or 'have an impact'. The second we describe as an empathy-driven altruism, in which the participants decided to become mentors in the afterschool program because they knew how important mentors can be based on their own experiences. In other words, they see mentoring as 'doing good' because of a belief that kids need and benefit from mentors. Finally, we found that the most common reason offered for mentoring was a desire to ensure that more underrepresented students, particularly males, were becoming interested in STEM. We describe participants' responses in each of these categories.

We heard from seven of the participants that their interest in mentoring stemmed from a desire to help and to have a positive impact of 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 to us 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).

Finally, one participant described the definition of being a mentor as having an impact on the life of the mentee. He said, "As a mentor I feel like one of your job is to get lessons engrave[d] … into the kids. I think if you're able to - the way I see it is you could try to impact everyone as long as you impact one or a few kids, you did your job." (Mentor 3, 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 elementary and secondary school and concluded that they would have benefitted from having a mentor. This realization was an important reason for their decision to mentor in the afterschool program. One student reflected on his own 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).

A fourth participant who expressed this concern echoed the sentiment that mentoring can help change the trajectory of the mentee's life. One told us that, "For me, it's important to give back so that people aren't in the same position that I was in" (Mentor 11, F18) and another said, [Program] is a good opportunity to dive into the upcoming generation, the new generation of students, get to connect with them and let them know of the opportunities that they may not know of because of their upbringing, their environment, and just continue learning. (Mentor 10, F18).

The final 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).

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. Though several reasons were mentioned, the transactional reasons did not come up in the interviews as frequently as did the reasons discussed above, particularly generativity. We offer examples from the mentors to describe each.

External Regulation

While all except for one of the participants were receiving a monetary stipend for their involvement with the mentoring program, only two participants mentioned the monetary compensation as a motivation for becoming a mentor. This compensation falls into the least autonomous category because it emerges from a completely external reward system. As one of the mentors pointed out to us, "Of course, you know college students they need money" (Mentor 3, F18). That same mentor also explained that he would describe the afterschool program to other potential mentors as a way to give back to the community and added that "a plus is you get a little bit of money." (Mentor 3, F18) Another mentor joked that he joined in part because the director of the program 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).

Introjected Regulation

Introjected regulation describes those motivations that involve the ego as well as internal rewards and punishments. The first of these motivations that four participants described for deciding to become a mentor was the belief that it would help 'bolster' their resumes. One of the mentors captured this sentiment clearly, telling us that, I decided to try [mentoring] because, well, I mean, I needed some volunteer hours on my resume. I wasn't really big into that kind of stuff in high school.… But, I started seeing that I needed volunteer hours and stuff like that like leadership, something to stand out on my resume (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 mentor described a similar reason, reporting that, …I think the human element, being able to interact and communicate what you know and what you learn to people who have no idea and who have a different level of understanding than you is really helpful, because it reinforces just going through and reviewing a lot of these concepts. It makes you better at articulating ideas and concepts. (Mentor 2, 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, whom many of them also had as their professor in their first-year engineering courses or as the director of a university-based program created to support engineering students. 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 to the participant’s personal values. 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 diversity the STEM pipeline by supporting the next generation of STEM professionals. Almost all of the mentors who expressed this motivation recognized that African Americans and Latinos are underrepresented in STEM studies and careers, and they felt they had a responsibility to ensure that underrepresentation in STEM ends. One mentor captured this sentiment clearly, telling us that, “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, 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 own values to help open doors into 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) Another mentor described wanting the kids to see themselves in him and to know that they too can be successful in STEM. He explained, So like I said, I think it's important to expose kids to these things for them to get these experiences so they feel comfortable and they feel like this is for them. It's not something that's like foreign or out of their reach. I'm hoping that whenever they talk to me or whenever they see that I'm doing it, like I always tell them like some of them have the – I ask them what they want to do. Some of them have the idea like STEM is too hard, or they're not good at math, or they're like it's not for them and I talk them out of that. I say, "I was there. I was in your shoes. I wasn't the best at math or anything like that but it is possible. You can do this and it is a really great career for you if you want it." (Mentor 2, F18).

Several mentors reflected that they saw themselves in the students, and that this was a motivation. One explained that he mentored "Because sometimes there's a kid or several kids that you see yourself through when you were a little kid." (Mentor 3, F18) A second echoed this sentiment, noting that, You get to see different people who look like you and share your experiences, do something that you've never seen people do before, like be engineers. A lot of the kids I grew up with, their parents weren't engineers, or anything of that type. A lot of them didn't go to college. Just having those types of people around you and seeing that, talking to those people will go a long way. (Mentor 11, F18).

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 that he had struggled at the beginning because he was unsure about 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).

Another first-time participant explained how he built up his self-confidence as a mentor by challenging himself. He recounted that, "I feel confident because this was a good experience. I was trying to put myself in situations where I'm not 100% proficient at but I'm able to catch up and be able to improvise."

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 that, "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 participant who returned for his second semester in the fall of 2018 explained why he felt better about his ability as a mentor and why he would return, telling us that, "I think I did decent. One, this is my second year doing it, two, I think have had experience with being a mentor" (Mentor 7, F18). A third 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)

Survivor's Guilt

One participant articulated the second motivation to mentor that also did not fit well into the SDT framework. Specifically, he reflected on how different his circumstances as a college student were relative to the circumstances of many of his peers 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

School-based mentoring is likely to continue to be an important intervention to support students at under-resourced schools, and so it is important to improve how we recruit, prepare, and retain mentors. Our results point to the importance of a multifaceted approach to recruiting and

maintaining college student mentors. Most participants reported multiple reasons for becoming a mentor ranging from completely intrinsic motivations of enjoying their time with the kids to more external rewards of being paid for their involvement. It was the combination of motivational factors that attracted the mentors and kept them engaged across multiple semesters. Interestingly intrinsic rewards were cited by participants more often than the monetary stipend. This is promising given that many school-based mentoring programs have small budgets are often unable to provide payment to mentors.

Our findings were mostly, but not wholly, consistent with the basic tenets of SDT, which argues that motivations lie along a continuum spanning extrinsic to intrinsic motivations. For example, we identified motivations that could be categorized as *introjected regulation*, which explains a choice as partially compulsory and partially of the individual's own volition. 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, as well as the need to improve one's resume, thereby demonstrating one's worth [16], by adding engineering-related volunteer activities. Similarly, we found motivations that could be categorized as *integrated regulation*, which describes motivation as emerging totally voluntarily from one's own values. The example we found of this type of motivation was the mentors' desire to get more students like themselves—underrepresented students—interested in STEM.

Our findings did not align perfectly with SDT, however. First, the theory predicts an additional type of motivation, external regulation, which explains motivation as a need to be in compliance or avoid punishment. We did not hear any of the participants articulate this as a motivation, but that may be because the program recruits mentors who have an interest in mentoring and volunteering. In other words, the structure of the recruitment process for this particular mentoring program means that there should not be mentors whose motivation falls into this least autonomous category. Second, SDT implies that individuals fall somewhere along the spectrum of motivations and therefore have single motivations. In other words, either someone is intrinsically motivated to do something, or someone has one form of extrinsic motivation. We found that the participants had multiple, often complex, motivations that brought them to mentoring: The mentors expressed one motivation that could be characterized as external regulation and then a few minutes later articulated a second or third motivation that could be characterized as introjected or integrated regulation. In this way, our findings raise questions about how we should use the SDT framework to study motivation.

The study and its findings contribute to our understanding of mentors' motivations in two additional ways. First, we found that generativity, a form of integrated regulation, was the most commonly articulated motivation to mentor. Given the purpose of the afterschool program—to link elementary school boys of color with mentors of color—it is not surprising that the mentors should mention their belief in diversifying the STEM pipeline as a motivation. Prior research, however, has not uncovered this finding or situated it into the SDT framework via generativity. Second, we contribute to our understanding of mentors' motivations by highlighting the role that survivor's guilt may play in getting an individual to begin and persist as a mentor. Though we heard from only mentor regarding survivor's guilt and therefore must categorize this finding as very preliminary, its presence points to the potential relationship between mentors' motivations and their own 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.

Finally, self- efficacy emerged as an influential motivator for retaining mentors over time. With this in mind, providing training, support and feedback to mentors throughout the course of the mentoring process should be explored as a way to boost the self-efficacy of mentors.

Limitations and Future Research

As with any study, this one had its limitations. We looked at mentor motivations in a small group of mentors in one mentoring program. All of these mentors were current or former college students, which limits the applicability of these findings to other groups of mentors who may be at different places in their lives and have other competing responsibilities. Additionally, only a small number of the participants were returning mentors. Without information from previous mentors that did not persist, we are unable to say whether or not the reported increase in self-efficacy was a contributing factor in their decision to return for a second semester. For these reasons, we are limited in our ability to generalize the findings from our study. Typically, case studies do not lend themselves to statistical generalization because they are small and both cases and participants are selected instrumentally [44]. They do lend themselves, however, to analytic generalization in that the case serves to flesh out existing theory. Future research should seek to understand if SDT is a helpful framework for mapping the motivations of other populations of mentors.

A final limitation of this study stems from our data. First, we only are able to report on one year of data. Within that one year, we only interviewed the mentors once during each semester they worked with the program, and only at the end of each semester. As a result, the participants were reflecting on an entire semester of mentoring and may have forgotten important 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.

Implications for Research

Given the limitations of this study as well as some of the interesting findings, there are several avenues for future research. First, though the afterschool program took place in two very different settings, we have not yet compared the mentors' experiences and motivations across those settings. We aim to do this going forward, but also encourage other researchers engaged in similar work to examine the extent to and ways in which the mentoring setting itself shapes the mentors' motivations to begin and then persist. Second, in our interviews with the mentors, we saw hints of reflection on the university and engineering more generally. More research is needed is 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. Finally, our finding that mentors have multiple

motivations points to the need for a person-centered approach in which different constellations of mentor motivations can be modelled across a group of individual mentors [45], [46].

Implications for practice

While our findings are completely descriptive they may shed some light into recruiting and retaining of mentors. Since many of the mentors in our sample indicated intrinsic or internalized reasons for mentoring, program directors may want to consider how to highlight these motivations in marketing of the mentoring opportunity as well as allowing mentors opportunities to articulate their own motivations for mentoring. Limited research suggests that having shared experiences or a certain level of cultural proficiency increases a mentor's ability to empathize with and connect to their mentees in ways that are meaningful [47]. Our study suggests that these shared experiences may be motivating to mentors as well. 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. Finally, our findings point to the importance of mentors' self-efficacy for their retention. Our participants who had returned for a second semester described how they felt more capable as mentors, which theory suggests can enhance their intrinsic motivation to mentor. Programs, therefore, 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 trainings and observations, while 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 so that they can reflect on their actions and take steps to improve.

Conclusion

The purpose of this study was to understand the motivations of undergraduate mentors in an after-school engineering program for underrepresented elementary school boys. 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's [16] 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.

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