

Board 327: Investigating Role Identities of Low-Income Engineering Students Prior to Their First Semester of College

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**Leveraging Innovation and Optimizing Nurturing in STEM:
Investigating role identities of low-income engineering students
prior to their first semester of college
(NSF S-STEM #2130022)**

The purpose of the *Leveraging Innovation and Optimizing Nurturing in STEM Program* (NSF S-STEM #2130022, known locally as LION STEM) is to support the retention and graduation of high-achieving, low-income engineering scholars with demonstrated financial need at Penn State Berks, a regional campus of The Pennsylvania State University. The LION STEM program builds upon the *Sustainable Bridges from Campus-to-Campus* project (NSF IUSE #1525367) which formed the backbone of the current curricular programs including a math-intensive summer bridge experience (Engineering Ahead), a first semester First-Year Seminar, and a second semester STEM-Persistence Seminar. In addition, co-curricular activities of the LION STEM program focus on professional communication skills, financial literacy, career readiness, undergraduate research, and community engagement. Although our primary outcome measure of the program is retention in baccalaureate Engineering majors (and other STEM majors), along the way we seek to take a holistic approach to analyzing STEM-persistence as a byproduct of one's development of their STEM-identity. This paper presents data collected about role identities from the first cohort of LION STEM Scholars ($n=7$) prior to their first semester of college and before participation in the *Engineering Ahead* summer bridge program.

Theoretical Framework

Examination of past research on identity reveals various viewpoints and their relative contributions to the progression of knowledge on identity formation and development, but much of the work done in this domain continues to result in a battle of dichotomous theories (Vionles et al., 2011). We believe however that the development of an individual's STEM-identity, and how that relates to increased STEM-persistence, should be modeled as a Complex Dynamic System (Guastello, Koopmans, & Pincus, 2009). The Dynamic Systems Model of Role Identity (DSMRI) proposed by Kaplan and Garner (2017) presents a "coherent theoretical perspective on the integrative nature of identity and its developmental mechanism" (p. 2037). Given that we wish to eventually examine STEM-persistence as a byproduct of the integrative nature of the LION STEM Scholars multiple role identities (Low-Income/College-Student/Future-Engineer), DSMRI (see Figure 1) serves as our theoretical framework. Specifically, this paper will begin to explore the (1) ontological and epistemological beliefs, (2) purpose and goals, (3) self-perceptions and self-definitions, and (4) perceived-action possibilities within and between the various role identities that the LION STEM Scholars possess prior to their first semester of college and before their participation in Engineering Ahead.

The objective of the DSMRI is identified as an action, the behavior taken by an individual and what that behavior means to the current state of one's role identity. "The action, in turn, represents a systemic event that feeds back and influences future iterations of the role identity system through its manifestation to the self and to others of commitments, or lack thereof, to certain meanings in the role" (Kaplan & Garner, 2017, p. 2040). For example, if an individual decides that in order to afford college a part time job is needed while in college, the action of

finding a job and making this decision to work validates the current (and can inform the future) low-income role identity of that individual. DSMRI aims to capture and analyze the actions taken in the role identity system and determine the extent to which content (frequency, type, and richness of elements, such as the goals, self-perceptions, and beliefs), structure (the extent of harmony or discord within and between components and across different identity roles) and process (the dynamics of change in the role identity components) have on identity development. The data in this paper will serve only as a baseline for future analysis of identity development.



Figure 1. The Dynamic Systems Model of Role Identity (Kaplan & Garner, 2017)

Procedure & Participants

All incoming engineering students at Penn State Berks who meet the NSF requirements for S-STEM eligibility (low-income status defined as Pell eligible) were invited to apply to become a LION STEM Scholar. An online portal accepts applications on a rolling basis throughout the year prior to admissions, with an early spring deadline for submission. Evaluation of applications and offers are made in early April along with the Colleges' other coinciding financial aid offers. The participants included in this paper are from the first (2022) cohort of the LION STEM scholars ($n=7$).

Table 1. Background Characteristics for the 1st Cohort of LION STEM Scholars

Variables	N	%
Pell Eligibility	7	100
Gender		
Male	6	86
Female	1	14
Ethnicity		
African American	2	29
Hispanic	2	29
White	3	42
First-Generation College Student	5	71

This paper provides data from semi-structured (Smith & Osborn, 2007) audio-recorded interviews (Appendix A) with all seven scholars prior to their participation in Engineering Ahead. The interviews were transcribed and then an interpretative phenomenological analysis was conducted. This analysis involved identifying superordinate themes across the narratives of all scholars, which provides a valuable baseline for understanding the STEM-identity of high-achieving low-income engineering students upon entrance to college. Student responses to the interview questions were categorized as being related to their (a) Low-Income identity, (b) College-Student identity, or (c) Future-Engineer identity. Next, adapting Kaplan and Garner (2017) coding scheme to reflect our context of low-income college engineering students, scholar responses were further broken down into the four components of the DSMRI model (1) ontological and epistemological beliefs, (2) purpose and goals, (3) self-perceptions and self-definitions, or (4) perceived-action possibilities. Examples of this coding are shown in Table 2.

Table 2. DSMRI example codes from scholar interviews (adapted from Kaplan & Garner, 2017)

DSMRI Component	Description of Component	Example Scholar Statements
Ontological & Epistemological Beliefs	Scholar knowledge and emotion from formal learning about what they believe to be the role identity of low-income/college-student/future-engineers; Sense of certainty and feelings about this knowledge.	<i>Ontological:</i> “Low-income families may not get the same opportunities let’s say in college or in the chance to attend college.” <i>Epistemological:</i> “I feel as if college isn’t affordable at all for low-income people and that’s discouraging.”
Purpose and Goals	The Scholars knowledge and emotion about their personal purpose for attending college to become a future engineer.	“I feel like getting a degree allows you to make more money and be more successful in your field, get a better job and allow employers to trust you.”
Self-Perceptions & Self-Definitions	The Scholars knowledge and emotions about their personal/social characteristics that pertain to being low-income and attending college to become a future engineer.	“My neighborhood is not that Nice compared to other places in the city...I am an African American girl going to be a civil engineer, not a lot of people do that.”
Perceived-Action Possibilities	The Scholars perceptions and emotions regarding actions that could or couldn’t be completed to achieve their purpose and goals.	“My financial situation, I could never afford to go to an Ivy League school. And I probably could have gotten into it, but I didn’t even try to apply because I already knew that it wasn’t worth me paying for an application for something I couldn’t afford and then have bitterness about that.”

Results

When asked explicitly to define their current identities, several scholars vocalized that they were unsure how to put into words who they were. In fact, one student mentioned that they did not “understand this question,” while another admitted that “that’s kind of a hard question.” In general, the consensus seemed to be that these scholars had most likely never been asked or had not previously spent time reflecting on their identities. Although recruited into the LION STEM program because of their low-income, college-student and future-engineer identities, only a few scholars mentioned any of these criteria when describing their identities. Despite all scholars having graduated from high school at the time of their interview, only three of the seven mentioned that they were on a path to enter college (*Purpose and Goals*) and no one explicitly identified as a college-student. Further, the same three students who mentioned that they would be attending college, also in some form mentioned engineering but only one explicitly mentioned “aspiring to be an engineer.” The other two scholars simply commented “going to college for Civil Engineering,” and “excited to learn about Mechanical Engineering.” Only one scholar mentioned coming from a low-income family as part of their identity (*Self-Definition: low-income*). More common characteristics of identity that scholars disclosed included ethnicity and geographical/cultural information about their hometowns (*Self-Definition: ethnicity & culture*) as well as just being a “normal teenager” (*Self-Perception: being like everyone else*). By and large, during these interviews the first cohort of LION STEM scholars did not self-identify as low-income, college-student and/or future-engineers.

When asked who or what has shaped their current identities, no scholar mentioned any academic oriented mentors, nor provided any specific formal educational experiences related to engineering. One scholar even made it a point to mention that school prohibited them from “getting hands on experiences” because they had to just “sit in the classroom” (*Action Possibilities, barrier: lack of engaged learning*). Two of the scholars did, however, point to athletic coaches as helping to shape their identities. Thus, formal educational experiences do not appear to have shaped these scholars’ identities, even though they consistently shared stories such “as a kid liking to take apart things, like electronics, and put them back together to see if it would work again” which shed some light on their beliefs (*Ontological & Epistemological Beliefs*) about becoming a future-engineer. Instead of pointing to academic experiences, scholars talked almost exclusively about the role that “difficult things (they) have dealt with as far as family” has had in shaping their identity. Whether it was about a grandfather who had passed, the struggles of a single mother, or the difficulties related to the divorce of parents, identities being shaped by overcoming family hardships (*Self-Perception: family hardships form identity*) was the common theme across these scholars. Although not initially describing their identities as low-income, several scholars connected their family hardships to the experiences of growing up within a low-income family. One mentioned “I’ve learned to say no to certain things as well as learn what is necessary for what I need instead of what I want,” while another scholar mentioned “I’ve learned to not be selfish and thus not a materialistic type of person” (*Action Possibilities, action taken: prioritize resources*).

Low-Income Identities

When asked directly to explain their view of income inequality in America, four scholars were very open and vocal in their responses while three seemed to have severe reservations with sharing their perspectives on this topic (*Self-Perceptions, emotion: hesitancy*). Of the students who were vocal, the common theme that emerged was that income inequality exists because some people “start out as poor and then stay poor and people who start out as rich...have a better chance of making it” (*Ontological Beliefs*). This was also associated with ethnicity in the following scholar’s response:

It all just comes down to money, because I’ve noticed that a lot of black people don’t have a lot of money, like even my family still struggles with income, but then you have other people’s families that are just set for life, like some people just have it all when they’re just born.

This scholar even went as far as connecting various income levels to educational opportunities in that “people that have more income...just like have everything, like the schools are different better education systems” (*Action Possibilities, barrier: education system*). Another scholar also pointed out the effects that income inequality has on educational opportunities but did so from the perspective of achievement. “A student in a low-income family may not be able to attend college or they can’t get any scholarships due to their grades, versus a high-income family the C average student can pay for their college and therefore can attend without scholarships” (*Action Possibilities, barrier: scholarship opportunities*). This was also connected to motivation as “a low-income students might not get the same motivation, because they just know that they’re not going to be able to eventually attend college.” The overall perception from the scholars who were open about talking about income inequality was that it is real, it is a problem but “it’s just a problem that people talk about but not that much is done to like really address it” (*Self-Perceptions, emotion: frustration*). After all, one scholar said, “it will always exist, there’s always been income inequality among societies” (*Action Possibilities, barrier: historical existence*).

The other three scholars’ responses were brief, and they seemed somewhat reluctant to share information about their opinions on income inequality. Two of these responses appeared to at least partially be due to a lack of knowledge (*Epistemological Beliefs: uncertainty*) about the topic as one scholar commented “income inequality...what does that mean,” while yet another stated, “I don’t like to read the news too much or like stay up to date with all that stuff” (*Action Possibilities: avoidance*). The other scholar who provided little insight to their thoughts on this question simply stated “I tend to stay out of controversial topics like this.... it’s not something that’s on my mind, okay” (*Epistemological Beliefs: controversial*).

When asked about how affordable they believe a college education is in today’s America, these low-income scholars unanimously agreed that it is not affordable (*Ontological Beliefs*). Common responses to this question ranged from simple “not affordable” replies to emotion filled answers associated with low-income status like “I feel as if college isn’t affordable at all for low-income people and that’s discouraging” (*Epistemological Belief: discouragement*). Without mentioning social class, other scholars more generally made statements like “we shouldn’t have to pay this

much for college, we shouldn't have to pay this much just to try to get an education" (*Epistemological Belief: frustration*). One scholar however mentioned that even "middle class people with middle class incomes still struggle to pay it off," which illustrates that at least some of these scholars believe (*Ontological Beliefs*) that college affordability is not a problem unique to low-income students. Interestingly, three of the scholars mentioned how unaffordable college is but put a condition on their response based on it "kind of like depends where you're going to college." For one scholar, the thought of "going to an Ivy League" school was out of the question since there was "no way to afford it" while yet another mentioned that "what college you're getting an education from [depends] what your situation is with your family and your background." In other words, several of the scholars appeared to associate a better education with a higher price tag, one in which they as low-income students could never access because of their financial barriers (*Action Possibilities, action taken: settling for a school they can afford*). This was summarized by another scholar who stated, "low-income families may not get the same opportunities let's say in college or the chance to attend college" (*Ontological Beliefs*).

While all scholars agreed that college is not affordable, they also view a college degree as a financial benefit which is necessary to give them a "one up in life" (*Ontological Beliefs*). When asked about what they believe the benefits are of obtaining a college degree, in one form or another and without hesitation they all mentioned "getting higher paying jobs." They all seemed certain that "when you obtain a college degree, it raises the amount of money you earn per job," but the scholars provided little detail about why they believe that "once graduated there are way more doors open for jobs that make you financially well off" (*Action Possibilities: earning college degree*). Even with follow-up questions designed to understand where the belief that a college degree equates to higher paying jobs originates, they simply responded with answers like "that's basically it" or referenced the idea that not as many opportunities exist with only a high school diploma (*Action Possibilities, barrier: highest level of education is high school*). Only one scholar mentioned anything beyond a financial benefit when they stated that a college degree would "allow employers to trust" them more (*Ontological Beliefs*). In other words, these scholars seem to have been told that a college degree is a financial benefit but can't explicitly describe why and in fact one scholar even admitted that someone with a "bachelor's degree, makes a lot of money doing things I don't know what they do, but all I know they have a bachelor's degree" (*Ontological Beliefs: uncertainty*). Interestingly, one scholar mentioned that a college degree would "allow employers to trust" them more.

Although college is viewed as a necessary but unaffordable cost for these low-income scholars, it appears as if very few of them have a financial plan in place to be able to pay for their education. Responses to the question about how worried they are about affording college and to what extent they have had conversations about this with their families indicates that they are somewhat worried (*Epistemological Belief: worrisome*) about college being "really expensive", but family conversations about college affordability are minimal due to a lack of financial support available from families. Because of this, a theme that was repeated over-and-over again is that most scholars just "started thinking" about the cost of college during their senior year of high school and thus serious "conversations with my family we've just started having them like this year" (*Action Possibilities, barriers: delayed financial conversations*). One scholar even mentioned that

the first time a formal family conversation about paying for college occurred was after a “financial aid talk” (*Action Possibilities, action taken: initiate financial conversation*) during an accepted student day on campus. No other scholars provided explicit knowledge about what sparked these conversations or why they were delayed, but it seems as if these conversations did not happen earlier because the scholars sole focus was on just making sure that they excelled academically since they knew there would be little to no financial support from their families. As one scholar put it, “I always thought like, if I could get into college then I’d be okay” and yet another mentioned that they always “knew I was going to go, and some way I’m going to find money to go to college” (*Ontological Belief: all will work out in the end*). It appears as if these low-income students and their families believe that there is only one ‘pathway’ for attending college: high grades equating to scholarships. Excerpts from two of the scholar interviews below best summarize this belief:

My mother always telling me that I had to study hard, because she wouldn't be able to help me to pay college, especially with her income she's still classified under a poor living income. And she knows that she wouldn't be able to help me with those expenses, so it's mostly been, you need to study because you need scholarships to get into college (*Action Possibilities: hard work = scholarships*).

I mean, even now, like, I know that college is expensive and, like my mom she's always like drilled that in my head oh it's really expensive. Like start applying for scholarships and stuff that has always been what she told me, so I know it was something that worried her in a sense, because she was always on top of me to apply (*Action Possibilities: hard work = scholarships*).

This belief was so strong in one family that when one of the scholars wanted to “get a job to save money for college” (*Action Possibilities: obtaining a job to help pay for college*) their family prohibited them from doing so since their job was to focus on getting into college.

College-Student Identities

Although only three scholars mentioned that they were on a path to enter college when initially asked to describe their current identities, when asked directly what their purpose was for attending college the scholars were very forthcoming with more details about their purpose and goals. While the obvious answer to this question might be to obtain a college degree in engineering, only two of the scholars mentioned engineering. “I just want to become a nuclear engineer basically and that's my purpose of attending college is to get a nuclear engineering degree” one scholar stated, while the other went a bit beyond the final product and talked more about the process when commenting that their purpose of attending college was to “really learn the ways of how I can solve a problem in the future because that's what an engineer does” (*Purpose and Goals*). Engineering was absent from the other five scholars’ responses. Instead, these scholars spoke more generally about their belief that obtaining a college degree would position them to have a better life. For instance, one scholar stated, “my purpose of attending college is really to better myself going forward in life” (*Purpose and Goals*). Although several

scholars mentioned that college would be able to help them obtain a better job or help them “break through the barrier of entry into a career,” (*Action Possibilities: earning college degree leads to better jobs*) no one explicitly talked about the financial benefit of obtaining a college degree. From their responses however it appears as if ‘better’ had some monetary component. For example, one scholar stated, “my main goal right now is to build myself my own house,” while another said, “success for me is to have a healthy family being able to live, not even like an extravagant life, like just a typical average life” (*Purpose and Goals*).

When asked about what expectations they had of becoming a college student, most scholars expressed the idea that this new educational experience would be a much harder journey. “I know it's going to be hard I know it's going to be very difficult” one scholar said, while another was even more blunt in saying “I think it’s going to be more gruesome in the sense that it's going to be more difficult more sleepless nights than usual” (*Ontological Beliefs*). When asked to define specific reasons why they believe college would be more difficult, becoming independent and taking more responsibility for their own education was a common theme reported by the scholars. “It's a lot of responsibility and a lot more on me,” one scholar said while another echoed “I believe that becoming a college student is really going to make me learn about how I am as an independent person because up to this point I’ve not really been independent” (*Self Perceptions*). In follow up questioning to see how these scholars anticipate overcoming these challenges, it appeared as if few had thought this out and instead plan to “just step up to it and just do what I got to do” (*Action Possibilities, emotion: confidence*). After all, as one scholar put it, “throughout all my life I never like really studied I just learned what I had to learn and remembered it, so I know that in order to get through college I’m going to have to switch that up” (*Action Possibilities: switching study habits*).

Even though the scholars unanimously stated that college would be difficult, they all reported mixed feelings about their level of preparedness (*Self-Perceptions: uncertainty*). “I think I am halfway prepared for college,” one scholar said, while another simply responded “I’m like 50/50 prepared.” The hesitancy in their answers seemed to not just come from being a “little apprehensive about stuff that (they) haven’t experienced yet,” but rather the fact that they did not feel challenged in high school and thus there exists a chance that their high school education really has not prepared them for the rigor of college (*Action Possibilities: barrier, lack of rigor in high school*). “Speaking to some people I understand there’s a big gap between high school and college” one scholar responded, while another admitted “high school it just felt like it was a little easy kind of because, like, I never had a C or a 70 at all.” Specific weaknesses that scholars pointed to in their education centered around the level of mathematics needed for engineering. For instance, one scholar said, “I know there's a lot of math and I am good at math, but there are some spots where I’m a little weak in,” whereas another mentioned “math people will be telling me it’s harder much more difficult examples” (*Action Possibilities: barrier, underprepared in mathematics*). One scholar also pointed to the COVID-19 pandemic as a reason for their lack of preparedness:

In that one year of COVID there was a lot of information that I didn't process or remember like let's say math formulas or things that might be necessary now or classes,

that I should have taken. And I lost those things because it was more difficult to pay attention during that time (*Action Possibilities: barrier, instruction during COVID-19*).

Future-Engineer Identities

It appears that interest in engineering for most of the scholars occurred early and often in their childhoods. When asked about why they decided to pursue a college degree in engineering and who or what influenced that decision, many of the scholars talked about hands-on experiences (*Action Possibilities*) that they had as children where they were fascinated with the idea of taking something apart and “put(ing) it back together, just to see how it works” (*Self-perception: fascination*). The context for these experiences ranged from “mess(ing) around with various electronics” like “building a TV and helping to take apart a toaster,” to just “playing with Legos,” and even to the simple task of “changing a broken light bulb.” Although they recalled these experiences vividly, multiple scholars expressed that they believed that this natural curiosity as a child was in some way abnormal. For instance, one scholar said, “it sounds silly, but as a kid I just loved creating things,” while another mentioned “for some odd reason whenever I was little, I would always just want to build things like I always just had this weird feeling that I needed to fix something” (*Self-perception: abnormal*). Throughout their responses however, time and again the scholars indicated that this abnormal curiosity of an engineer was also tied to the desire to help people. In one instance after immediately discussing the experience of changing a lightbulb as a child, one scholar said “I don't know why that struck something in me...but growing up, I was kind of fascinated with the idea of helping people.” This was echoed by other scholars who said, “that's what engineers do, they help build things, they help people” and another whose goal for the future is to “help lead the advancement of humanity” (*Purpose and Goals*).

Missing from many of the scholars’ responses to who or what influenced their decision to pursue a degree in engineering were connections to formal academic related experiences. Although one scholar mentioned “falling in love with Physics” because of an eleventh-grade class and two other scholars referenced excelling in Technology-Education classes while in high school (*Action Possibilities: educational experiences*), it is clear from these interviews that the influence of family members is the primary reason why these scholars are pursuing engineering. In fact, five of the seven scholars explicitly pointed to a family member as their greatest influence and in two of those cases the scholar identified their father as being an engineer. Speaking about this influence, one scholar said since “my father was an electrical engineer, I already knew that was like a big possibility for me” (*Action Possibilities: following in steps of role models*). Through follow-up questioning it is interesting however to note that in both cases neither of the fathers had completed a college engineering degree from a United States university (one of the fathers was trained in the engineering field in a foreign country and the other father worked many years in an electrical engineering setting without a college degree). At least implicitly this points to a belief that an engineering identity might not be tied to a college degree for some of these scholars. Other scholars referencing family influences included “I think I was like five or six and I helped my grandpa like helped him with things like building things and stuff like that” while another pointed to “my dad and my grandfather had a carpentry business and hanging around

them being around the environment it (engineering) kind of just grew on me” (*Action Possibilities: informal childhood engineering experiences*). In addition, even though one scholar indicated that “it definitely was people around me saying oh you’d be a good engineer and bringing that up to me, my mom has called me an engineer for a while, my dad always said it to me, my grandparents always said it to me,” the family influence does not appear to have enough impact for low-income engineering students entering college to explicitly self-identify as engineers (*Self-Definitions, lack of engineering identity*). The two scholars who did not mention that family influence contributed to their desire to pursue engineering both reported they “just discovered it (engineering) for myself.”

Discussion

Our results indicate that identity in general does not appear to be something that these scholars have invested much thought into, nor have they had much experience expressing who they are (identity) at a specific instance in time. When asked explicitly to discuss their identities, only a few scholars briefly referenced their low-income, college-student or future-engineer identities. Yet, these three factors are all important ways in which these scholars are classified by the university upon admission. A mismatch between how the university views these students and how they view themselves could possibly lead to struggles surrounding identity development. It therefore seems necessary to implement more robust K-12 identity education programs and for institutes of higher education to be more transparent and open about how prospective students are identified throughout the admission process. This appears to be especially important for low-income students as several of the scholars in this sample were uncomfortable with or appeared to be conditioned not to talk about their low-income status.

We also note that low-income status students (and their families) believe that the only pathway to college is working hard academically so that they can secure scholarship money to be able to afford college. This belief inhibits family conversations about college affordability from occurring until the few months leading up to high school graduation. After all, what planning is there to do, or discussions are there to be had if saving money or taking out loans is not a financial option? It therefore is not a surprise that other than the scholarship money provided by this S-STEM grant, these low-income scholars have no financial plan in place to pay for their education. For those low-income students who aspire to earn a college degree but whose academic records might not translate into scholarships, this lack of financial planning and delayed college affordability conversations appear to be a barrier for entrance to college. We also imagine that the pressure associated with this pigeonhole that low-income students are forced into negatively affects their mental health. It therefore seems warranted that financial aid counseling programs be developed and implemented earlier for families of K-12 students with college aspirations. With proper counseling and planning, perhaps low-income students and their families can realize other pathways for college affordability.

The belief of these high school graduates is that college is going to be more difficult than their prior educational experiences, but they are not exactly sure how to quantify that difficulty. They know that they will have more independence and need to take on more responsibility for their own learning, but they couldn’t vocalize how they plan on doing so. Except for one student who briefly mentioned taking Advanced Placement classes in high school, these low-income scholars

do not feel as if they were challenged and do not feel as if their high school experiences have prepared them for the rigor of college. Moreover, even though these scholars were required to provide two letters of recommendation from STEM teachers for their LION STEM application, no academic mentor was referenced by any scholar when asked who influenced their current identities. Instead of formal educational experiences, family hardships were the driving force behind their decisions to attend college. The scholars repeatedly talked about their need to obtain a college degree in order to position them to have a better life, not because of their interest in a STEM related career. We call for higher education institutions to collaborate more with K-12 partners to examine curriculum and rigor and to develop further opportunities to help students prepare for the transition to college.

As mentioned above, these low-income students appear to be hyper-focused on obtaining a college degree, but not necessarily an engineering degree. The scholars repeatedly talked about how a college degree will help them better their lives, but in these conversations, they very rarely talked about an engineering degree. Their college-identity (or at least their purpose and goals related to this part of their identity) seems to be further developed than their future-engineer identity upon entering college. The influence on their future-engineer identities has mainly been family members and not formal engineering educational experiences from school and their desire to become engineers is mainly rooted in helping people. While many of the scholars talked about their fascination with building things or taking things apart from their early childhood, not a single person mentioned any elementary or middle school curriculum related to engineering. This absence from early formal education perhaps is the reason why several scholars viewed their early interests in engineering as weird or abnormal. We thus call for normalizing young children's desire to use their hands, creation of more formal engineering education experiences in elementary school curriculums and a need to begin talking about engineering not just as scientists or technologists, but as a more human service-oriented career that sets out to make peoples lives better.

Conclusions

The result of this interpretative phenomenological analysis captures an important baseline snapshot of how low-income, high-school graduates who are pursuing an engineering degree view their identities prior to the beginning of their first semester of college. In the future we plan to analyze similarly recorded interviews from all scholars after their participation in Engineering Ahead (four-week summer bridge program) and at other various times throughout their undergraduate journeys. Through these analyses we hope to be able to better understand how the integrative nature of low-income, college-student and future-engineer role identities affect one's overall identity. Further, by continuing to use the Dynamic Systems Model of Role Identity (DSMRI) we will gain further knowledge about how ontological and epistemological beliefs, purpose & goals, self-perceptions and definitions, and perceived-action possibilities within and between role identities relate to STEM-persistence as a byproduct of the development of undergraduate students' STEM-identities.

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Appendix A

Pre-College, Pre-Engineering Ahead Interview Script

1. Who are you? How would you explain your identity at this current moment in time?
2. Who or what has shaped your current identity?
3. How often was the thought of you attending college discussed in your childhood? Can you explain those conversations?
4. Why did you decide to pursue a college education? Did you always know you would be attending college?
5. What are some barriers that you have had to overcome to be where you are today?
6. To what extent do your family/friends support your decision to attend college? Can you provide some specific details?
7. Why did you decide to pursue a degree in Engineering? Who or what influenced that decision?
8. What is your view of income inequality in America?
9. How affordable do you believe a college education is in today's America?
10. How worried are you about being able to afford your college education? Have you had any conversations in the past with your family about this?
11. What is your purpose for attending college? At this point in time, what are some of your personal goals?
12. How prepared do you believe you are for college? What are some specific reasons why you feel this way?
13. Is there anything about your academics that you know you will need to work on to improve to be successful in college?
14. What do you believe to be the benefits of obtaining a college degree?
15. What are your expectations of becoming a college student? How similar or different do you think it will be to your other educational experiences to date?
16. What do you do when you run into an academic struggle? How do you overcome academic setbacks?
17. What does the phrase academic persistence mean to you?