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Outcome Expectations and Environmental Factors Associated with Engineering College-Going: A Case Study

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Abstract

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Outcome Expectations and Environmental Factors Associated with Engineering College-Going: A Case Study

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Abstract

Family, school, and community contexts each link to secondary school enrollment, yet these factors have been comparatively examined only in limited ways. A holistic examination of contextual factors will be particularly important for engineering where college enrollment patterns vary by demographics. To begin explaining patterns of engineering college-going at different high schools across the Commonwealth of Virginia, we answered the following research questions: *Within a single school system and from a socializer's perspective, what outcome expectations and environmental factors influence students' engineering-related postsecondary educational plans? How are these factors the same and different between high schools within a school district?* Using a single-case-study approach and in-depth interviews with socializers (teachers, administrators, and counselors), we examined similarities and differences in outcome expectations and environmental factors at three high schools within a single school district. By integrating the results regarding outcome expectations and environmental factors, three important findings emerged: (1) relationships between outcome expectations and environmental factors vary across schools within the same system, (2) proximity to a postsecondary institution is not just about physical distance, and (3) messaging regarding career pathways matters. Each of these has practical implications but can also set the foundation for future research.

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Introduction

Research shows that high school students have unequal access to preparation for career aspirations (e.g., Wells, Wolniak, Engberg, & Manly, 2016). Engineering is a career aspiration that is particularly impacted by these disparities (Carrico & Matusovich, 2016) because enrollment in engineering degree programs is aided by completion of advanced mathematics or introductory engineering courses in high school (Phelps, Camburn, & Min, 2018). Completing such courses requires recognizing that engineering is a viable career option at a fairly early age, developing an interest in engineering, knowing such courses are needed, and then having access to relevant courses (Carrico & Matusovich, 2016). Understanding disparities in access to engineering degree enrollment is particularly important as engineering is a high-paying career that can provide steady employment, both desirable attributes for people in lower socioeconomic regions (Boynton et al., Under Review).

To begin explaining patterns of engineering college-going at different high schools across the Commonwealth of Virginia, we examined the relationship between school context and the potential for engineering degree enrollment from the perspective of high school socializers. High school socializers are the principals, teachers, and counselors who interact with

students and presumably influence their career aspirations and knowledge. Using a single-case-study approach (Yin, 2014), we examined similarities and differences in outcome expectations and environmental factors at three high schools within a single school district. Outcome expectations are the “imagined consequences of performing particular behaviors” (Lent, Brown, & Hackett, 1994, p. 83). Environmental factors include contextual supports and barriers encountered during the pursuit of one’s career choice goals (Lent & Brown, 2006). Specifically, our research answers the following questions:

Within a single school system and from a socializer’s perspective, what outcome expectations and environmental factors influence students’ engineering-related postsecondary educational plans?

How are these factors the same and different between high schools within a school district?

Drawing on in-depth interviews, our findings reveal similarities and differences within and across the schools, specifically with regard to the role of people-, programs-, and place-related resources.

Background/Framework

Although it is generally accepted that family, school, and community contexts are linked to secondary school enrollment choices and achievement-related outcomes (e.g., Roscigno & Crowley, 2001; Rowan-Kenyon, Perna, & Swan, 2011), research has examined comparisons and interactions among these contextual factors in limited ways. For example, the University of California San Diego modeled college grade-point average as a function of the backgrounds of entering students, and even after controlling for income, gender, and race, students’ high school and neighborhood socioeconomic statuses had an independent effect (Betts & Morell, 1999). However, studies have commonly focused on only one context and/or demographic. For example, participation in a college-preparation program in an urban high school increased college attendance and persistence (Knaggs, Sondergeld, & Schardt, 2015). In a rural area, researchers showed that students who are physically farther from a university are more likely to go to community college (Burke, Davis, & Stephan, 2015). By having a narrow and focused approach, nuances of the environment, such as being in urban or rural settings, are lost because they are essentially held as constants for the individual study.

We framed our investigation using Social Cognitive Career Theory (SCCT), which describes the effect of the relationship between person, environment, and behavior on career interest formation, choice, and performance. This theory was designed to understand the process through which students form academic and career choice goals and determine supporting actions to attain their goals (Lent et al., 1994; Lent & Brown, 2006). We focus specifically on outcome expectations and environmental factors that potentially influence students’ post-high school engineering-related plans. Within SCCT, environmental influences may be divided into proximal and distal, in recognition that past (distal) and present (proximal) influences can simultaneously impact career choices. However, the degree to which something is distal versus proximal can be difficult to disentangle. Thus, we have considered environmental influences as a single construct and have not identified a specific timing for the influence. Conversely, outcome expectations will always have a future temporal perspective.

There is considerable research from the student perspective using SCCT to examine science, technology, engineering, and mathematics (STEM) career choices. Though there is some specific literature on engineering that is grounded in an SCCT perspective (e.g., Flores, Navarro, Lee, & Luna, 2014), engineering is often embedded within STEM. In a notable and recent review, Fouad and Santana (2017) examined research studies situated in SCCT that explored the factors involved when women and people from underrepresented groups make STEM-related career choices. Although self-efficacy tended to be the most common factor studied, Fouad and Santana provide evidence for the importance (and interconnectedness) of outcome expectations and environmental influences in middle and high school students. For example, they cite Fouad and colleagues (2010) who assessed five types of environmental influences (parents, schools, financial/environmental, social, and individual) and found differences across subjects (math and science) and across years (middle school, high school, and college), including which influences served as supports and which as barriers to persistence in math and science classes. As operationalized in this study, supports and barriers included perceived outcomes associated with math and science, for example, more test anxiety in science classes. Fouad and Santana (2017) claim theirs to be an exhaustive literature review. However, other sources not included therein also examine outcome expectations (e.g., Turner, Joeng, Sims, Dade, & Reid, 2019) and environmental influences (e.g., Garriott, Raque-Bogdan, Zoma, Mackie-Hernandez, & Lavin, 2017) of high school students who consider STEM careers.

Current literature identifies two ideas as being underexplored. First, environmental influences and outcome expectations matter but can matter differently for different groups of people. For example, when Turner and colleagues (2019) examined the role of socioeconomic status in high school student STEM plans, they found the predictive value of outcome expectations to choice goals and actions to be less than the SCCT model and research might suggest. They thus concluded that outcome expectations are not a unitary construct across cultural, social, and economic differences. Second, people within school contexts, such as teachers and counselors, matter in developing career choice pathways. For example, when

Fouad and colleagues (2010) identified schools as an important environmental factor, they included teacher behaviors (e.g., being supportive or not) in the operationalization of the construct.

Collectively, this prior research supports the need to further examine outcome expectations and environmental influences of high school students considering STEM careers. This current study does just that, approaching student career choices toward (or away from) engineering by comparing high school and community resources within a single school district. The focus is specifically on engineering because, unlike other disciplines, choices to enroll in engineering must be made early as transferring into engineering from other majors is notoriously difficult (e.g., Ohland et al., 2008). Moreover, we take a school-socializer perspective as they are an influential part of shaping the school contexts.

Methods

As part of a larger mixed-methods study (unblinded: NSF-EEC-1647928) designed to identify and explain demographic variations within the Commonwealth of Virginia at the high school level regarding proportions of students enrolling in postsecondary engineering degree programs, the quantitative phase analyzed student high school and postsecondary data from the Virginia Longitudinal Data System (VLDS) (e.g., demographics, test scores, postsecondary program of enrollment) (Gillen et al., 2017). The present analysis, part of the qualitative phase, is a single-case-study design bounded by a single county. Single-case studies are appropriate when the case selected is representative of similar situations (Yin, 2014). We know from the quantitative phase of the project that the patterns of enrollment from this county mirror those from other counties across the state, namely in their mixed engineering college-going rates among schools within the same division. The embedded units of analysis in this case study (Yin, 2014) are the individual high schools within the county. Although we are interested in trends at the case level, it is important to differentiate these subunits to build an understanding of how influences compare among high schools in the same county.

Case Site and Participants

Our case site is a rural geographic region in Virginia. Based on the results of the quantitative phase of our larger mixed-methods project, Table 1 shows the region's number of high school completers and college-going percentages averaged over the eight-year period of 2007–2014. Federal and state statistics provide a useful comparison for indicating the relative socioeconomic status of the region which is tied to college-going (Bradburn, 2018). The median household income falls below the national metric, but there is a higher percentage of people over the age of 25 that hold a bachelor's degree than at the national level (U.S. Census, 2016). The latter is unsurprising given the proximity of multiple colleges and universities that may draw higher-educated individuals to the area, a factor which we specifically explored through our conversations with participants.

There are four high schools in this county, three of which agreed to participate in this study: High School A (HSA), High School B (HSB), and High School C (HSC). Insights into the fourth high school, High School D (HSD), were discussed through conversations with study participants, and thus we have included information on all four schools. HSB and HSD can be classified as large public secondary schools (>750) and HSA and HSC as small public secondary schools (<400) based on the ranges from Grauer (2012). State-level data (Virginia Department of Education, 2018) on the percentage of students that receive a free or reduced lunch at school can further illustrate the relative socioeconomic status of these schools. HSB is closest to a four-year institution and has the lowest percentage of students on free or reduced school lunch (10–20%). Thirteen miles away, HSC had over half of its student population receiving free or reduced lunch (>60%). HSA falls in between these two extremes (30–40%) as does HSD. Because these schools are in the same county, resource equity within the division is important, but in practice, barriers may still exist. For example, school cooperation enables access to course offerings for all students within the county (e.g., students may travel via bus during the day to take a math class only

Table 1
College-going rates for each high school in the county averaged over 2007–2014.

High school	Completed high school	First institution after high school		Ever attended 4-year	Ever enrolled in engineering
		2-Year	4-Year		
High School A	85	38.7%	30.6%	37.6%	9.8%
High School B	257	22.0%	60.9%	66.6%	10.7%
High School C	70	29.1%	20.9%	25.8%	4.1%
High School D	233	34.7%	33.6%	40.2%	8.0%

offered at another high school), but additional course scheduling constraints may arise for those students who must travel to take select classes.

We used a snowball sampling approach starting at the school-system level and seeking interview recommendations for people perceived by participants as being influential with regard to students' career choices. During the course of some interviews, a participant would recommend a potential additional interviewee. For example, an administrator suggested one of their teachers who talked about engineering with students. If no recommendations were given during the interview, we purposely asked who, if anyone, they would recommend we contact. Any new person recommended was contacted and offered an opportunity to interview with us. We interviewed participants representing a range of professional experiences at each school, including those who were new to their position (three years of experience or less), and those with more tenure (six to nineteen years). Our sample includes men and women, principals, engineering teachers, a career and technical education (CTE) teacher, a math teacher, and a counselor. The variety of positions and experience levels of the participants provided a variety of perspectives on students' postsecondary plans across schools in the county.

Data Collection

We conducted a total of eight interviews: one principal and one teacher at HSA; one principal, two teachers, and one counselor at HSB; and one principal and one teacher at HSC. These interviews were in-depth and semi-structured, approximately 30 to 60 minutes. All interviews were recorded and transcribed verbatim for analysis. Particularly salient interview questions for this study included:

- What postgraduate four-year pathways do you see students taking? Why do you think students choose a four-year university?
- In your position, do you think you have a role in helping students choose college/career paths?
- What do you think it takes to be an engineer?
- Do the students you interact with talk about engineering? What do you think influences students to choose engineering postsecondary programs?

The interviews were held at the participants' respective schools (e.g., in a teacher's classroom or principal's office). Faculty and student researchers from our team conducted all of the interviews. No interviewer had children enrolled in these schools, but some interviewers had previously volunteered in extracurricular programs with the schools.

Data Analysis

Guided by Miles, Huberman, and Saldaña (2013), we used a provisional coding scheme which allows the researcher to start with a list of codes generated from theory or other means, while still letting other codes emerge (Saldaña, 2016). The constructs started with SCCT-guided first-cycle coding of individual interviews but allowed latitude for other codes. Several iterations of first-cycle coding included checking with the quantitative team to corroborate emergent findings. The quantitative team consisted of other principal investigators on the larger project (including two co-authors on this paper) as well as graduate research assistants. The quantitative team analyzed data from VLDS, which included school data as well as longitudinal individual student data. These cross-team checks primarily took the form of debriefs during regular whole-team meetings, in which we compared preliminary qualitative findings to quantitative results. For instance, quantitative results suggested that math courses may relate to engineering college-going and math discussions were found to factor into our analysis. In second-cycle coding, we identified patterns across excerpts from our most prominent first-cycle codes. Example codes included "proximal influences" from SCCT and "school values" as an inductive code that emerged.

Research Quality

We attended to validity and reliability according to case study guidelines from Yin (2014). We promoted construct validity by using the well-studied SCCT and supporting literature to guide our interview protocol development. Additionally, several research team members have significant experience with SCCT which supported researcher triangulation (Creswell, 1998). Consistent with Yin (2014), we promoted external validity by designing our interview protocol and interpreting results using theory, in this case SCCT. Additionally, the research team engaged with an external auditor to review the research design, further promoting external validity (Creswell, 2014). We promoted the transferability (Creswell, 2014; Denzin and Lincoln, 2003) of our study by detailing a rich description of our findings and selecting a case that is similar, with regard to quantitative findings, to other counties in the Commonwealth of Virginia. By detailing our data collection and analysis methods, such as our interview protocol and code development, we contributed to our study's

reliability. Checking our transcripts for obvious errors and for intercoder agreement also promoted reliability (Creswell, 2014).

Limitations

Our study has several limitations that result in informative, though not exhaustive findings. First, sampling all schools in the system was not possible, as one school did not respond to requests to participate; we thus may be missing a perspective. While this does limit our findings about the region as a whole, the patterns noted across three of the four schools provide sufficient evidence to support our findings. Second, differing numbers of teachers and counselors within the three schools participated in interviews, so we may not have reached saturation. However, the impact of this was reduced by our regular debriefs with the quantitative team to corroborate findings within the larger scope of the project, and not one participant at a school provided contradictory data to others. Third, individuals may have provided responses that they believed were more socially acceptable out of a desire to reflect positively on the school system; we recognized and worked to mitigate this by seeking multiple perspectives from each school and debriefing with the quantitative team.

Results

Our study examined what outcomes socializers thought students were aiming for (outcome expectations) and what environmental factors socializers described as salient to those outcomes. Regarding outcome expectations, we found differences across schools on the salience of higher education in engineering, both broadly and specifically. Regarding environmental factors, we identified five factors perceived by socializers to influence postsecondary enrollment in college (and by default engineering), namely: (1) proximity to postsecondary schooling, (2) parent and family background (typical work in the area), (3) tuition-support programs, (4) funding or program availability at the high school, and (5) the role of counselors and teachers. Figure 1 visualizes key results with regard to distances between schools, contexts of the regions, and typical employment expectations.

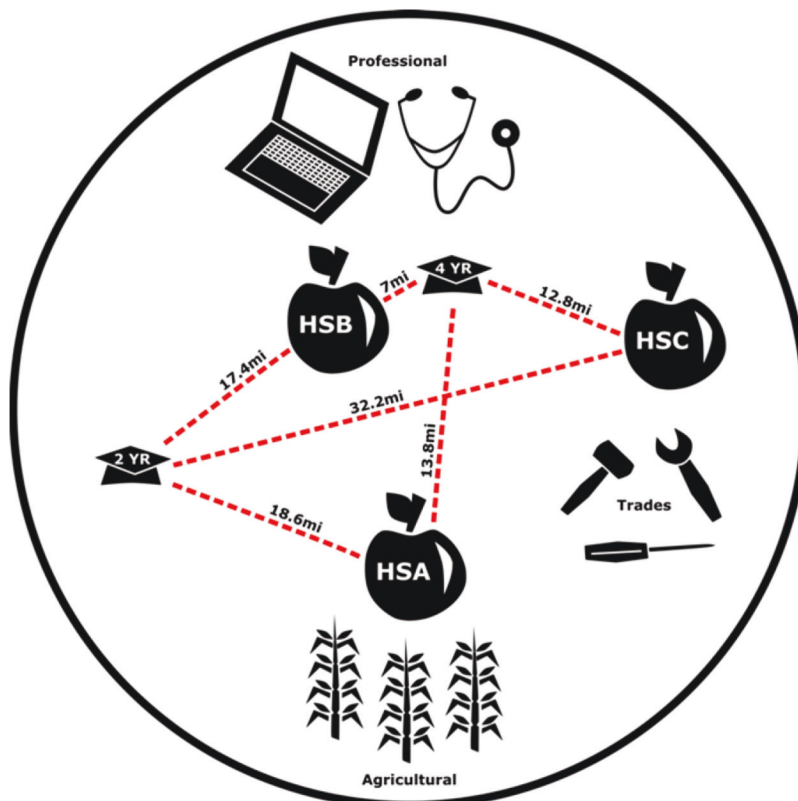


Figure 1. Visualization of distances and contextual differences between schools.

HSB	HSA	HSC
Students have specific college degree intentions (including engineering) and are enacting them	Students have loose goals for postsecondary schooling but not a major (including engineering)	Not all students have a post-high school plan and it likely does not include college education (thus not likely engineering)

Figure 2. Socializers' perceptions of students' outcome expectations by school.

Perceptions of Students' Outcome Expectations

When we asked participants about their perceptions of the outcomes that high school students expect at graduation, we found clear differences across schools with regard to the prominence of higher education and therefore engineering (as a subset of higher education). Figure 2 summarizes the results by school; it is ordered such that the greatest likelihood of outcome expectations including engineering is on the left and the least is on the right.

Starting with HSB, the outcome expectation was enrollment in postsecondary schooling so students, often in response to pressure from parents, positioned themselves for a four-year degree while in high school. For example, an administrator said:

But in terms of the majority of kids...they gravitate toward being involved in sports, or in academics, or filling their plate and their resume with service and giving back to the community, and making themselves a presentable candidate. It's what they're ingrained from home.

Because they were considering college, students at HSB could and did consider engineering as a specific major. By contrast, at HSA more students "are thinking about a school and not so much a major" according to an administrator. When asked why students choose a four-year university, a teacher responded:

[Student] would like to have the full experience. She would like to move away from home, and live in a dorm, and have that whole, "I'm an adult now." Whereas community college feels sort of like an extended high school. And so, you don't feel like you're really in college. You just feel like you're in the upper levels of high school by doing that.

Although participants did speak of particular career plans or majors, the general idea of going to college was more prevalent. There was little mention of specifically preparing for engineering-related careers as an outcome.

Finally, at HSC, postsecondary plans were less certain for students. The administrator had a goal of helping students *have* a postsecondary plan when they graduate and spoke of working with students to identify possible careers and pathways. Postsecondary education, and consequently engineering as a subset, was not in the forefront for many of these students.

Environmental Factors

The five environmental factors perceived by socializers to influence postsecondary enrollment in college (and by default engineering) are shown in Figure 3. It is ordered to correspond to Figure 2, where the school with the greatest likelihood of outcome expectations including engineering is on the left and the least is on the right. Gray shading indicates similarities across sites.

Environment—Proximity to Postsecondary Schools

Proximity to postsecondary institutions creates an affinity toward the school through increased awareness of and contact with that institution. Each of our high schools has its closest proximity to a different postsecondary institution.

HSB is geographically nearest to a university that offers engineering degrees. Socializers at HSB all noted that being close to a university that offers four-year degrees, and specifically degrees in engineering, results in more students pursuing such opportunities. For example, a teacher said, "Because we are in the shadow of [University 1], I think we have a lot more students in [HSB] who are thinking about engineering than you might have at your typical high school in a typical non-college community." Both the administrator and a teacher at HSB talked about specific collaborations with University 1 that were enabled by proximity. The teacher stated:

HSB	HSA	HSC
Proximity to Postsecondary School		
Closest to a 4-yr university offering engineering and has more interactions with that university	Close to a 4-yr university and community college with a career coach that encourages the community college and a 4-yr college that does not offer engineering	Close to a 4-yr university but proximity is not enough
Parental and Family Background		
Long family history of education, high pressure to get into the local postsecondary institution	Farming community with low financial resources resulting in a need for students to commute	Families tend to work in trades
Community College Tuition Assistance Program		
For students without many other options for success	Important pathway that they would like to see more students take advantage of	Important pathway that they would like to see more students take advantage of
Availability of High School Programming		
One of the resourced high schools (money, programs, etc.)	Students must travel to HSB or HSD	Students must travel to HSB or HSD
Role of Counselors and Teachers in College Preparation		
Counselors help with the logistics of college preparation (applying, paperwork, financial aid, etc.) and teachers help with career choices	Counselors help with the logistics of college preparation (applying, paperwork, financial aid, etc.) and teachers help with career choices	Counselors discuss future work options and what should be done now to prepare

Figure 3. Socializers' perceptions of salient environmental influences by school.

...with my program I've tried to schedule field trips. We're having a [specific competition], which is a student organization where they can choose something they want to compete in. [University 1] is hosting us at a classroom on campus. And I'm kind of arranging some judges to come in. But I think having the students go visit the labs and see what programs are available, I think that helps them.

It is important to note that students at HSB do hear about other schools as well. For example, the teacher we interviewed also mentioned a local community college:

[Representative] at [Community College 1] has invited us over several times because he wants students to come in and see what programs he offers, what equipment he has.

Although other schools are mentioned, there is greater affinity toward University 1 for HSB as associated with other environmental factors.

Similarly, participants at HSA believe that being in proximity to and interacting with a career coach from Community College 1 (CC1) leads students toward enrolling primarily in community college. Referring to this career coach, a participant at HSA stated, “When they speak, they speak to a lot of experience about [CC1] and give a lot of examples about [CC1], which tends to lead kids that are headed that direction to [CC1]. And also the proximity of the school as well.” Like HSB, students at HSA have exposure to other postsecondary schools via a career fair at University 2 (a local university without an engineering degree program). Participants at HSA did not mention University 1 specifically with regard to proximity.

Participants at HSC mentioned both local universities but described them as non-options. One participant said:

[The students] know [University 1] exists, but they’ve never been to the campus. They know that [University 2] is there, but they’ve never been to [University 2]. And part of it is they can’t afford the gas. The parents have no reason to take them there. It’s a waste of time, because we can’t afford to send you to that school, so why get your hopes up?

In this third example, socioeconomic status overshadows proximity with regard to considering local postsecondary institutions. Another participant at HSC did mention visiting a specific engineering department and having college students from that department come to the high school. This teacher believed that role modeling from the college students could help his students see their options: “That’s my goal, is to get them to think about things. Not just engineering, but other technological types of career paths. Just let them know there’s something out there besides the Burger King and Walmart’s.”

Environment—Parental and Family Background

The parental and family backgrounds of students attending the three schools also differ. HSB represents an area with a long family history of postsecondary education, whereas HSA is in a farming community, and HSC is in a trade community. Unlike HSB, where participants noted that parents are supportive of special programming, HSA and HSC participants note that it can be difficult to get parental engagement.

Family background suggests more affluence near HSB than at the other high schools. Although the background and wealth of the students’ families were considered to be a positive influence on student enrollment in postsecondary institutions, one teacher at this high school offered an interesting caveat. The teacher noted that too much pressure to succeed in a student’s community/family, especially in math, can be discouraging. He said:

There’s a lot of pressure to succeed in school in this community, and I have seen students who have been pushed along maybe too far, too fast with their mathematical education in an effort to keep up with the Joneses, if you will.

At the same time, this teacher notes that a long family history of education and proximity leads students to pursue a four-year degree. Similarly, another teacher at the school mentioned that students have “grown up hearing the name” of local schools from their parents. A counselor also noted that “parents help support things like the engineering program.”

Participants at HSA also see the importance of parent and family backgrounds as influencing decisions about postsecondary plans. They see a dominant story in their area: “Background of their parents and grandparents plays a huge role” in this rural farming community. Students may need to be able to live at home and drive to campus for financial reasons. Parents do not take them to tour universities because they know they cannot afford it anyway.

Though only 20 miles from HSB, the family background and parental influence at HSC are perceived differently. One participant referred to the “generational poverty” of the area, while a teacher noted the trade background and lack of role models in other careers:

[The students] do have people that work in factories...Maybe there’s a few people that’s in the trades. And probably a bunch of them just work at Walmart. A lot of the people, they are in very disconnected families. Like I said, they don’t have role models.

In the rarer cases, in which a student does pursue a four-year degree directly out of high school, this teacher notes that they may actually have some parental influence or may be more motivated to envision different futures for themselves.

Environment—Community College Support Programs

Community college support programs in this county provide free tuition to any student with the requisite GPA for two years at the local institution. In general, these programs are intended as significant sources of money for any, or all, of their students to attend college. One participant from HSA talked about their child, a student in the school, being accepted to University 1 for a non-engineering major. However, given that CC1 had the same major, the student was also considering starting at CC1 for two free years through the community college support program. At HSC, the program is seen as a real opportunity for a group of students:

And so I've been really encouraging [community college support program] for a lot of them because I know that a lot of these kids like to work with their hands. They really like hands-on stuff. And if I can just get them into some of these technical classes at [CC1], instrumentation or welding or any other type of technical class, that they will probably do really, really well. So to get them out of there with the grades to get into there so they can go for free.

While still viewed as a significant source of financial aid and a great opportunity to attend college, participants at HSB view the community college support programs as intended for students who are seeking an associate's degree or who would later transfer to a four-year school:

A kid [who] has a shot that really may not have the money, or may even not go to a school where the resources are aligned to get kids who fall below, through the cracks or under the radar, into a school, can go to two years [engineering-technology major] at [community college] and automatically transfer into engineering at [local four-year].

Similarly, a counselor stated that such programs are good for all students, including those who want associates or certification and those seeking to transfer.

Environment—High School Programming Availability

Engineering-related programming is recognized as an important precursor to possible enrollment in engineering programs (Boynton et al., Under Review), inspiring particular attention to such programs. We broadly defined such programming to include advanced math classes, engineering classes, or other in-school programming opportunities associated with engineering. The participants clearly recognized differences in programming availability across the system's four high schools. A participant at HSB, a school viewed as well-resourced, said: "the kids at [HSC] and the kids at [HSA] just, you know, they don't have the offerings that the kids would have at [HSD]." Recall that HSD is the school that did not participate in this study. The schools with limited resources may have the option of busing to other schools, but the reality of that option is not appealing to students who would rather dedicate the time spent on a bus to earning credits toward graduation.

Differences were also perceived in the purpose of engineering-related programming. For example, students at HSC who take engineering class may not be oriented toward engineering. Many take it because of the hands-on projects or because they are interested in construction or design. Some are genuinely interested in engineering, but others just need another elective. This universal focus on helping students make post-high school plans is consistent with the idea that, for students who come from family backgrounds associated with trades, the priority tends to be postsecondary employment rather than postsecondary schooling. Conversely, at HSB the engineering class is treated like an introductory engineering course at the college level. There is still a mix of student motivations for taking the class, but the classroom culture is shifted toward wanting to be an engineer.

Environment—Role of Guidance Counselors and Teachers

The roles of guidance counselors and teachers are viewed similarly at HSB and HSA, but differently at HSC. Participants at HSB note that guidance counselors help students with college application processes, whereas teachers help students with career questions. A participant at HSB explained that, in particular, high-level math and science teachers talk about engineering with students, and students go to them with questions. He says the engineering teacher is a resource for students and parents interested in engineering: "I have a lot of parents that'll come in and ask or send me emails and say they really like your class. What could they do after high school that would be similar?" The teacher tries to steer students and parents in the direction of engineering schools. She sees her role as getting them excited about engineering and informing them of what's out there, but not to be their guide through the application process.

At HSA, participants also noted that counselors focus more on college than career goals. Likewise, they acknowledged the role of teachers as helping with career choices. However, instead of the science and math teachers, participants at HSA emphasized the CTE teachers' influences. Note that at this school, CTE includes programs such as "Project Lead the Way" and more trade-oriented classes. The principal commented, "I probably say our CTE, our career and technical education

teachers, probably play a pretty big role with students in terms of careers.” A teacher at the same school also said that teachers do career assessment activities with their students.

However, at HSC participants noted that “counselors help students think about jobs or interests and then what courses in high school are needed to take you there.” A participant stated that career counseling work starts with students during middle school:

But one of the things we’re doing in school system, is starting in middle school, seventh grade, we’re using a program called specific program name. And the counselor there will do a lot of career exploration with them and they will come to high school with a career plan.

Teachers are similarly aligned in helping students with career pathways.

Discussion, Implications, and Future Work

By integrating the results regarding outcome expectations and environmental factors, three important findings emerge: (1) relationships between outcome expectations and environmental factors vary across schools within the same system, (2) proximity to a postsecondary institution is not just about physical distance, and (3) messaging regarding career pathways matters. Each of these has practical implications but also set the foundation for future research.

Particularly salient in our results is the finding that outcome expectations and environmental factors are related but they vary even across schools within the same school district. Such stark contrasts across schools in the same division are consequential when critical decisions are made by local school boards with the intent to ensure equity across the division (e.g., school-by-school allocation of combined funding sourced by federal, state, and local levels). Plans for equity may not account for all salient considerations. For example, while access to resources such as advanced math coursework is enabled through division-wide busing, school personnel indicated that this is not a favorable option for many that would actually have to ride those buses. Similarly, school personnel identified various degrees of importance that division-wide aid programs, such as the community college access program, could play in supporting students within their school. The significant within-division variation across schools that we identified suggests that division-level analyses might unintentionally obscure important issues. For example, a division-wide mean percentage of students taking advanced math courses would misrepresent the bi-modal distribution suggested by the qualitative results (i.e., many students in HSB and HSD, and a few in HSA and HSC). Future research should disaggregate division-level to school-level data when possible to provide a more nuanced, accurate picture. Furthermore, school administrators and counselors working at schools impacted by issues, such as distance busing for access to advanced math courses, might leverage studies such as this one to advocate for alternative solutions that result in more equitable outcomes across schools within a given division.

Our study also suggests that while proximity to key resources such as community colleges and universities impacts postsecondary enrollment (e.g., distance elasticity discussed in Hillman (2016)), it is clear that factors beyond distance alone impact how proximity as a construct influences student choice. All of the high schools in our study are arguably located sufficiently close to any of the local postsecondary institutions. However, outcome expectations and environmental influences intersect, and enrollment patterns consistent with the postsecondary aims of students (as described by socializers) emerge. This finding is consistent with SCCT because perceived outcome expectations (e.g., college-going or immediate employment) might drive the decision-making despite readily available resources and support (e.g., close proximity to postsecondary institutions). Moreover, this finding confirms arguments that outcome expectations vary by group and career goals and actions (Turner et al., 2019). This finding suggests that, specifically for this case region and perhaps beyond, a focus on exposing students to local institutions may not be sufficient to make postsecondary enrollment seem more accessible. In addition to exposure, significant work such as sharing financial aid resources and cultivating the beliefs of school personnel and family socializers who shape student outcome expectations seems especially critical. School personnel looking to improve postsecondary outcomes for their students might use these findings to further consider possible relationships between outcome expectations and environmental factors in their own regions. SCCT and career pathway researchers could do the same.

Finally, our study suggests careful consideration of general versus career-specific guidance from school personnel, as well as appropriately messaged guidance for local outcome expectations and environmental factors. However, despite several engineering-focused questions, school personnel more often distinguished between general four-year institutions, community colleges, and vocational training than they discussed engineering as a specific subset of university or community college study. Therefore, efforts to increase enrollment in college or a specific major might require nuanced consideration of local factors. In recognition that high school students (e.g., Montfort, Brown, & Whritenour, 2013) and pre-K–12 teachers (e.g., Sengupta-Irving & Mercado, 2017) have different conceptions of engineering, and given efforts to broaden participation in engineering by minority groups, it would be valuable if school personnel could have more targeted conversations with

youth about engineering. At the same time, it is important to acknowledge that the literature suggests such a role could be a double-edged sword, once again depending on how outcome expectations intersect with environmental resources. For example, an influential math teacher might strongly encourage some students to pursue engineering without realizing that persistent implicit biases cause them to encourage more men than women to consider engineering as a possibility (e.g., Corbett, 2015). While the rapport developed between individual students and teachers can be a powerful positive force in student goals, narrow or biased views from these significant influences can limit or undermine student aspirations. In acknowledgment of these challenges, counselors and university administrators could collaborate to create documents that encourage broad and inclusive definitions of engineering and who might excel in the field, and appropriately communicate this to students considering the local context, specifically its outcome expectations and environmental factors.

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