People not Print: Exploring Engineering Future Possible Self Development in Rural Areas of Tennessee's Cumberland Plateau

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ABSTRACT

This study explores how students in rural areas of Tennessee's Cumberland Plateau area perceive engineering as a future career. This area is a portion of the greater Appalachian region, which has historically, faced disproportionate economic struggles when compared to other areas of the United States. However, little research on career choice exists outside of the coal producing areas of Central Appalachia. This research, in contrast, focuses on rural counties without interstate access, situated along the Cumberland Plateau in Tennessee, an area with an economy historically based in manufacturing.

This research focuses on understanding students' perceptions of engineering as a future career and on factors that support and inhibit the development of these perceptions. To understand these perceptions, the study used qualitative, semi–structured interviews, situated in a Social Constructivist worldview, informed by the Future Possible Selves framework. Participants include 27 high school students, 7 college engineering students, and 5 college students who had exposure to engineering through a formal program but are currently enrolled in another major.

Results of the study show that without access to formal programs or professionals to expose them to engineering, participants did not have a clear perception of engineering, and were not likely to pursue this career. Exposure through a formal program seemed to spark the start of engineering future possible self development by aligning engineering with activities participants enjoy. However, these participants often also believed that they lacked some key "ability" needed to become an engineer. Participants who had access to both formal programs and professionals were able to provide a clear description of potential engineering careers, aligning such careers with activities they enjoyed and, importantly, with desired attributes of their future. In addition, participants typically described relationships with professionals as mitigating the fear that an engineering career was beyond their "ability." These results provide evidence, that in this study area, printed materials and programs are not enough; people clearly make the difference in helping students develop a clear perception of engineering as a viable future career choice. This result has multiple implications for engineering educators and industries interested in K-12 outreach.

Dedication

In honor of my Grandmother

Mrs. Thelma Blackburn Boynton

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Chapter 1: Introduction

As reports such as *Rising Above the Gathering Storm* argue, although the United States has enjoyed a robust economy and led the world in innovation and technology in the modern age, globally; the advancement of communication and the economic development of many other portions of the world leave the United States struggling to remain an innovative leader (*Rising Above the Gathering Storm,* 2007). The building blocks for a strong economic future in the United States include not only a larger, but a more diverse, pool of students entering Science, Technology, Engineering and Mathematics (STEM) fields. The literature shows that strengthening this pool is not easy because barriers to recruitment can vary based on gender, socio-economic status, culture, and geographical limitations (Dick & Rallis, 1991; National Science Board, 2012; *Raising Public Awareness of Engineering*, 2002; Ross, 2011; Valla & Williams, 2012).

To contribute to this effort, the present study focused on students in the Appalachian region of Tennessee to better understand engineering as a career choice in this area given its cultural, economic, and geographic conditions. This study used a qualitative methodology to study career choice among high school and college students from a central, non-coal area of Tennessee. Participants include 27 high school students, 7 college engineering students, and 5 college students who had exposure to engineering through a formal program but are currently enrolled in another major. Each student in the sample participated in semi-structured interviews, which were analyzed through the lens of the Future Possible Selves (FPS) framework (Markus, 1986).

1.1 Need for this Research

Despite a long history of efforts to increase enrollment in engineering and robust research on career choice broadly, research regarding entry into engineering careers is limited. Previous work does show that barriers to STEM fields start early as students often begin to lose interest in science and math subjects as early as middle school (Faud, 1995; Gooden, Borrego, Edmister, Waller, & Watford, 2010; Hanesian et al., 2004; Valle & Steen, 1989). At the same time, work on both general career choice and engineering choice suggests that academic success, along with the advice of parents, peers, teachers, and mentors (referred to as socializers), are important for entry into the engineering field (Dick & Rallis, 1991; Jawitz & Case, 1998; Jawitz, Case, & Tshabalala, 2000). However, other work indicates that socializers often lack the experience necessary to inform students about an engineering career, thus increasing the difficulty of recruitment efforts (*Raising Public Awareness of Engineering*, 2002; Valla & Williams, 2012). Finally, previous research regarding barriers faced across gender, ethnicity, location, culture and other factors has identified a variety of barriers unique to each group studied (e.g., Goode, 2007; Holmes, Redmond, Thomas, & High, 2012; Marshall, 2008; McGee, 2011; Schultz, 2011; Slovacek et al., 2011; Trenor, 2008, 2009). Such work, described in detail in Chapter 2, suggests that increasing recruitment is a complex task that requires contextually relevant approaches based on robust, localized, empirical evidence – evidence we currently lack (*Raising Public Awareness of Engineering*, 2002; Valla & Williams, 2012).

One area that has seen limited engagement with engineering careers is the rural Central Appalachian region of the U.S. The Appalachian region of the United States

follows the Appalachian mountain range from southern New York to northern Mississippi. This region has historically struggled with low levels of education, high poverty levels, and outmigration of educated individuals (Lichter & Campbell, 2005). On the surface, the population appears to have an advantage of belonging to two historically privileged categories: approximately 85% white and mostly Christian (Lowry, 2002; Pollard & Jacobson, 2013). Career choice literature in the region is limited and typically focuses on Central Appalachian areas where coal and extractive industries are the main economic drivers as these have historically been isolated areas with high levels of poverty (Ali, 2006b; Bennett, 2008; Chenoweth, 2004).

Such research suggests that individuals in this region face challenges similar to other groups typically classified as minority, including students of color (McGee, 2011; Slovacek et al., 2011). As a result, Tang (2007) refers to Appalachians as an invisible minority because as a whole the region is predominately white. However, Appalachian's face challenges associated with racial and ethnic minorities. Tang (2007) suggests that this status has served to limit previous research and attention to distinctive needs and cultures within Appalachia. The need for locally meaningful approaches to strengthening the engineering pipeline, coupled with the limited research into career choice in rural Appalachia, makes this study crucial to the future recruitment of engineering students in these areas. In doing so, my goal is not to imply that all students in rural Appalachia should pursue a career in engineering, but rather to ensure that students in these areas have equal, meaningful access to engineering as a viable, accessible career option to expand their range of possible futures. This work, in particular, focuses on students from rural areas of the Cumberland Plateau in Tennessee, a non-coal area of Appalachia about

which there is little to no previous research regarding career choice. Findings from this study will aid future intervention and recruitment techniques by identifying barriers unique to the study area and more fully exploring the local context as it relates to career choice.

1.2 Purpose of the Study

To better understand why students in rural areas of the Cumberland Plateau are not choosing to pursue engineering careers, this study seeks to provide a better understanding of how students in rural areas of the Cumberland Plateau perceive engineering as a future career. To do so, I analyzed interviews with high school and college students from the study area, including those pursuing and those not pursuing engineering careers. This data includes information about the participants' experiences growing up in this area, how they view themselves in the future, and their access to information about engineering careers. Using the FPS framework to analyze the data, the following questions were addressed:

RQ1 How do high school and college students from rural areas of the Cumberland Plateau perceive their future career?

RQ2 How do these students perceive engineering as a career?

RQ3 What supports these students in envisioning and pursuing a future self that includes an engineering career?

RQ4 What inhibits these students from envisioning and pursuing a future self that includes an engineering career?

In conducting the study, I followed a Social Constructivist worldview to understand how the participants develop reality in relation to their future professions. The study

utilized rich, qualitative, semi-structured interviews to understand the experiences and perceptions of participants. The data was then manually coded utilizing a blend of a-priori and inductive codes. Each interview was then summarized, and a visual matrix was created to analyze the data. This process was used to categorize participants into three categories based on access to engineering and their intent to pursue an engineering career.

1.3 Significance of the Study

This work complements and extends previous research into Appalachian career choice that employed structured, often quantitative, instruments that typically omitted information related specifically to engineering and to localized areas such as the rural Cumberland Plateau.. The study provides a foundation on which stakeholders in the study area can build meaningful methods to strengthen engineering and expand students' access to engineering careers in general. Key findings indicate that generally students in the study counties have limited access to formal engineering programs and professionals, thus limiting their perception of the career. Students with exposure through formal programs and access to engineering professionals typically have a more defined perception of an engineering career, allowing them to make more informed choice regarding this career. These students' perceptions typically align engineering with activities they enjoy and attributes they desire in their future career. With this foundation in place, successful methods to recruit and retain future engineers in the study area can strengthen the entire area and more fully engage it in the STEM fields that have become central to the U.S. economy.

1.4 Limitations

This study has several limitations, including the recruitment process for high school participants and my personal bias. Recruiting minor participants in high school settings presented a challenge. Counties were selected for study and school officials were contacted to allow their school systems to participate, thus making recruitment dependent on a third party and limiting the number of study counties since not all schools contacted chose to participate. School personnel, teachers, principals, or counselors were then contacted to recruit participants at the school level. This approach led to some sample bias as the recruiter acted as a gate-keeper within each school, selecting students they deemed "appropriate" for the project. Often these "appropriate" students were very high-achieving college bound students with highly supportive families. While these students provided very rich data, this bias may have limited access to a full range of students from the study counties. Additionally, the word "engineering" in the recruitment letter may have limited the number of willing participants. This limitation may have discouraged students without an interest in engineering from participating in the study, particularly those with exposure but no interest in this career path. This limitation was addressed with the college sample, as students with exposure through formal programs in high school who chose another major, were recruited to understand factors associated with their career decisions.

Personally, I grew up in one of the small, rural counties on the Cumberland Plateau in Tennessee included in the study, and I have experience teaching engineering classes in high schools in the area. This introduces bias as some participants, particularly the college participants, were my former students. While this does present a limitation

regarding potential bias, it also was a strength as my connections allowed me access to the schools and college participants. The potential bias was introduced as these participants described their engineering exposure, and as I interpreted these experiences. I bracketed these experiences in an effort to derive meaning only from the data as described in detail in Chapter 3.

1.5 Overview of Chapters

In this chapter, I have provided a brief overview of career choice literature, the need to study career choice within rural Appalachia, particularly rural areas of the Cumberland Plateau, stated the research questions, and addressed the significance this study adds to the literature.

Chapter 2 presents a review of relevant literature, beginning with engineering career choice. This review includes previous studies of underrepresented groups across the globe. The chapter then moves to discuss prior career choice research in Appalachia and current conditions within the study area. The chapter concludes with a review of previous studies utilizing the FPS framework and qualitative methods for understanding students' perceptions of their futures.

Chapter 3 provides a detailed description of the study design, as well as details of the study area and participants. Data collection methods, including a specific look at the development of the interview protocol, are presented, along with analysis methods. Limitations of the study and presentation of researcher bias follow.

Chapter 4 provides the results from the study. Results common to all participants are presented, along with those specific to three categories of participants based on their level of access and intent to pursue an engineering career. Within each category, the

results describe participants' access to information about engineering, their perception of future careers, and barriers inhibiting engineering career choice.

Chapter 5 presents conclusions to the study. This chapter synthesizes the results across categories to provide answers to the four research questions of the study.

Chapter 6 presents the implications of the results. This includes a model providing a visual representation of supports and barriers to engineering future self development in the area. In addition, this chapter provides suggestions to stakeholders that may benefit from these results and how this research may be used to inform future intervention efforts.

Chapter 2: Literature Review

The literature review presents research that informs this study of engineering career choice in rural areas of Tennessee's Cumberland Plateau. The review begins by introducing previous research on engineering career choice, which highlights the need for locally developed, contextually relevant approaches to recruitment. Second, because this study treats rural Cumberland Plateau students as an underrepresented population that merits attention, the chapter then presents studies of other underrepresented groups to better understand the challenges faced by such populations. Third, to support the need to study Tennessee's rural non-interstate, non-coal Cumberland Plateau communities, the review of research on the study area is presented. Finally, literature on the FPS Framework is presented as an appropriate lens to better understand the barriers that exist between Appalachian students and an engineering career.

2.1 Engineering Career Choice

Efforts to increase STEM enrollment, including enrollment among historically underrepresented groups such as women and racial minorities, have been underway for many years. Studies date back to the early 1990's when Dick (1991) identified the need for academic success and support from parents, teachers, and other mentors. And these efforts have yielded some improvement in strengthening the STEM pipeline. Positive signs include higher numbers of students entering post-secondary education, more student participation in math and science courses, and higher high school graduation rates

(National Science Board, 2012). While these signs are positive, racial and ethnic minorities still display gaps in standard test scoring and graduation rates, and novice teachers are more prevalent in high poverty schools (National Science Board, 2012). To better understand these efforts and the persistent gaps, literature on career choice, career choice in engineering, and successful measures to date is presented.

How an individual chooses a career is complex and involves many factors including personal interest and ability, previous work-related experience, and financial and social supports (Lent et al., 2002). Barriers can include financial concerns, negative social influences, and role conflicts (Lent et al., 2002). Conversely, social supports, access to mentors, high self-confidence, and access to financial resources can support an individual in their pursuit of a desired career (Dick & Rallis, 1991; Lent et al., 2002). Successful individuals without these supports, or with negative social support, utilize a range of coping strategies to offset the barriers (Lent et al., 2002).

Factors influencing career choice into STEM fields specifically reflect those noted above. Dick (1991) indicates that the decision to major in a math or science intensive field comes through intrinsic and extrinsic values determined by past experiences. These experiences range from success in previous coursework to influences and expectations of socializers such as teachers, counselors, parents, and mentors (Dick & Rallis, 1991). Findings from Dick's study showed that both men and women who chose to major in engineering relied on the advice of parents and teachers, referred to as socializers, more than their peers (Dick & Rallis, 1991). Moreover, without early intervention and exposure, students can become disinterested in science and math, underestimate their

abilities, and develop misconceptions about what type of person achieves a career in a STEM field (Valla & Williams, 2012).

The results of such studies have led to multiple recommendations to strengthen the engineering pipeline. One consensus among researchers regarding recruitment is to start early. Multiple studies have shown that early intervention is imperative as students begin to lose interest in math and science, limiting their career paths early in their education (Faud, 1995; Gooden et al., 2010; Hanesian et al., 2004; Valla & Williams, 2012). The National Academy of Engineering recommends successful engagement of students in STEM subjects in grammar school (*Raising Public Awareness of Engineering*, 2002). However, Ross (2012) suggests that many early educators do not have the knowledge, attitudes, and behaviors to properly inform their students about engineering as a career choice. But Ross's work also showed that school counselors could pass knowledge on to teachers and students after intervention to increase their understanding of engineering (Ross, 2012). Thus, broad suggestions to strengthen the pipeline include better education of the public and educators, and a redesign of school curriculum to include engineering (Ross, 2012).

2.2 Studies of Underrepresented Groups in Engineering

Notably, however, while career choice information exists, no single method of recruitment has offered long term effectiveness (*Raising Public Awareness of Engineering*, 2002; Valla & Williams, 2012). Underrepresented groups have unique cultural, geographic, and demographic characteristics that make a single, monolithic intervention difficult. While studies provide recommendations, suggestions, and

description of interventions to strengthen STEM recruitment, the unique characteristics of different underrepresented groups clearly call for specific research into the barriers each group may encounter to effectively reach future engineers. A better perspective of these barriers can be seen in Table 2.1, which presents a representative sampling of studies across a range of populations to illustrate the frameworks, methods, and outcomes of studies on STEM career choices among underrepresented groups.

Table 2.1 Overview of Studies of Disadvantaged STEM Students

Study	Focus Area/Participants	Theoretical Framework	Methods	Findings
Trenor, J et al. (2008) Influences for Selecting Engineering: Access to Social Capital from Two Case Studies	Female engineering students	Social Capital	Qualitative-Case Study	Social Capital makes navigation through engineering easier for first generation female college students
Young, D et al. (1997) Factors Affecting Students Career Choice in Science: An Australian Study of Rural and Urban Schools	Rural vs. urban high school students in Australia	N/A	Mixed Methods	Students typically choose their careers based on experiences, family support, gender, available information, and value beliefs.
Goode, J (2007) If You Build Teachers, Will Students Come? The Role of Teachers in Broadening Computer Science Learning for Urban Students	Female, Latino, and African American students in Los Angeles, California	Social Reproduction /Social Change	Mixed Methods	Teachers are critical in recruiting more minority high school students into computer science.
Trenor, J. (2009) A Phenomenological Inquiry of the Major Choice Processes of an Overlooked Demographic: First Generation College Students in Engineering	First generation college students	Social Capital	Qualitative-Phenomenology	First generation college students often lack the social capital necessary to navigate college.
'McGee, E et al. (2011) You Would Not Believe What I Have to Go Through to Prove My Intellectual Value!" Stereotype Management Among Academically Successful Black Mathematics and Engineering Students	Black mathematics and engineering college students	Critical Race Theory, Micro-Aggressions, Stereotype Threat, and Stereotype Management	Qualitative- Semi-structured life story interviews	Stereotype threat exists in Math & Engineering, black students can learn to overcome. Intervention needs to help students manage.
Holmes, S et al. (2012) Girls Helping Girls: Assessing the Influence of College Student Mentors in an Afterschool Engineering Program	College female engineering students and Middle school female students	N/A	Quantitative-Post-Test Survey	Interventions can increase Math/Science confidence.
Slovacek, S et al. (2011) Minority Students Severely Underrepresented in Science, Technology Engineering and Math	College minority students (Asians Excepted)	N/A	Quantitative	Faculty mentors, and activities increase students confidence and make a PhD more likely
Marshall, A et al (2008) Adolescents Science Career Aspirations Explored Through Identity and Possible Selves	High school juniors in a biology preparation program in an urban secondary school	Social Cognitive Career Theory and Future Possible Selves	Qualitative	Classroom activities are important but family and mentor experiences are critical to career choice
Schultz (2011) Patching the Pipeline : Reducing Educational Disparities in the Sciences Through Minority Training Programs	Students supported by a Research Initiative for Science Excellence(RISE)	N/A	Quantitative Surveys	Minority students' participation in research as an undergrad increased persistence toward science careers

The tabular overview of studies shown in Table 2.1 includes first generation female college students, female students in the K-12 setting, urban and rural students, minority college students, and minority K-12 students (Goode, 2007; Holmes et al., 2012; Marshall, 2008; McGee, 2011; Schultz, 2011; Slovacek et al., 2011; Trenor, 2008, 2009). As Table 2.1 suggests, studies in this area employ both qualitative and quantitative methods, and they invoke a range of theories, including those drawn from career choice literature (e.g. Social Cognitive Career Theory), race studies (Critical Race Theory), social mobility (Social Capital), psychology (FPS), and other domains.

Similarities can be found across groups represented in Table 2.1. Findings across these studies show that access to support networks is critical. These support networks include teachers, mentors, and family, particularly those who are knowledgeable of and connected to STEM fields.

At the same time, some differences also emerge. For example, first generation college students across all groups often lack the social capital and support networks necessary to navigate the path to their desired career, while black students may face barriers associated with stereotype threat limiting their confidence levels in STEM fields. Female students may also experience barriers related to confidence, sometimes associated with stereotype threat, but not always, as they question their ability to succeed in STEM fields.

The following sections examine findings associated with different underrepresented populations in more detail to highlight both commonalities and

differences that demonstrate how barriers can be unique to a particular group of individuals.

2.2.1 First Generation Female Engineering Students

Looking at past studies, Trenor (2008) identified several factors indicative of first-generation female students' choice of engineering and science as a career path. The influencing factors included high confidence levels in math, a family member or friend who was an engineer, college-educated parents, and/or other strong role models (Trenor, 2008). For clarity, Trenor (2008) introduced Ava, the third generation college student, who was encouraged to enter engineering by her father, who was an engineer, and her mother, who found camps and other college visits for her (Trenor, 2008). Ava named six sources of encouragement to enter into the engineering field and indicated that employment would not be a problem upon completion of school because of her father's connections (Trenor, 2008). In contrast, Maria, another college student, named only middle school career day and the desire to seek high paying employment as motivators and, unlike Ava, did not have social capital to find employment upon completion of her degree (Trenor, 2008). Maria also expressed feeling like an outsider in engineering as she worked her way through school. Working also limited her ability to build social capital as a student (Trenor, 2008). While both students developed an interest in engineering in middle school, access to social capital made the path to graduation much easier for Ava. As a result, Trenor (2008) suggests pre-college access to engineering role models and activities to help first generation college students gain social capital as very important in recruitment and retention of first generation college students.

2.2.2 Rural Australian K-12 Students

Young (1997) found that students in rural Australia face challenges with role models similar to those faced by first generation college students, but also faced other obstacles associated with their cultures and geographic location. These challenges include a culture not supportive of higher education, a desire to stay close to home, a lack of information about and exposure to higher education, and a lack of peer support (Young, 1997). Influences of students' family, particularly mothers, and the SES status of the family were critical indicators of higher education success (Young, 1997). In addition, students in the rural areas expressed their understanding of the benefits of higher education, but realized that the careers stemming from higher education did not exist in their rural area (Young, 1997). This phenomenon left students with the reality that pursuing higher education also means leaving home, which many were unwilling to do (Young, 1997). Unlike FGCs, then, the challenge for these rural students was just as much geographic as social. Rural students often identified with outdoor careers that would provide work for them in the country due to their range of work experiences (Young, 1997).

Overall, Young (1997) identified three categories of factors that affected rural students' career choice: out-of-school, in-school, and personality types. Out-of-school factors include the support of friends and family, work experiences, career location, a reluctance to leave home, and other supporting influences. In school, teacher support and access to career information were found important. Personality factors include a desire to succeed, positive self-perception, and personal interests. The study concludes with suggestions for future research to provide more factors associated with career aspirations

of these unique groups, and states that students in rural communities should be provided with better access to a wider selection of career information and work experiences.

2.2.3 Urban Minority Students

Similar to struggles faced by rural and first generation college students, urban minority students often face limited career exposure, but that exposure may be specifically tied to available courses. For example, Goode (2007), in a study of female Latina and African American students in Los Angeles, found a strong divide in course offerings among schools based primarily on economic status; moreover, only a certain group of students were tracked into advanced computing courses at the high school level (Goode, 2007). Preliminary research indicated that low socioeconomic status (SES) students used computers more frequently but at a surface level, while higher SES students were more likely to utilize computers for higher level academic purposes (Goode, 2007). This tracking limits students' access to the exposure and mentoring available in advanced courses. In addition, students in high SES schools with fewer minorities were more likely to engage in Advanced Placement (AP) technology courses while students in other schools were likely offered a basic keyboarding course (Goode, 2007). Even in the high SES schools where AP courses were available, guidance counselors often acted as gate-keepers, tracking "appropriate" students into these courses and creating a barrier for low SES students (Goode, 2007).

In addition to the different affordances created by economic conditions, findings from the study also indicated that urban science teachers were often left with little training and support (Goode, 2007). Goode (2007) recommends that since many school districts have budget and time limitations for training, pre-service programs need to

implement more specific training to address issues minorities face in STEM curricula because teachers are on the front line in motivating students toward higher education (Goode, 2007).

2.2.4 Summary

As can be seen in Table 2.1, while there are some similarities, each group of students present unique geographic, cultural, academic, and socioeconomic attributes that make a single recruitment strategy impossible. Whether addressing issues of self-efficacy and identity faced by female students or geographic and cultural factors for rural students, effective outreach and intervention models need to adapt to the unique needs of the particular group. One common theme that emerges is the critical role "socializers" play in the recruitment and retention of students in engineering disciplines, but identification of key socializers and the kinds of support they need to provide varies as the socializing process appears to be heavily influenced by geographic, cultural, and economic factors. Thus, to understand how to effectively prepare socializers for underrepresented groups, we need studies to identify the barriers faced by individual populations.

2.3 Understanding the Study Area

In an effort to expand our understanding of local context, this study focuses on participants in Tennessee in an area commonly referred to as the Cumberland Plateau. Counties of interest in this area are classified as "rural" and "distressed" by the Appalachian Regional Commission (ARC), and do not have interstate highways in the county. Specific counties included in the study are Bledsoe, Clay, Jackson, and Pickett, shown in Figure 2.1. To better understand the selection of this area, the following

sections highlight key features of the Appalachian region of the United States and focus on the specific study area (rural Cumberland Plateau), with an emphasis on the rationale for selecting this area.

The drive to study career choice among rural Cumberland Plateau students stems from a combination of low economic and educational achievement levels in the area and a marked absence of students from the area in engineering careers. An ARC report released in 2011 paints a disturbing picture of economics across the entire Appalachian region (Appalachian Regional Commission, 2011). While the region strives to diversify its economy, there is a consistent lag of its economy behind the nation. Traditional industries such as mining, manufacturing, textiles, and paper and wood products are declining due to global competition. With the traditional industries in decline, the ARC is making targeted investments in human and physical capital across Appalachia, including diversification into professional and technical services and auto manufacturing. As a result, the period of 2000-2008 saw a 24.7% rise in Professional and Technical Services, but with this rise, employment shares are still very low in the region (Pollard & Jacobson, 2013). During the same time period, farming, forestry, manufacturing and utilities, which represent the dominant employment sectors, saw large declines, accounting in part for the current economic struggles in Appalachia (Appalachian Regional Commission, 2011). The region also sees some of the highest outmigration in the nation, creating concern over the number of available workers between the ages of 25 and 55.

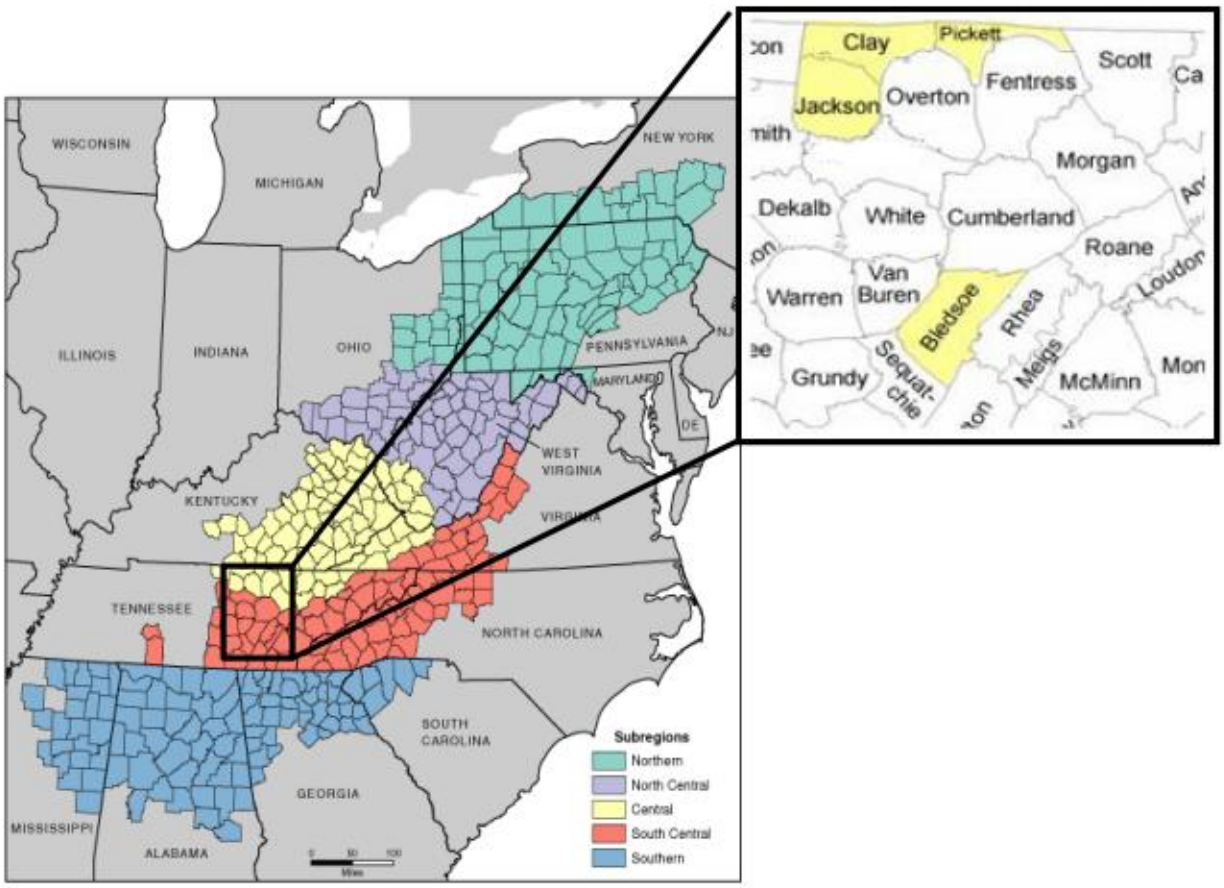

Figure 2.1 Map of the Study Area (Appalachian Regional Commission, 2013b; Map of Tennessee showing county names and boundaries, 2013)

Appalachia, shown in Figure 2.1, is a highly diverse region spanning from Northern Mississippi to Southern New York along the Appalachian Mountain Range. Data for the region often masks significant economic, cultural, educational, and social disparities. While various agencies within Appalachia have attempted to address this issue by defining "sub regions" and districts, such definitions often reflect political or geographic boundaries that continue to mask differences. As a result, educational levels, economic opportunities, cultures, and environment can vary greatly within these

categorical “sub regions.” Thus, studies of Appalachia need to define more meaningful boundaries.

Because this study focuses on the FPS of high school students, the area of interest is defined by counties, which serve as primary organizing units for K-12 education. In particular, the study focuses on four rural counties on the western edge of the Appalachian Mountain chain in an area commonly referred to as the Cumberland Plateau: Bledsoe, Clay, Jackson, and Pickett. All four are included in the ARC’s definition of Appalachia, feature cultural and demographic characteristics typically associated with Appalachia, and are economically and educationally below national and regional averages.

The study counties were selected based on their similarities across a range of variables not currently well-accounted for in existing career choice literature or studies of Appalachia: rural, “non-interstate,” non-coal counties. The fact that these counties do not rely on coal production as a main economic driver is significant given that coal mining has played a role in shaping the cultures and economics of much of the Central region of Appalachia. Much of the existing research on career choice in rural Appalachia focuses on coal-producing areas (e.g., Ali, 2006c; Chenoweth, 2004; Mcllmoil & Hansen, 2010). The economy in the study area, in contrast, historically has a stronger base in manufacturing, creating a different set of economic and cultural dynamics at play in students’ perceptions of available, possible, and desirable career choices -- dynamics not fully explored in previous studies.

The selected counties, moreover, are representative of a number of similar rural, distressed, non-interstate, and non-coal counties in the Cumberland Plateau area that may benefit from the findings of this study, including, but not limited to, Macon, Overton, Fentress, Scott, Morgan, DeKalb, Cannon, Warren, White, Van Buren, Sequatchie, and Rhea in Tennessee. Figure 2.2 shows both study counties and the similar counties. Exploring how students in this area view engineering as a future career can provide a more localized understanding of the kinds of barriers and supports available to them and thus assist future efforts to strengthen economies here and in similar areas throughout Appalachia.

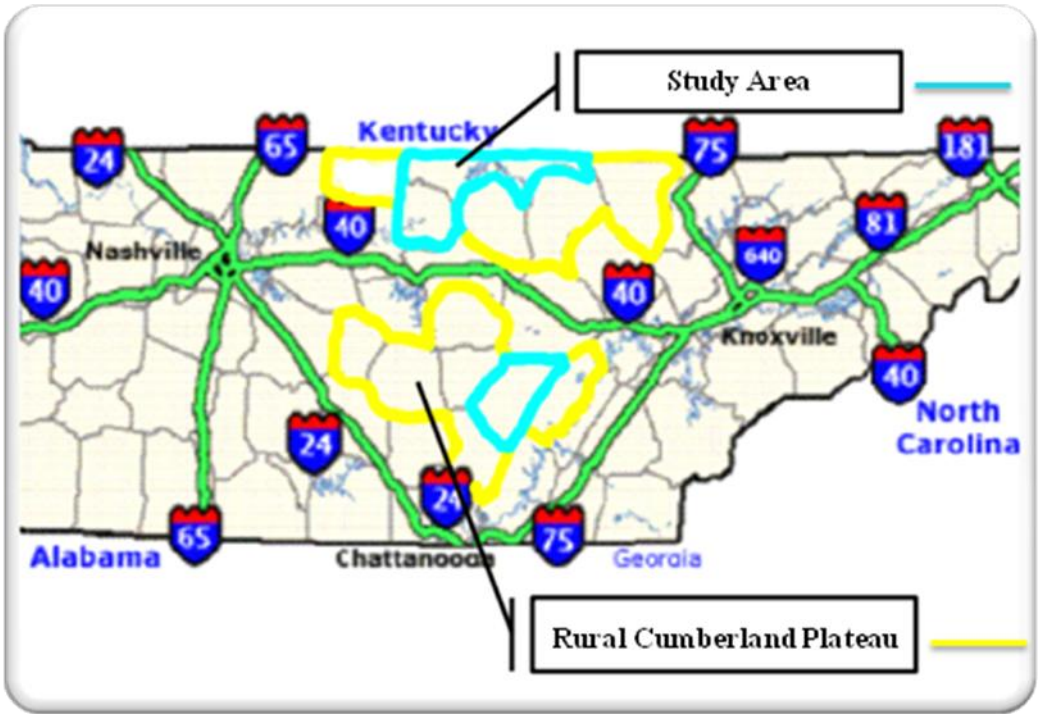

Figure 2.2 Rural Cumberland Plateau (Tennessee Interstate Highways Map)

Geographically, the Cumberland Plateau is less mountainous than areas typically associated with Appalachia such as those in Eastern Kentucky, West Virginia, East

Tennessee, and Southwest Virginia. This geography allows for better roads and more rapid access to populated areas than more mountainous sections of Appalachia. Better transportation networks have been described as critical in developing the Appalachian region by increasing access both within the region and to the rest of the country (Isserman & Rephann, 1995). This access is a link to more diverse career exposure, which, as noted earlier, has been shown to influence and broaden student's possible career paths (Carrico, 2013; Marshall et al., 2011). Access in this area can provide a broad range of exposure and future possibilities for individuals and allow the choice for individuals to remain relatively close to family and cultures. However, the study counties do not have interstate access, which creates economic and distance barriers. This limits access to economic opportunities, which in turn limits exposure to career options within these counties. This distance separates these counties from their neighboring counties with interstate access.

The counties under investigation lack access – access via an interstate, but also access to career choices for their children. To better understand how the counties selected compare to the United States and Appalachia as a whole with respect to key variables, Table 2.2 provides education, economic and population data for the U.S., Appalachia, and the four counties under study taken from the American Community Survey and the most recent reports available from the Appalachian Regional Commission at the time of this research (Appalachian Regional Commission, 2013a; U.S. Census Bureau, 2013) . The data show that, while similar to each other, these counties fall well below the country and the larger Appalachian region's averages in all categories. These counties have fewer college graduates in residence than the United States or Appalachia, with only approximately 10% of

individuals holding a B.S. degree or higher - well below the U.S. (28%) and the Appalachian region (21%). This area also struggles economically, with 19% of individuals in the selected counties falling below the poverty level and an average income of just over $32,000. In comparison, over 15% of Appalachians, as a whole, are below the poverty level and the median household income is below $43,000, while only 14% of U.S residents earn below poverty level and the average national household income is approximately $52,000. The study counties are also more rural. Appalachia has a population density of 122 persons/square mile, while the U.S. average is 86 persons/square mile; the counties under study fall well below each of these with an average of 34 persons/square mile. Finally, the counties studied exhibit far less racial diversity. Minorities comprise 16% of the Appalachian region, as compared to 35% of the U.S. population. The data are even more dramatic for the study counties; minorities comprise only 3.4% of the population in these counties.

Table 2.2 Education Level Data (U.S. Census Bureau, 2013)

Education Highest Level Attained	% H.S. Diploma	% B.S. Degree	% Below Poverty Level	Median Household Income $	Persons/Square Mile	% Minority
United States	49.6	27.9	13.8	51,914	86.1	35.3
Appalachian Region	54.8	20.7	15.6	42,498	122.3	15.7
Four Counties Selected Counties						
Clay County	40.2	10.8	19.9	28,682	33.2	3.5
Jackson County	43.1	9.3	22.9	32,846	37.7	2.2
Bledsoe County	40.9	9	21	35,137	31.7	5.9
Pickett County	44.8	11.9	17.1	31,157	31.2	2.1
Average of four county area	42.25	10.25	19.2	32,342	33.5	3.4
Difference of four county area and U.S.	-7.35	-17.65	+5.4	-19,572	-52.6	-31.9
Difference of four county area and App.	-12.55	-10.45	+3.6	-10,156	-88.8	-12.3

Table 2.3 offers a closer look at the counties under study, providing more details regarding the conditions within each county. Commuters in these counties report a mean travel time of 30 minutes, compared to 25.5 minutes nationally. Each county falls in ARC's lowest economic category of "distressed," based on a three year average of unemployment rates, per capita income, and poverty rates (Appalachian Regional Commission, 2013a). For example, in Bledsoe County, only a third of the population is of working age and employed. Educational data in Table 2.3 also portrays an image of schools with low populations, ACT scores below the national average, and high numbers of economically disadvantaged students (ACT, 2012).

Table 2.3 County Level Data (ACT, 2012; Appalachian Regional Commission, 2013a; U.S. Census Bureau, 2013)

County Data	United States	Bledsoe County	Clay County	Jackson	Pickett
Population	316,326,000	12,876	7,861	11,638	5,077
Mean travel time to work (minutes)	25.2	32.8	29.7	31	29
ARC County Economic Status(2013)	NA	Distressed	Distressed	Distressed	Distressed
INDUSTRY DATA					
Civilian employed population 16 years and over	140,399,548	4,211	3,154	4,146	2,336
Percent civilian employed population 16 years and over	44%	32.7%	40.1%	35.6%	46%
Agriculture, forestry, fishing and hunting, and mining	1.9%	4.6%	3.3%	4.0%	7.0%
Construction	6.1%	15.1%	13.6%	11.2%	12.2%
Manufacturing	10.4%	18.1%	13.6%	15.9%	15.7%
Wholesale trade	2.77%	0.3%	1.7%	3.4%	1.0%
Retail trade	11.6%	14.6%	13.2%	11.9%	6.1%
Transportation and warehousing, and utilities	5.0%	2.1%	5.1%	7.4%	8.7%
Information	-	1.6%	1.3%	3.2%	4.9%
Finance and insurance, and real estate and rental and leasing	6.6%	4.0%	2.6%	3.3%	5.0%
Professional, scientific, and management, and administrative and waste management services	10.7%	3.5%	3.1%	6.3%	6.1%
Educational services, and health care and social assistance	23.2%	18.3%	23.6%	26.8%	20.8%
Arts, entertainment, and recreation, and accommodation and food services	9.4%	5.9%	6.2%	2.0%	4.9%
Other services, except public administration	5.0%	4.6%	4.1%	1.2%	3.9%
Public administration	5.1%	7.4%	8.5%	3.5%	3.6%
EDUCATION DATA					
High School Population	NA	531	287	458	197
% Considered Economically Disadvantaged	-	70.6	66.9	66.7	55
2012 Graduation Rate(%)	-	81	96.1	90	96.2
2012 ACT Composite	21.1	19.3	18	17.3	18.9
2012 ACT Math	21.1	19	17.8	17	18.7
2012 ACT Science/Reasoning	20.9	19.5	17.7	17.3	19.1

With respect to employment options, industry data in Table 2.3 shows that unlike much of Central Appalachia, mining is not a primary source of income. In fact, agriculture, forestry, fishing, hunting, and mining represent a very small percentage of the workers in the study counties. Traditionally, the study counties have relied on manufacturing as the primary employment sector (Smith, 2012). Recently, however, the primary employment sector has transitioned toward educational services, healthcare, and social assistance, moving manufacturing to second. Construction and Retail Trade also employ a large percentage of workers in this area, while science, engineering, and technical related careers make up a very small percentage of the workforce. Together, these characteristics are indicative of economic and educational struggles attributed to rural Appalachia.

2.3.1 Engineering along the Cumberland Plateau: Access and Opportunities

Despite the apparent challenges, however, the study area also provides opportunities. The study area is centrally located between three of the state's largest metropolitan areas - Nashville, Knoxville, and Chattanooga. As opportunities are discussed, "area" opportunities refer to this geographic area including Nashville, Knoxville, and Chattanooga unless otherwise stated. While the counties under study do not have direct access to an interstate, interstates and other highway networks are in proximity to the counties and connect the area to the metro centers, as seen in Figure 2.2. As previously described, this connection provides individuals residing in the study area access to multiple educational and employment opportunities within commuting distance, 1 hour, of their home. These opportunities include higher education institutions, engineering opportunities, and the potential for future expansion.

With respect to higher education, Tennessee Technological University (Tennessee Tech), located in Putnam County Tennessee, is within a 1-hour commute of most portions of the study counties. While Tennessee Tech is the closest engineering school for most portions of the study area, engineering can also be found in universities in Knoxville, Chattanooga, and Nashville, providing access to multiple higher education options within a two hour commute (100 miles) of the study area. Schools in these cities include the University of Tennessee, Vanderbilt University, and the University of Tennessee at Chattanooga. These schools all offer accredited engineering programs in many disciplines.

The broader area also offers employment opportunities for engineers within commuting distance of the study counties, with numerous opportunities in the middle and eastern portions of Tennessee (Nashville, Knoxville, and Chattanooga). Bledsoe County is situated in Southeast Tennessee in proximity to Chattanooga and surrounding areas, where opportunities include the Volkswagen automotive plant, the Tennessee Valley Authority, and many others. Currently, hydropower is produced in the area through the Tennessee Valley Authority and the Corps of Engineers along the network of lakes and rivers in the area. In addition, other opportunities for engineers exist in Putnam County, in close proximity to Jackson, Clay, and Pickett counties. This area offers several manufacturing facilities including Oreck, Russell Stover, and Flow Serve. In addition to these highly visible opportunities, Chattanooga, Cookeville, and other towns within the area offer opportunities with small engineering firms, state agencies (environment, transportation, economic development), and other facilities.

Moreover, current needs for economic development identified by Smith (2012) offer additional opportunities, including expansion of infrastructure to remote areas, expansion of

businesses, diversification of the economy, and unification of the larger community toward common goals. Much of Appalachia, including the Cumberland Plateau, is working to diversify its economy, and energy represents a key development sector – a sector tied directly to engineering (Energy Workforce Trends and Training Needs in Appalachia, 2011; Smith, 2012). The construction of the Wacker plant, a facility to purify silicon for solar cell production, is a current example of this diversification in Southeast Tennessee. These efforts may create even more opportunities for students to pursue technology-related careers and still remain close to home, thus making the idea of engineering as a career choice even more relevant. Moreover, the energy sector, or any technology-based industry, includes opportunity for multiple professions. These industries not only need engineers who develop and design, but include supporting roles such as electricians, construction workers, business professionals, laborers, and many other professions.

Diversification of the current economy within the study area includes, and may rest on the shoulders of, engineers in the future. Universities and community colleges in the broader area have the potential to educate a diverse workforce, including engineers; who are key in this diversification. Reports from both the ARC and Upper Cumberland Development District agree that innovation and entrepreneurship are the key to developing new and sustainable industries that can help the region grow, and engineers are often entrepreneurial leaders with the necessary skill to support such innovation (Energy Workforce Trends and Training Needs in Appalachia, 2011; Hixon, Paretti, & Lesko, 2012; Smith, 2012).

To illustrate this potential, in a personal interview, Mrs. Lillian Hartgrove, economic development Vice President, at the Cookeville Chamber of Commerce

described efforts to utilize Tennessee Tech's College of Engineering to make the Upper Cumberland a headquarter location for engineering and design (Hartgrove, 2012). She described a successful venture in Putnam County that services the unique market of spy equipment to customers worldwide (Hartgrove, 2012). She described this successful company, which employs approximately 50 engineers, as a prime example of the potential that exists in the area (Hartgrove, 2012).

Tourism offers another development avenue that could create engineering opportunities. With respect to the four counties under study, Dale Hollow Lake provides Pickett and Clay counties with over 3 million visitors per year and approximately 14 million in revenue between the two counties (Dyle, 2012; The Economic Impact of Travel on Tennessee Counties, 2011). Jackson County is also located along the Cumberland river and Cordell Hull lake, but receives much less tourism and only approximately 2 million in revenue (Dyle, 2012; The Economic Impact of Travel on Tennessee Counties, 2011). Bledsoe County includes portions of Fall Creek Falls State park, one of the state's largest and most visited parks, but only reports 3 million in tourism revenue (The Economic Impact of Travel on Tennessee Counties, 2011).

Despite this potential, Mrs. Ruth Dyle, Executive Director of the Upper Cumberland Tourism Association, described the cultures of the area as not accepting tourism as a "real" industry because it does not align with the traditional work of manufacturing that has historically sustained the area. She then described the need to educate the public on the benefits of tourism, describing tourism as an industry that could not be exported and that supports countless jobs including service, entertainment, dining, construction, and infrastructure support (Dyle, 2012). Dyle (2012) also described tourism

as an industry that enhances the local community, builds infrastructure, and adds services without adding the burden of supporting a larger population. Growth of infrastructure, in particular, relies on engineering as a critical component of growth as the profession supports building, construction, planning and utilities.

Whether through tourism, the energy sector, spy equipment, or a currently undeveloped market, the ARC and Upper Cumberland Development District describe education, innovation, unified goals, and entrepreneurship as key ingredients in diversifying the Appalachian region's economy. Engineering has the potential to be a key support profession to each of these endeavors. Engineering is not the sole answer to the problem, but a strong engineering workforce in the area could provide the innovation and technical leadership necessary to support diversification. The work engineers produce will create jobs for multiple professions from attorneys to laborers helping to diversify an economy and cultures.

2.3.2 Summary

The Appalachian region of the United States has historically faced many economic challenges and many rural areas of Appalachia still struggle with low educational attainment, correlating with higher poverty rates and lower income levels. This area is currently struggling to build a stronger and more sustainable economy, but doing so depends heavily on effective education and training. For those efforts to be successful, high school students need to be willing and open to pursue careers that have not been part of the their local economy. Creating that willingness, and helping students make informed choices about their future careers, requires first understanding how students see their own futures and how they currently understand career options such as

engineering. But such understandings are always locally influenced by the communities and cultures where students grow up. While the counties under study reside on the border of Central and South Central Appalachia as defined by the ARC, such broad definitions fail to account for the needs of these rural counties. Understanding how rural students from the Cumberland Plateau view engineering as a future career will assist efforts to reach potential students and further diversify the economy of this area.

2.4 Future Possible Selves as a Framework for Exploring Career Choice in Appalachia

2.4.1 Future Possible Selves

As explained in Chapter 1, the proposed study will explore perceptions of engineering career choice among students in Tennessee's rural Cumberland Plateau communities using the FPS framework. The framework, first proposed by Marcus and Nurius in 1986, provides a means to represent "individuals ideas of what they might become, what they would like to become, and what they are afraid of becoming" (Markus & Nurius, 1986, p. 954). Markus and Nurius (1986) explain that individuals are free to create any variety of possible selves, but those possibilities are derived from social experiences: "an individual is free to create any variety of possible selves, yet the pool of possible selves derives from the categories made salient by the individual's particular socio-cultural and historical context, from the models, images, and symbols provided by the media, and by the individual's immediate social experiences" (Markus & Nurius, 1986, p. 954).

FPS is salient to rural Appalachian youth because of its strong connection to socio-cultural factors in shaping future possibilities and because of the link between available role models and the ability to envision future careers. As previously described, rural Appalachian youth have a strong rural cultures and often limited experience with a full range of career-related experiences, which may inhibit their abilities to develop visions of themselves in the future as engineers. Looking at this population through the lens of FPS provides an understanding of how individuals in the study area connect past experiences with their plans for the future, how these students construct realities associated with their future, and the factors and barriers that influence their choices. To better understand how FPS relates to the study of rural Cumberland Plateau youth and their future career choices, the following work examines how the framework has been utilized across other at risk or underrepresented populations.

2.4.2 Future Possible Selves in Action

Markus and Nurius (1986) are credited with the development of Possible Selves as a framework (Kerka, 2003). Since the initial article was published in 1986, the framework has been used to study a wide variety of participants across multiple settings, addressing participants with various backgrounds, economic statuses, and living conditions. The following sections highlight findings from several of those participant groups.

One of the leading scholars in FPS is Daphne Oyserman, who often focuses on inner city youth. Her studies have used FPS to examine how inner city youth view their future, how this view is constructed, how intervention changes this view, and how this view affects their decisions and paths in life (Kao, 2000; Oyserman, 1995, 2002;

Oyserman, 2004b; Oyserman, 2006, 2007; Oyserman, Terry, & Bybee, 2002). Findings from these studies indicate that the lens through which adolescents make sense of the world has a large impact on achievement (Oyserman, 1995). For example, Oyserman found that eighth grade youth whose academic possible selves provide them a better road map were more successful in school (Oyserman, 2004a). She also found that interventions associated with enhancing students' vision of their possible selves can positively impact academic achievement, moderate the effect of low parent involvement, increase interest in doing well, and help male students create less trouble at school (Oyserman, 2002, 2006, 2007). In addition, Oyserman (2002) reported that an intervention aimed at helping students imagine themselves as successful adults resulted in students acquiring a more balanced set of possible selves. A balanced possible self occurs when an individual has clear vision of feared and hoped for possible selves; balanced selves are important because they provide additional motivational resources to strive for the hoped for future and avoid the feared future (Oyserman, 1990b).

In addition to inner city youth, which include multiple races, studies have used the FPS framework to better understand the possible selves development of specific groups of minority students in a range of different settings (e.g., Perry & Vance, 2010; Pizzolato, 2006; Yowell, 2000, 2002). For example, Yowell (2002) found that ninth grade Latino students identified a gap between their dreams and perceived realities of their future states. Perry (2010) indicated in his study with urban youth of color that boys were more likely than girls to indicate lower occupational prestige. Pizzolato (2006) studied possible self construction processes in college students of color from low income communities and found that to be successful, students need to maintain community, family, and peer

relationships. Such studies show the need for high career self-efficacy and enhancement of minority students' view of possible selves throughout community and family networks.

The framework has also been used to study the role that gender plays in the development of FPS, and specifically how career decisions are influenced by gender roles (Brown & Diekman, 2010; Chalk, 2005; Kerpelman, 2002; Lee, 2007, 2009; Robinson, 2003; Shepard & Quressette, 2010). Gender influences career choice among all groups, but that influence varies with the individual situation. For example, Brown (2010) found that men and women college students' feared future roles were congruent with their respected gender. He found that women focused more on family while men focused on career (Brown & Diekman, 2010). In contrast, Lee (2007) found that low income mothers focused on caring for children and making ends meet. As a result, the study suggests welfare programs and policies would better serve women's long term interests if they addressed the educational possible selves of low income women (Lee, 2009).

Rural populations similar to the study area have also been studied by a limited number of researchers utilizing FPS, with most studies focusing on rural women. Findings from these studies indicate that participants from rural settings often lack exposure to multiple career options, report few occupational future selves, and often report a general lack of hope (Robinson, 2003; Shepard, 2003; Shepard & Quressette, 2010). For example, Shepard and Quressette (2010) found that rural adolescent women reported few occupational and educational future selves. These adolescents described mostly personal attributes, but could say little about school and work pursuits, reflecting a lack of exposure to various careers (Shepard & Quressette, 2010).

Collectively, these studies demonstrate the ways the FPS framework has proven beneficial in understanding how individuals from various underrepresented or at-risk groups view their future state. These future states are influenced by a number of factors, ranging from rural students lack of exposure to career options to low income mothers' focus on the present need to feed their children (Lee, 2009; Robinson, 2003).

2.4.3 Approaches to Studying Individuals' Future Possible Selves

In addition to understanding how FPS relates to rural Cumberland Plateau youth, it is important to understand how the FPS framework has been used, and the results of various methodologies and approaches. While the FPS framework can provide rich description from participants linking their situation to their perceived future state, the measures used to study participants possible selves determine the depth of description captured in the study. The FPS of participants have been measured utilizing a variety of techniques. Methodologies used by past researchers include qualitative, quantitative, and mixed method approaches. The following sections provide an overview, along with representative studies, of each of these approaches.

2.4.4 Qualitative Approaches

Studies intending to understand how certain conditions influence individuals' future aspirations often use a qualitative approach to explore the participants' perspectives. Many studies following the FPS framework utilize qualitative methods (Packard, 2006). Among these, Packard (2006) reviewed 141 articles detailing FPS research and identified four methodological clusters: structured survey and interview methods, narrative methods, visual methods, and drama methods. Of the clusters, the

structured survey, notably the Possible Selves Questionnaire by Oyserman (2004c), remains the most common (Packard, 2006).

The FPS Questionnaire, (Appendix A), is a qualitative measure that asks participants to list what they expect to be next year and their actions directed toward those goals, then to list what they would like to avoid next year and their actions directed toward those goals. Oyserman (2004c) describes coding schemes to be used for analysis of the possible selves, providing strategies for successful coding of expected positive, negative, and balanced possible selves. Expected selves are coded for items such as achievement, relationships, and personality traits. Feared selves are coded around the same topics, focusing on feared attributes of the description. The entire codebook appears in Appendix A, along with the questionnaire. The questionnaire and codebook method have been utilized broadly in possible selves research and influenced qualitative, quantitative, and mixed method variations to understanding an individual's future ambitions. One advantage of this structured survey method, as seen in the mixed method approaches, is the ability to administer the measure to a large number of participants (Packard, 2006). That said, the one-on-one format is more likely to yield complete responses from certain participants, including adolescents and the elderly (Packard, 2006).

Narrative, visual, and drama methods are less frequently utilized in qualitative FPS studies (Packard, 2006). Narrative methods involve asking participants to respond to questions about their future in written narrative descriptions. Open-ended narrative methods have been shown to provide rich description of possible selves by allowing the participant to tell their story. Visual methods, although rarely used, allow the participant

to represent their possible selves through imagery rather than limiting the description to verbal or written responses (Packard, 2006). Drama methods invite participants to act out their possible selves. This method is often used with children, allowing the participant to express possible selves through actions rather than written or spoken word. Such approaches are particularly helpful for participants who may not have language to describe their future vision. While this method may enhance data collection, it is often seen as difficult and time consuming to administer and properly analyze (Packard, 2006).

Despite innovative visual and dramatic approaches, though, the FPS Questionnaire remains the backbone of most studies following the FPS framework, including those researchers who desire to develop the rich, in-depth data that interviews can provide (Marshall, 2008; Pizzolato, 2006; Shepard, 2003). For example, Pizzolato (2006) used the FPS questionnaire to develop hour long semi-structured interviews to understand how students of color from a low income community constructed their college student possible selves. These interviews were transcribed and codes emerged to suggest that these students' possible selves developed as a way of avoiding their feared possible self (Pizzolato, 2006). Similarly, Marshall (2008) studied urban adolescents' career goals related to STEM fields, again using semi-structured interviews along with the Possible Selves Mapping Process, an innovation that utilized visual aids to assist in engaging youth participants (Marshall & Guenette, 2011; Marshall, 2008). Participants in this study were 16-17 year olds in a biology career preparation program from multiple backgrounds in an urban school. This study was longitudinal and multiple interviews were conducted with participants over time. The study indicates that while classroom activities are important, mentoring, experiential learning, family influences, and relationships with

professionals are critical in developing career related possible selves (Marshall, 2008). Similarly, Shephard (2003) examined the possible selves of eight rural female adolescents, age 17-19, from the interior of British Columbia using the Possible Selves Mapping Interview. Findings indicate that the rural participants focused on personal attributes and relationships as their primary possible selves, indicating a lack of exposure and knowledge of the world of work (Shepard, 2003).

2.4.5 Quantitative Approaches

While most studies utilizing the possible selves framework tend to follow a qualitative approach adapted from Oyserman's questionnaire, Markus and Nurius (1986) introduced the possible selves framework with results from a quantitative survey. The initial quantitative survey was derived from the responses of a study in which the researchers asked students to "tell us what about what is possible for you" (Markus, 1986, p. 958). This survey consists of a list of 150 possibilities for the future in six categories: the self, physical description, life style, abilities, occupation, and how others' opinions matter (Markus, 1986). Each of the possibilities includes positive, negative, and neutral possibilities, resulting in a determination that "individuals can reflect on their possible selves and that these selves are not identical with descriptions of their current or now selves" (Markus, 1986, p. 959).

This questionnaire is often referred to as the Closed End Possible Selves Questionnaire, and has been used by other researchers since its introduction. The questionnaire is often used in conjunction with other quantitative measures to better understand how different aspects of life influence possible selves. One such pairing can be seen in Dunkel (2000), where he paired the closed-end possible selves measure with

an identity status classification. Perry (2010) simply applied a Likert-type scale to the level of education students hoped for, then paired this data with a peer belief scale to conclude that peer beliefs were not related to career and educational possible selves. Other quantitative studies following the FPS framework follow this same pattern, pairing quantifiable measures of participants' possible selves with other measures such as personal attributes, occupational interest, school success, or self regulation (e.g. Chenoweth, 2004; Oyserman, 2004a; Perry & Vance, 2010).

2.4.6 Mixed Method Approaches

Finally, many studies utilizing the FPS framework follow a mixed methods approach, in which quantitative methods are used to gather information about large numbers of people, then use qualitative methods to gather information in more depth from some or all of the participants. The qualitative portion tends to focus on understanding how the participants view their future following the FPS framework.

Leonardi (1998) followed this approach with a sample of 289 high school students from a neighborhood of lower and middle class families. The questionnaire utilized existing quantitative instruments to analyze self-esteem, motivation, and persistence. Additional student data, such as grade point average, was also used to predict school performance. FPS were then obtained with a qualitative open-ended item in which students wrote a short essay to describe themselves in the future. Results showed that students were able to provide a rich description of their positive future selves and less elaborated images of negative selves. Females generally outperformed their male counterparts academically, but provided evidence of lower self-esteem. Results indicate that students with a clear imagination of a positive self in the future were more successful

academically (Leondari, 1998). A similar approach was utilized to study the possible selves of low income mothers (Lee, 2009). This study involved 327 participants recruited from a welfare office and job training programs. Quantitative measures included demographic information and implementation of previously developed measures of work - family conflict and self efficacy regarding managing work and family (Yowell, 2002). Possible selves of the participants were again assessed with the open-ended measure, in this case the one developed by Oyserman (2004c). Results indicate that mothers in job training programs were more focused on job-related possible selves than mothers recruited from the welfare office (Lee, 2009). Similarly, to study the relationship between Latino student's conceptions of their futures with their risk for school dropout, Yowell (2002) utilized quantitative data from a large sample and in-depth interview data from a smaller subset. Survey items measured educational and occupational possible selves, risk for school dropout, and background characteristics. A sub sample of 30 students then participated in hour-long qualitative interviews to further investigate participants' possible selves (Yowell, 2002). The findings showed that Latino students demonstrate a gap between their hoped for and expected selves, and that their feared selves were indicative of academic performance. Interview data, providing more depth in description, showed that specifics and beliefs within the possible selves of the students were critical in determining the academic performance of these students (Yowell, 2002).

These examples illustrate mixed method approaches to identifying individuals' possible selves. Quantitative approaches are appropriate for gathering specific information from large groups of individuals and can link possible selves to other constructs. Qualitative measures provide a more detailed and rich description of an

individual's perception of their future and can identify key contextual factors and provide more honed individualized possible selves definitions.

2.5 Selection of a Qualitative Approach

While many studies exist that identify college aspirations, career aspirations, vocational aspirations, college expectations, and other post-secondary activities of Appalachian individuals, these studies typically utilize existing instruments to gain a quantitative measure of the issue (Ali, 2005, 2006c, 2008; Ali & Saunders, 2006; Chenoweth, 2004). These studies provide useful information about the lives and challenges facing Appalachian individuals based on known constructs, but no study directly identifies the social and cultural barriers Appalachian students face in choosing engineering as a career. This gap points to the need for qualitative inquiry to more fully explore these cultural and social dimensions.

Qualitative methods give researchers the ability to understand participants' experiences and how they construct meaning. Creswell (2009) describes qualitative research as exploring and understanding meaning interpreted from data gained from individuals and groups. Value is found in qualitative research, particularly open-ended questions, by understanding the world through the views and realities of the respondents (Patton, 2002). This methodology allows researchers to understand the points of view of other individuals without predetermining these points through previously identified categories, making it well-suited to the proposed study (Patton, 2002).

More specifically, as described by the Social Constructivist worldview, human beings have the capacity to interpret and construct their reality, which is shaped by

cultural and linguistic constructs (Patton, 2002). Social constructivists develop meaning from participants by listening to how they describe their life setting (Creswell, 2009). Previous studies using the FPS framework implicitly adopt this view, even when not stated, by seeking to understand how individuals view their possible selves through interviews in which the participants express their meaning and experience (Marshall, 2008; Patton, 2002; Pizzolato, 2006; Shepard, 2003). Similarly, utilizing a semi-structured interview protocol will help to understand how these students view an engineering career in their future and will provide interested stakeholders with the necessary information for future work with this population.

2.6 Conclusion

Literature on engineering career choice shows that strengthening the pipeline to produce more engineers is not a homogenous task. No "one size fits all" approach exists for recruitment of students into the engineering pipeline. Suggestions point to strengthening engineering curriculum in K-12 settings, but teachers often resist as they have little experience and understanding of the engineering field. In addition, Dick (1991) shows that strengthening education is not enough because students need a range of socializers including teachers, parents, and mentors. Underrepresented groups are even more complex as they often face challenges related to culture, demographics, gender, and other factors unique to their situation. Prior research suggests that Appalachian students demonstrate characteristics of many of these underrepresented groups, but look like historically successful Americans, leading Tang (2007) to refer to Appalachian as an invisible minority. Despite low levels of educational and occupational attainment in this

population, however, very little research into career choice has been done in this area. The FPS framework has been used to understand how individuals, particularly those from underrepresented or low-achieving populations, form their future, and thus provides an appropriate lens to view the challenges faced by this "invisible minority."

Chapter 3: Methods

3.1 Overview/Introduction

This chapter describes the design of this study. The section begins with an introduction describing this work and its relation to a larger project currently underway. The following sections then provide a brief overview of the study area, participant information, data collection methods, and analysis methods.

Data for this work is taken from a larger study currently underway within the Engineering Education Department at Virginia Tech. The study, entitled "Understanding Barriers to Engineering as a Career Choice Among Appalachian Youth," is referred to as the EIA (Engineering in Appalachia) project in the remainder of the chapter. Funded by the National Science Foundation, NSF Grant Number EEC-123269, the EIA Project, seeks to develop a theory of rural Central Appalachian students' low participation in engineering majors and identify potential interventions. This dissertation is drawn from data collected during Phase 1 of the project, which involved semi-structured qualitative interviews with high school students, college students, and working professionals in the engineering field. As discussed in Chapter 1, this dissertation study uses the FPS, following a Social Constructivist worldview, to understand how Appalachian students in rural areas of Tennessee's Cumberland Plateau make career choices and answer the following research questions:

RQ1 How do high school and college students from rural areas of the Cumberland Plateau perceive their future career?

RQ2 How do these students perceive engineering as a career?

RQ3 What supports these students in envisioning and pursuing a future self that includes an engineering career?

RQ4 What inhibits these students from envisioning and pursuing a future self that includes an engineering career?

Establishing answers to these research questions will help stakeholders understand challenges and opportunities these rural Appalachian students face in choosing a career. By understanding students' perceptions, we may be able to design more appropriate and effective interventions for this unique population.

3.2 Study Design

To address the research questions, this study uses a qualitative design following a social constructivist approach. Following this approach, the study uses the theory of FPS to understand 1) how students from rural Tennessee counties along the Cumberland Plateau have constructed perceptions of their future educational and career selves, and 2) how these perceptions influence their career choices, particularly relative to engineering. Participants consist of high school students and college students from the rural areas of Tennessee's Cumberland Plateau. College students include those majoring in engineering and those who were exposed to engineering in high school who are currently enrolled in another major, as described in section 3.4, the latter population is particularly important because they describe factors other than lack of formal exposure that influenced their

choices. To better understand methodology for the study, the following sections describe Social Constructivism and the overall study design in greater detail.

3.2.1 Social Constructivism

As noted earlier, this work seeks to understand how students from rural areas of the Cumberland Plateau make career choices, and specifically how they perceive engineering as a career. A better understanding of how this perception intersects with students' views of their future self will aid stakeholders such as guidance counselors, teachers, and college recruiters in developing outreach methods in this and other areas with similar cultures. A useful worldview to frame the study is Social Constructivism. The following section describes Social Constructivism in more detail, providing a description of constructed reality, how this reality can be investigated, and its alignment with studying engineering career choice in rural Appalachia.

The intent of Social Constructivism is to make sense of the meanings individuals have of the world (Creswell, 2007); this perspective posits that meaning is negotiated socially and historically and formed through interactions, and cultural norms (Creswell, 2007; Crotty, 1998). This meaning is viewed as relative to time and place and cannot be generalized across settings (Patton, 2002). Social Constructivism is based in the premise that the human world is different from the natural or physical world in that it is not an objective, measurable reality, but one shaped by cultural and linguistic constructs (Patton, 2002). This constructed reality, however, is perceived and experienced as "real" by individuals and is real in its consequences (Patton, 2002).

Research that uses Social Constructivism as its worldview seeks to study the realities constructed by individuals and how these realities influence their lives (Patton,

2002). It assumes the reality is constructed by individuals as they seek understanding of the world in which they live and develop meaning from their past experiences, and it becomes "truth" as consensus is negotiated among individuals in dialogue with their familial, social, professional, and other communities. It thus takes a broader and less clearly bounded view than methods such as phenomenology. (Creswell, 2007; Patton, 2002). Phenomenology, which is grounded in Social Constructivism, seeks to understand how individuals construct reality around a clearly bounded phenomenon such as how first generation college students experience the first year of college (Creswell, 2007; Trenor, 2009). Social Constructivism, in contrast, addresses how individuals construct and act on the social realities that are less clearly bounded. Because the process of constructing future selves and selecting careers is complex and embedded in an array of localized social, cultural, and economic factors and experiences that accumulate over time, the broader scope of Social Constructivism makes it a useful framework for this study.

To explore how individuals construct reality, social constructivist researchers focus on participants' perceptions of the broad situation under study (Creswell, 2007; Creswell, 2009), the historical and cultural setting where these perceptions were formed, and how these perceptions influence participants' reality (Creswell, 2007). To obtain these perceptions, researchers interact with participants, often in the field, (Crotty, 1998); interviews that seek to solicit participant's views, meanings, and realities are thus a common and effective form of data collection. Interviews allow the researcher to hear what participants have to say about their world as they describe their reality and how it shapes their actions. Data analysis then seeks to understand the meanings participants have constructed. Bias potentially enters into the study as researchers' past experiences

inadvertently shape interpretation and meaning (Crotty, 1998). To reduce such bias, social constructivist researchers continually return to the data representing the participants' perceptions of reality and ensure that the analysis reflects the participants' rather than the researchers' meanings (Creswell, 2009; Crotty, 1998). Development of a codebook for data analysis is a critical process to reduce bias and ensure accuracy in the analysis process.

3.2.2 Study Design

In the context of this study, understanding participant perceptions about possible engineering careers in rural areas of the Cumberland Plateau is critical in answering the research questions. Utilizing a Social Constructivist worldview and FPS to frame the study allows participants' perceptions of their future to emerge in data generated through semi-structured interviews. Notably, the FPS framework is rooted in a social constructivist perspective as it seeks to understand how participants envision their future (Markus, 1986; Patton, 2002). The interview data reflect the participants' perceptions, "truths," explanations, beliefs, and worldviews regarding their future career choices. Investigation of college age participants helps to explain consequences of these perceptions as students progress toward their hoped-for future.

Figure 3.1 below shows the overall design of the study, which relies primarily on interview data, with additional insights provided by county, state, and regional demographic data.

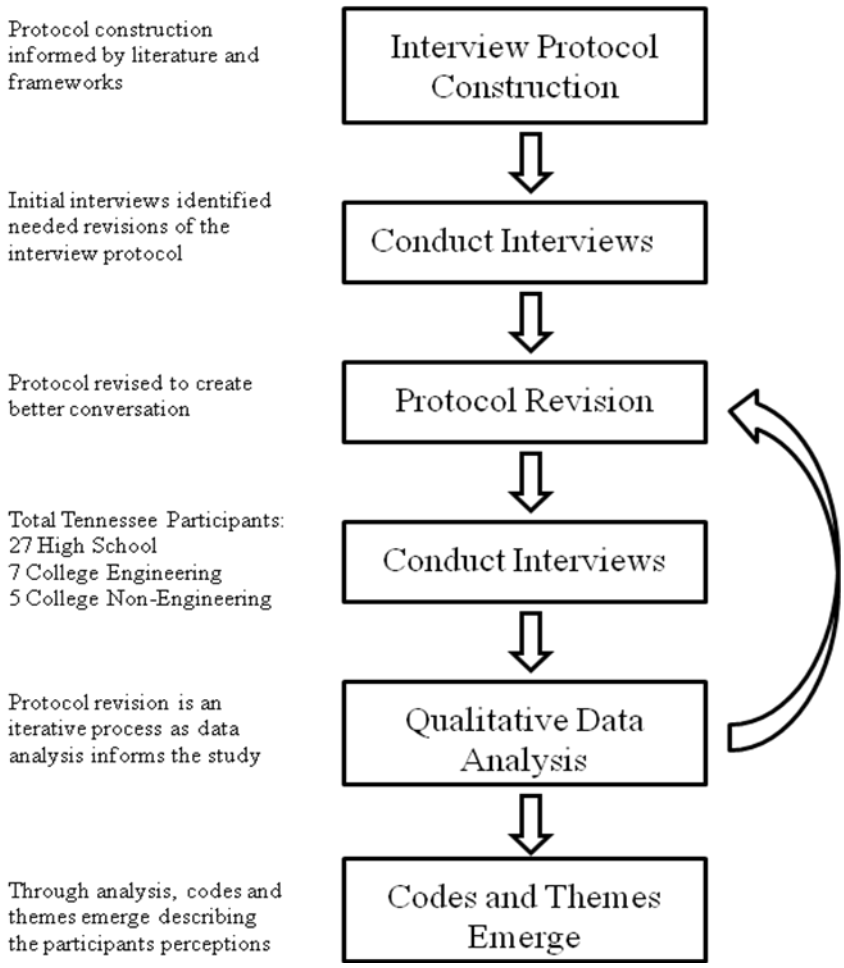

Figure 3.1 Visualization of Qualitative Design

The first phase involved creating the interview protocol. To serve the full scope of the EIA project, the interview protocol was informed by both FPS and Social Cognitive Career Theory (SCCT), along with prior research on career choices among Appalachian youth (e.g. Ali, 2005, 2006a, 2008; Chenoweth, 2004; Lent, Brown, & Hackett, 1994; Markus & Nurius, 1986). Pilot interviews informed revision to the initial protocol before a broader set of interviews was conducted. The EIA project included interviews in both southwest Virginia and middle Tennessee, and, as noted above, employed multiple analytic frameworks. This dissertation includes only participants from rural counties of

Tennessee's Cumberland Plateau and uses only the FPS framework for analysis; for work relating to the SCCT component, and the Virginia participants, see the dissertation entitled Voices in the Mountains: A Qualitative Study Exploring Factors Influencing Appalachian High School Students' Engineering Career Goals by Dr. Cheryl Carrico (Carrico, 2013).

Data analysis included an iterative process that started with an initial codebook with high level codes derived from previous literature and the FPS framework. This codebook informed a second iteration of coding involving a more direct application of the FPS framework. These derivations informed a final codebook and method in which the data was manually coded utilizing a blend of a-priori and inductive codes derived through these iterations. Each interview was then summarized and a visual matrix was created to analyze the data. This process was used to categorize participants into three categories based on access to engineering and their intent to pursue the career, a process described in detail in section 3.6. Care was taken throughout the process to ensure that reliable and trustworthy data emerged from this study to reflect the voice of participants. This care is reflected in the thorough description of the methods used throughout the study seen in the following sections. Section 3.7 reflects this care as I describe my bias to ensure that my interpretation of the data reflects the voice of the participants.

3.3 Area of Interest

As described in detail in Section 2.3, this study focuses on participants in area commonly referred to as the Cumberland Plateau in Tennessee. Counties of interest in the area are classified as “rural” and “distressed” by the Appalachian Regional Commission (ARC), and do not have an interstate in the county (non-interstate). Specific counties included in the study are Bledsoe, Clay, Jackson, and Pickett. A full description of these counties appears in Section 2.3; key details are briefly summarized here.

As noted earlier, this area has been selected as it represents a subset of Appalachia with very little previous research around career choice. This study area demonstrates very low participation in higher education (10% B.S. degree attainment), high rates of poverty (19%), low population density (34 persons/square mile), and is predominately white (3% minority). The area’s economic base is centered on manufacturing, in contrast to other rural areas of Appalachia commonly studied where coal production is dominant. Tables 2.2 and 2.3 provide detailed data on the achievement and employment variables for the selected counties.

This study area is also of interest to me personally because I am from, and have numerous family ties, to the area. I grew up in a rural community on the Cumberland Plateau in Bledsoe County. Many of my family members are educators and have dedicated their careers to serving students in this area. After completing my B.S. in Civil Engineering and practicing in industry for a few years, I found myself pursuing my M.S. in Civil Engineering at Tennessee Technological University in Cookeville, Tennessee while teaching engineering courses utilizing the Project Lead the Way curriculum in

Jackson and Clay counties. Thus better understanding students' choices and increasing their access to a broader range of career opportunities is a strong personal goal during this dissertation study.

3.4 Participants

3.4.1 Sample

Following advice presented by Creswell (2007), criterion sampling was used in selecting participants for each category of the study. Criterion sampling is used to ensure that the participants meet the criteria for the study. For example, the Tennessee study counties were selected based on location, demographics, and access. As previously described, the four counties selected for study with high school students represent a unique subculture of Appalachia. These counties represent demographics and geography associated with other areas of Appalachia, but with industry not heavily reliant on coal and extractive technology, and with notably lower levels of education and higher levels of poverty.

While criterion sampling identified several representative Tennessee counties for recruitment, the four counties chosen for study resulted from my relationships with school personnel and administrators. This access and support ensured access to high school participants in the four distressed counties and identified representative demographics from which to choose college participants. Through these relationships, contacts in each high school were identified to assist with recruitment of participants. These contacts included principals, guidance counselors, and teachers. Each contact was

presented with information about the study and proper parental consent and student assent forms. As is common in research involving K-12 students, recruitment of high school students was left to these contacts because they have direct contact with students and parents/guardians to disseminate invitations and consent for participation. Contacts were asked to provide a representative sample of students from their school. Sample size and participant experiences varied within each of the schools, as shown in Table 3.1. The pool of participants ranged from 5 students in Jackson County to 8 participants each in Bledsoe and Clay Counties. A total of 27 high school student interviews are included in this study.

Table 3.1 Tennessee High School Participants

High School Participants by County				
County	2012 Students	Male	Female	Total
Bledsoe	531	3	5	8
Clay	287	3	5	8
Jackson	458	4	1	5
Pickett	197	2	4	6
Total		12	15	27

College students were selected using the snowball approach in which initial college students, who met the study criteria, helped in soliciting additional participants for the study (Miles & Huberman, 1984). Criteria for the college students included students from one of the four counties who were either majoring in engineering or had formal exposure to engineering in high school and currently enrolled in another major. Using this approach, administrators and teachers from the high schools in the four counties assisted in recruiting previous students. Through these participants' connections,

other college students from the area were recruited to participate in the study. Importantly, the snowball technique yielded participants from counties throughout the Appalachian region of Tennessee, including counties outside the bounds of this study. Following the criteria for this study, however, only those college students from within the selected counties are included for data analysis. As shown in Table 3.2, this method provided 7 college students pursing engineering degrees and 5 college students with prior exposure through a formal program but now in another major.

Table 3.2 Tennessee College Participants

College Participants by County				
County	Engineering	Male	Female	Total
Bledsoe	Yes	2	-	2
	No	-	-	0
Clay	Yes	3	2	5
	No	-	3	3
Jackson	Yes	-	-	0
	No	1	1	2
Pickett	Yes	-	-	0
	No	-	-	0
Total		6	6	12

Participants were added as the analysis proceeded in an effort to reach saturation with respect to the findings to develop meaning and present an exhaustive description of the participants' perceptions of their FPS (Creswell, 2007; Patton, 2002). Table 3.3 shows the total participants in each category.

Table 3.3 Tennessee Interview Participants

Rural Cumberland Plateau Interview Numbers			
Category	Male	Female	Total
High School	12	15	27
College – Eng	5	2	7
College - Non-Eng	1	4	5
Total	18	22	39

With saturation achieved, these participants demonstrate what students, across career paths, desire in their future careers and factors that enhance their association between engineering careers and these desires.

3.4.2 Participant Protection

To ensure the protection of participants, the research protocol and all supporting documents were submitted to Virginia Tech's Institutional Review Board (IRB) prior to interviewing participants. IRB # 12-444, was approved and any subsequent alterations to the study were submitted as amendments throughout the interview process. As a part of the IRB process, directors from each county school system involved in the study submitted support letters. In addition, because I was also employed as an adjunct faculty member at Tennessee Technological University during the course of data collection, a parallel IRB was approved by Tennessee Technological University on September 26, 2012. Participants under the age of eighteen provided both parental consent and the minor student's assent before participating in the interview. The Institutional Review Board of Virginia Tech requires the assent of able minor participants; this assent is not legally binding, but without permission from the child and parent the participant must be removed from the study. Two researchers (myself and a female researcher from the EIA

project) were present during each of the high school interviews as an additional safeguard for the participants and researchers.

3.5 Data Collection

3.5.1 Use of Semi-Structured Interviews

As detailed in Chapter 2, the Appalachian community has been described as an invisible minority in previous research (Tang & Russ, 2007). Limited research has been done regarding career choice in Appalachia, and no exhaustive studies are available to describe engineering as a career choice in this area. Without previous research to guide inquiry, this study used qualitative, semi-structured interviews to explore engineering career choice in this area. Interviews are the primary collection tool utilized with the FPS framework when studying populations without extensive prior work, and a common method for social constructivist approaches generally (Creswell, 2007; Packard, 2006; Patton, 2002).

Although some FPS studies use a structured approach, this study employed a semi-structured protocol to provide both consistency and flexibility in the interview process and to create a discourse or conversation involving interpersonal engagement between the researcher and participant (Langdridge, 2007; Valle & Steen, 1989). Structured interviews may save time, but they elicit more narrowly constructed stimulus-response type interactions (Valle & Steen, 1989). In a semi-structured interview, the researcher poses open-ended questions, shifting the power in the conversation to the participant as the researcher accepts and values how the participant frames responses

(Rossman & Rallis, 2012). Semi-structured interviews, for this research, are designed to follow categories established by the researcher while simultaneously establishing rapport and seeking to explore participants' beliefs about their futures (Rossman & Rallis, 2012).

The protocol allows the researcher to ask open-ended questions and probe for responses from the participant, allowing the researcher the flexibility necessary to explore participants' experiences and perceptions (Rossman & Rallis, 2012). This approach also aligns well with the oral, storytelling culture of rural Appalachia. Glen (1995) describes the use of oral history in the region to learn how people understand their past and present conditions as particularly effective. Finally, the semi-structured approach is well-suited to work with young adults; Rossman (2012) discusses the need to be flexible when interviewing young adults, describing past studies where delicate probing throughout the interview was beneficial. Similarly, Freemen (2008) provides tips from an attorney's standpoint on interviewing minors in a short handbook, including establishing strong rapport, keeping questions simple, refraining from using words not easily defined, framing questions in terms of the participants' experience level, and monitoring time as minors attention spans are often shorter than adults. When employing a semi-structured protocol, however, it is the responsibility of the researcher to monitor the interviewing strategies and be prepared to make adjustments as necessary for the benefit of the research and participant (Rossman & Rallis, 2012).

3.5.2 Protocol Development

Following advice from Langdridge (2007), questions for the protocol were developed by combing the literature to establish key issues in rural Appalachia to be explored, forming the overarching structure of the interview; these issues included rural

Appalachians' desire to remain close to family, low education levels limiting available mentors, traditional physical working conditions, and lack of confidence in acquiring higher education, as noted in Chapter 2. Topics within the protocol also include two central frameworks of the EIA project, FPS and SCCT. The questions were structured to flow logically and naturally (Langdridge, 2007).

Pilot interviews were conducted with high school students, college students, and working professionals that informed protocol revisions. Interviews with working engineers informed the overall protocol, but were not included in the analysis because students were better able to reflect on their perceptions of an engineering career and the experiences that result in these perceptions than professionals currently in an engineering career. The protocol was restructured through multiple EIA team meetings to ensure quality (Carrico, Boynton, Matusovich, & Paretti, 2013). Initial structuring of the protocol began with the participants' plans for the future, then shifted to the current setting tracking toward these future plans. However, the pilot interviews showed that participants struggled to frame their future plans early in the interview. Shifting the interviews to flow chronologically through time, beginning with discussion of their current situation (e.g. high school participants are asked about school); and asking about future plans near the conclusion of the interview provided more insight into the factors that shaped the participants' future decisions and richer descriptions of the participants' FPS. In addition, engineering is intentionally not addressed early in the interview to allow the topic to emerge with each participant. However, pilot interviews also showed the need to include a probe about engineering when discussing the participants' career plans if the topic had not emerged. This probe helped to uncover the participants' exposure to

and understanding of engineering as a career choice, and was especially useful when participants had little understanding of the engineering field.

Table 3.4 provides the general structure of the interview and sample questions used for both high school and college students. Note that questions are not neatly divided into FPS, SCCT, and Appalachian issues. Rather, questions were developed to capture salient dimensions of each of these frameworks while providing conversational flow. Complete high school and college protocols are provided in Appendix B.

Table 3.4 Interview Protocol Sample

EIA Interview Protocol Sample		
Timing	**Focus**	**Question/Prompt**
Past	**Home/Cultures**	Where did you grow up? Tell me what it was like growing up there/here? Are there any other key people who influenced you in your life and why? Growing up, what kind of jobs did some of the adults you know have?
Present	**Career Plans**	What type of job are you considering? Why? Does the location of the job matter to you? Why? Is there a job or a career that you wish you could pursue, but can't? Have you ever thought about engineering or technical jobs as a career choice for you? or Why are you thinking of engineering or a technical job?
Future	**Future Possible Selves**	So, we have talked about your plans. Imagine yourself in 10 years…Describe what your life is going to be like? Who do you want to be? What do you want your job or career to provide? What do you expect to become? What is most exciting about your future? What do you want to avoid? What scares you most about the future?

The protocol begins by building rapport with the participant before discussing childhood, geographic location, family, and mentors. This portion of the interview explores participants' past experiences to understand childhood experiences and how they relate to career choice. Questions in this portion of the interview are largely based in the Appalachian literature and explore how cultures, family, and geography influence perception. These questions are also framed by SCCT, which provides insights into career choice through constructs such as interests, supports and barriers, outcome expectations, and choice goals.

The protocol then moves to the present. This section asks the participant to describe jobs or careers under consideration, and is particularly influenced by FPS protocols such as those developed by Oyserman (Oyserman, 2004b). Relating to previous work in Appalachian literature, seeking to understand how the perceived location of the future job influences career choice is important. Appalachian literature demonstrates the desire for participants to remain close to family (Bennett, 2008). It is also important here to understand previous experiences the participants may have had with engineering. In addition, self-efficacy and other barriers are explored by asking participants if jobs exist that they cannot pursue. As this portion of the interview concludes, participants who have not mentioned engineering are probed about this career choice. This question allows the researcher to determine the participants' previous exposure to and understanding of an engineering career. It also represents an intersection of frameworks in the protocol as environmental factors associated with rural Appalachia (SCCT) are explored to determine how these influence perceptions of hoped for and feared future states (FPS).

The interview then transitions to the participant's future, asking them to imagine themselves in 10 years. This time frame was often adjusted so that participants were visualizing themselves in their career of choice. This portion of the interview is most directly influenced by the FPS framework (Markus & Nurius, 1986). The questions are modified from the FPS Questionnaire developed by Oyserman and previously used in several studies to determine how underrepresented youth made choices about their future (Marshall, 2008; Oyserman, 1990a, 1993; Oyserman, Bybee, Terry, & Hart-Johnson, 2004; Oyserman et al., 2002). This portion of the interview explores how participants' experiences have shaped their view of the future. Probes are in place to determine hoped for and feared FPS, since both aspects of the self provide motivation toward an end state (Oyserman, 1990b).

Though following the same general structure, the protocols for high school and college populations differ slightly to reflect the current situation of participants. After initial rapport building, the high school protocol focuses on the students' current situation and interests in school before transitioning into discussion of their home/cultures. The college protocol, in contrast, explores the participants' current setting, their major, and reasons for their choice prior to exploring their home/cultures. Thus high school students discuss college plans near the end as they describe their future, while college students discuss major choice and career selection as a current situation.

3.6 Analysis Methods

As indicated in Table 3.3, the data set for this study includes interviews with 27 high school students, 7 college engineering students, and 5 college students who had

exposure to engineering through a formal program but are currently enrolled in another major. High school and college participants span the four counties in the study area. Each of the interviews was audio recorded and transcribed verbatim to produce transcripts for analysis. Analysis of the transcripts focused on answering the research questions, building an explanation of how students in this rural Appalachian area of Tennessee perceive engineering as a future career, and identifying supports and barriers to this career choice. The richness of qualitative data allows explanatory and causal relationships to be determined without randomized and controlled experiments (Miles & Huberman, 1984). The findings are supported by direct quotations from the data to ensure reliable and trustworthy results (Patton, 2002).

3.6.1 Coding

Coding of the data took place through an iterative process to reach a final codebook and set of results. Similar to the process described by Miles and Huberman (2014), an initial list of codes was developed from previous literature, the conceptual framework, and the research questions. Similar to most previous research following the FPS framework, this initial codebook, seen in Appendix C, was influenced by Oyserman's FPS Questionnaire. This initial coding took place with the qualitative analysis software MAXQDA. Through the use of initial codes, I met with the EIA team multiple times as data was collected and transcribed to review and discuss initial results. Miles and Huberman (1984) describe this procedure as very beneficial as it allows the researcher to identify blind spots and enhance the interviewing strategies, leading to better quality data.

Through review within these meetings, coding was revised to more fully utilize the FPS codebook developed by Oyserman (2004c). This codebook can also be viewed in Appendix C. The codes presented in the FPS codebook were used across time intervals to capture how a participant's culture and past influenced perceptions of their future self, including engineering. This coding process also utilized MAQQDA software. While this process provided a useful perspective, the results did not fully align with the research questions or effectively capture the local perspectives regarding how these participants view engineering as a career, so a final round of analysis was conducted.

The final codebook was developed using the codes developed through prior analysis, but then manually reviewing each transcript and creating a summary sheet for each participant. This summary was initially informed by previous literature, the conceptual framework, the research questions, and results of previous coding. Additional codes were added inductively throughout the process to fully develop the summary sheet and codebook. Miles et.al (2014) supports the process of inductive coding as beneficial when uncovering a local factor. This process transformed the initial summary sheet into a useful tool to ultimately answer each of the research questions. Table 3.5 displays the final codebook, with the associated summary sheet available in Appendix D.

Table 3.5 People not Print Codebook

People not Print Codebook		
Code	**Definition**	**Example**
Community	**Description of the participants' local community.**	*Very safe area* *Don't ever lock the doors* *People are nice*
Home/Cultures	Description of the participants' home life particularly related to education and career.	*Parents very supportive of education*
School Culture	Description of school culture particularly related to higher education and engineering as a career.	*Small school, teachers know students and care about their success*
Personal Connections	Participants' description of relationships within their community.	*Everybody knows everybody*
Geographic Location	Description of the participant's geographic location including physical characteristics of the area and proximity to resources such as entertainment, education, and careers.	*Long distance to the movie theatre/store*
Access to Information	**Includes description of career exposure through formal and informal experiences and personal connections.**	*Ag Department discusses engineering in courses related to building.*
Formal Program	This code includes description of any formal program or activity that introduces engineering. This code can include a course, camp, or other formal event credited with providing engineering exposure. In addition this code captures any description of exposure provided by the program.	*School offers dual credit courses and PLTW engineering classes*
People	This includes description of people described as a career mentor. These codes include discussion related to any professional credited with providing exposure to a future career.	*Met engineers through summer internship.*
Primary Support	This includes people that the participant credits as their primary source of personal exposure or support to a future career.	*Father, an electrician stresses the importance of a degree in electrical engineering to avoid physically demanding work.*
Local Careers	This includes parent/family careers and associated education level, careers in the local community, location of these careers, and careers/jobs directly experienced by the participant.	*Factory workers, many factory workers displaced when local factories closed.*

People not Print Codebook		
Code	**Definition**	**Example**
Future	**Participants' description of their perception of their future.**	***Stable employment, good income***
Hope For Future	Description of the participants desired future self.	*use science for the general good of people.*
Career	Description of the participants intended future career.	*Nuclear Engineering*
Career Attributes	Attributes the participant associates with their intended future career.	*variety, financial stability,area opportunities*
Personal Attributes	Desired attributes of the participants' future self.	*parent, provider, independent*
Future Location	Information associated with the participants' desired future location.	*don't want to leave family or place, will commute to work if necessary*
Future to Avoid	Description of the participants' feared future self.	*failing classes, slaving for low pay*
Career	Description careers the participant hopes to avoid in the future.	*Save-A-Lot bag boy*
Career Attributes	Attributes of a future career the participant hopes to avoid.	*physically demanding, monotonous*
Personal Attributes	Attributes of a future self the participant hopes to avoid.	*drugs, alcohol, dependent*
Fears	Fears associated with the participants' future.	*uncertainty, limited career opportunity*
Confidence	Indications of the confidence level the participant displays related to their intended future career.	*low ACT scores in math has participant questioning engineering as a career choice*
Barriers	Any description of a barrier that the participant perceives in pursuit of their hope for future.	*never been good in math*
Engineering Perception	Any description of engineering as a career presented by the participant.	*building, designing, mechanic*
Alternate Career Perception	Any description of careers (other than engineering) presented by the participant.	*Nurses "help"*
Reasons	This category includes reasons associated with future career choice. This can include any factors including actions by people, financial considerations, Interests associated with the career, location/availability of higher education, and/or any other motivating factor related to the career of choice including actions to avoid.	*help others, make things better, financial security, area opportunity*

I analyzed a printed copy of each transcript, filled out a corresponding summary sheet, and then created a visual matrix of the data. Upon completion of the analysis, my visual matrix allowed me to synthesize the data across participants while still seeing the whole story for each participant. Miles and Huberman (2014) describe a number of benefits to such a visual representation of qualitative data (Miles et al., 2014). These benefits include the ability to systematically analyze large data sets and create organized displays for dissemination of results. In this case, visual representation helped organize the data coherently, identifying the portions of data necessary to address each of the research questions. This matrix was created using Microsoft Excel, with each participant representing a horizontal row and codes representing vertical columns. An additional benefit of the matrix is in presentation of results (Miles et al., 2014). Portions of the matrix accompany the results throughout Chapter 4 and can be reviewed in tables 4.1-4.3. These tables do not include the participants' county as the combination of data could identify the student.

3.6.2 Categorization

In addition to providing a useful tool to present the data, the matrix allowed me to see patterns within the data and cluster similar participants into categories (Miles et al., 2014; Patton, 2002). These patterns that emerged shape the presentation of results in Chapter 4 and allowed the localized perspective of this data to emerge. These patterns resulted in clustering participant views of their community and desired attributes of their future, patterns that are truly influenced by the geographic and cultural influences in the study area and are common across all participants. In addition, participants were clustered into three categories based on their access to formal programs and professionals and

intent to pursue engineering as a future career. The combination of coding full transcripts by hand on paper, which allowed insight into the participants entire story, and creating the Excel matrix for visual representation of the data yielded quality results that were then used to answer the research questions of this study.

The three categories found through analysis of the visual matrix are a foundation of the study findings. As mentioned, these three categories were developed based on access to formal programs and professionals. Access is defined as an encounter with the field of engineering. These encounters are separated into those occurring through formal programs and those occurring through interactions with professionals. Formal programs can include in-school or extra-curricular activities. Professionals include individuals with the experience necessary to support engineering career choice. Intent is then categorized based on a participant's verbalization of their desire to purse an engineering career in the future.

To develop the three categories, access and intent were each divided based on the level of access and the intent to pursue. Participants categorized as having minimal access typically reported little to no experience with formal programs or access to professionals. Those participants with access include those who reported an in-school or extra-curricular activity that provided engineering exposure and/or a relationship with a professional that resulted in the development of a perception of an engineering career in their future. Intent to pursue an engineering career was determined simply based on the participants' verbalization of their intended career during the interview and was determined through the "future career" code presented in Table 3.5.

The three categories that emerged among this group of participants include: Category 1, Minimal Access-Minimal Intent to Pursue an Engineering Career, Category 2, Access-Minimal Intent to Pursue an Engineering Career, and Category 3, Access-Intent to Pursue an Engineering Career. Notably, no participants with minimal access described intent to pursue an engineering career, eliminating the use of a possible fourth category, Minimal Access-Intent to Pursue an Engineering Career. While participants fitting this fourth category may exist in the study area, none were part of the interview pool; as a result, the study offers no insights regarding whether these participants exist or how they might fit into the final model of engineering future possible self development. The three categories that did emerge were sufficient to categorize the participants within this study. For simplicity, the categories are often referred to as simply "Category 3", or "Access-Intent" in the remainder of the work.

Importantly, while intent to pursue was easily defined in the data, some participants presented more complex boundaries with respect to categorization based on access. For participants whose description of access left questions regarding their true exposure to engineering, their perception of engineering as a future career was used for final categorization. For example, two participants with minimal access did present some interest in an engineering career. Further investigation indicated that these two participants, unlike all others in the access categories, were not able to provide a detailed perception of their future self as an engineer and were thus categorized as having minimal access.

In developing these categories, high school and college students were categorized together because the categorizations were based on the participants' access to formal

programs and professionals prior to college that influenced their career choice. This focus on access prior to college resulted in similar findings across high school and college participants. While the college participants were often able to provide a more concrete reflection on how this access influenced their intent to pursue an engineering career, their responses reflected themes similar to those voiced by high school participants. Combining both groups of participants within the three categories thus reflects the consistency of findings across all participants. It is important to note, however, that no college students appear in Category 1, Minimal Access-Minimal Intent, because college students were recruited based on either intent to pursue an engineering career or a previous experience in a formal engineering course. As discussed in Chapter 6, including such participants may be another useful line of inquiry for future work.

Finally, the analysis excluded explorations of patterns by race or gender. While not specifically asked as part of the interview protocol, based on appearance all participants in the sample population were white. While the study did include both male and female participants, the sample populations were not large enough (particularly at the county level) to confidently use gender as an analytical category. For the purposes of this study, then, analysis focuses on the access-intent categories holistically in an effort to gain a general understanding of how these participants perceive engineering as a future career and the activities that support or inhibit the development of this perception across participants.

3.6.3 Quality

Throughout the analysis process, measures were taken to ensure high quality, trustworthy results. From the beginning phases of the study, providing trustworthy results

was a high priority. As part of a larger study, the EIA project, the research team took early measures to ensure quality with the interview protocol and data collection, processes further described by Carrico (2013) and in section 3.5 and 3.7 of this study. To ensure trustworthiness of results, several measures were taken. These measures include peer debriefing, prolonged time in the field, triangulation, member checking, a thick description of results, and identification of bias (Creswell, 2009).

Trustworthy results began early in the study with peer debriefing. To ensure the interview protocol provided the data necessary for the study, the EIA team met frequently during the initial phases of the interview process to review results and revise the protocol. Only two researchers, myself and Dr. Cheryl Carrico[1], performed all interviews associated with the larger EIA project. I conducted all of the interviews associated with this study, and Dr. Carrico was present for all high school interviews. Most of the high school interviews took place within the participants' school. This location allowed me prolonged time in the field to gain a deeper understanding of the study counties and participants. In addition, my connection to these schools and communities supported this immersion. Travel time to these schools allowed ample time for peer debriefing between myself and Dr. Carrico, which continually improved the interview process and interpretation of findings. Co-interviewing with Dr. Carrico also helped reduce my bias as I personally knew several participants. In these interviews, I often directed the conversation to Dr. Carrico to prevent leading the participant. In addition to peer debriefing with Dr. Carrico, the EIA team typically met on a bi-weekly basis to debrief, review results and update the protocol as necessary throughout the process.

[1] Dr. Carrico completed her doctoral work after data collection for this project was completed but prior to the submission of this dissertation.

Triangulation involved multiple methods and investigators to ensure quality in the results of this study (Creswell, 2007; Miles et al., 2014). To ensure this quality, data analysis was informed by iterative meetings with the EIA team members since sometimes it was whole-group and sometimes it was just us. These meetings informed initial revision of the codebook. As data analysis proceeded, a second coder, outside the EIA team, assisted by reviewing codes and providing intercoder checks. During the first iteration, this second coder utilized the FPS codebook shown in Appendix C. Upon completion of this review, the second coder was instrumental in helping develop the final codebook and visual matrix that produced the results of this study. In addition, the second coder provided checks on the final codebook and results to ensure trustworthy findings.

A very useful method of checking the trustworthiness of these results involved a modified method of member checking, which provided insight into the final codebook and analysis. Typically member checking involves seeking participants views of credibility of findings and interpretation of results (Creswell, 2007; Miles et al., 2014). This check involved a luncheon where stakeholders from each of the county school systems, a representative from a local university, and an area chamber of commerce representative convened to discuss initial results from this study. While these stakeholders were not study participants, the small tight-knit nature of community's means that school personnel know students quite well. These stakeholders agreed with the findings of the study and provided additional insight into my final data analysis procedures by highlighting and providing explanations of particularly salient results. This meeting validated the finding that people are critical to career choice decisions in the area, and thus informed my codebook, analysis procedures, study title, and results.

A final method to ensure trustworthiness is a thick description of results. This description involves detailed description of the study counties, participant categories, and results which allows sufficient detail for the reader to determine transferability of results (Creswell, 2007). Study counties and participant categories are described in Chapter 2 and 3. The presentation of results in Chapter 4 includes presentation of direct quotes and descriptions of data from participants related to views of their community, future, and perceptions of an engineering career in their future. In addition to direct quotations from the participants, portions of the visual matrix are presented to provide the reader with a more realistic, rich account of the data that informed the research questions of this study.

Efforts to accurately reflect data presented by participants in this study have produced trustworthy results aligned with the study's research questions. These efforts began with the development of instruments and proceeded through intercoder checks during analysis and a thick description of results. In addition to these efforts, section 3.7 provides a detailed description of researcher bias and limitations of the work.

3.7 Researcher Bias and Limitations

Performing qualitative inquiry following a social constructivist worldview involves interpretation of transcribed interview data with careful focus on participants' own meaning-making. Social construction is founded on the belief that individuals interpret and construct their reality, shaped by cultural and linguistic constructs (Patton, 2002). To interpret how individuals in the study area construct reality and how this reality influences engineering as a career choice, I have attempted to ephoche, or bracket, my own experiences to understand the experiences as described by the participants.

Bracketing involves presenting an open and honest narrative of the background experiences that may influence my interpretation of the results (Creswell, 2007).

I grew up in Bledsoe County, Tennessee, one of the rural counties included in this study. I attended a community college during my first two years of college, transferring to an in-state, four-year university to acquire a B.S. in Civil and Environmental Engineering. My access to engineering prior to my college degree was primarily limited to access to professionals, both degreed engineers and others. My grandmother, who this work is dedicated to, was trained as an electrical engineer during World War II as an attaché to the Air Force and worked in a research lab on radio equipment during the war years. In her later career she taught science, among other subjects, in my hometown and always supported and encouraged my pursuit of engineering. While not a degreed engineer, my father is a land surveyor, which provided exposure to engineering projects. I also had a pastor who worked as an engineer with TVA and I was acquainted with a local Civil Engineer. All of these individuals supported my pursuit of an engineering career. In addition, many other members of my family have college degrees in other areas and highly supported higher education.

Upon graduating with a degree in Civil Engineering, I worked in industry for approximately three years. I then returned to school to pursue my M.S. in Civil Engineering with electives in education. While working on my M.S., I taught Project Lead the Way (PLTW) engineering courses in local rural high schools in two of the study counties, and I continued to teach one course online while pursuing my PhD.

My personal experiences growing up in rural Appalachia and my experiences teaching engineering in a public high school in Tennessee influence my understanding of

the experiences and perceptions reported by participants. To ensure that each participant's experiences and meaning are derived from the interviews rather than my personal bias, I have taken several steps. My experiences growing up in one of the study counties with an engineering degree may provide me with insights into the experiences the participants discuss, but I risk reading my experiences into the data. To counteract this bias, first, two interviewers were present during all high school interviews, with one interviewer not from the study area. Second, Engineering Education graduate student, Mr. Benjamin Lutz, and the EIA team helped ensure that the results accurately reflect the data. This effort has been underway from the early stages of the project through iterations in developing both the interview protocol and the codebook, and through use of Mr. Lutz as a second coder to analyze the results. Third, results were taken back to stakeholders in the study area. This meeting involved a presentation of results to representatives from each of the four school systems, an area chamber of commerce, and a local university. Through this meeting, results were discussed with feedback from the stakeholders guiding further data analysis. This meeting reinforced the importance people play in student career choice in the area, strengthening further analysis of the data and providing a modified member check of the data.

Other limitations of the study associated with researcher bias center on participant selection. My work teaching engineering classes in rural schools in Tennessee helped the EIA team gain access into these schools, but opened up the possibility of interviewing my own students. Interviews were conducted with current and prior students of my course. The number of rural schools offering engineering curricula is very small, so the choice was made to interview within these settings despite the limitations because it allowed the

study to move beyond "exposure" as a single solution. To minimize the effects of this limitation among high school students, care was taken to reassure all high school participants of confidentiality, and both interviewers took care to evaluate participants during the interview and intercede if necessary. This effort was taken to ensure that participants felt comfortable disclosing information. Often when discussing my course, the interview was shifted to Dr. Carrico in an effort to allow participants to feel comfortable providing their true perception of the formal program.

For college students, where I was the only interviewer, the process was slightly different. Again during the interview process I reiterated confidentiality and, for my former students, stressed to each participant that the interview was in no way an evaluation of my course and that the purpose was to gather their perceptions. Recruitment was also different, these students were contacted initially due to their availability and familiarity with the research team, which provided easy access to initial students and started the snowball process. The limitation comes with the individuals' relationship as a student of the researcher. The true limitation of this relationship on the interview data cannot be quantified, but measures were taken at the beginning of each interview to inform the participants of the IRB protections and confidentiality of each interview. In addition, I made every effort to bracket my experience as the instructor while asking questions of former students. I attempted to question without assuming shared knowledge in an effort to fully capture the participants' perception. I also made every effort to only make meaning from the student responses and not include my personal bias into the results.

Finally, sampling in each high school also presented a limitation. Administrators at each school were contacted and introduced to the study. The contact at each school then recruited students to participate in the study. Each contact was informed of the study's purpose prior to recruitment of participants. This purpose was presented as an attempt to gain student perspectives of engineering as a career choice in the area. While the intent was to gain this perspective across a variety of students with varying prior experiences, within some schools this sampling technique may have limited the pool of participants recruited to students with high levels of academic achievement very focused on postsecondary education. This could provide some insight into the absence of a fourth category, minimal access-intent. That said, this may have been an attempt by school partners to provide students who would provide a "good" interview, the title of the research study including the word "engineering" and the requirement for parental permission to "study" the child, may also have limited the number and variation of participants within each school.

3.8 Conclusion

This study used a qualitative design to better understand how students from rural areas of Tennessee's Cumberland Plateau perceive engineering as a future career. The study sought to understand how these students constructed their beliefs about the future and how these beliefs influence their career choice. Semi-structured interviews were conducted with 27 high school students, 7 college engineering students, and 5 college students who had exposure to engineering through a formal program but are currently enrolled in another major. Students utilized for this study are from rural areas along the

Cumberland Plateau in Tennessee. Following a Social Constructivist worldview, the FPS framework was used to analyze the textual data developing codes and themes.

Chapter 4: Results

This chapter presents findings from the qualitative interviews with high school and college participants from rural areas of the Cumberland Plateau. These findings address the research questions associated with the study:

RQ1	How do high school and college students from rural areas of the Cumberland Plateau perceive their future career?
RQ2	How do these students perceive engineering as a career?
RQ3	What supports these students in envisioning and pursuing a future self that includes an engineering career?
RQ4	What inhibits these students from envisioning and pursuing a future self that includes an engineering career?

Analysis of the data resulted in a division of participants into three categories, as described in section 3.6, based on their access to engineering and intent to pursue a career in engineering. These categories were developed based on participant descriptions of their access to engineering through formal programs and/or access professionals and their intent to pursue engineering as a career. Intent was determined based on the participants' verbalization of their intended future career. In some cases where the participants' level of access was "fuzzy," the determination was made based on the presence of a future self that included an engineering career. The following work presents a more detailed description of the three categories:

Category 1: Minimal Access-Minimal Intent to Pursue an Engineering Career

This category represents participants who did not describe exposure to engineering through formal programs or access to professionals. These participants could not present a perception of an engineering career in their future. These participants do not plan to pursue engineering as a future career.

Category 2: Access-Minimal Intent to Pursue an Engineering Career

This category represents participants who did describe exposure to engineering through formal programs and/or access to professionals. These participants could present a perception of an engineering career in their future. These participants do not plan to pursue engineering as a future career.

Category 3: Access-Intent to Pursue an Engineering Career

This category represents participants who did describe exposure to engineering through formal programs and/or access to professionals. These participants could present a perception of an engineering career in their future. These participants do plan to pursue engineering as a future career.

The findings are divided across these three categories to understand how participants in the study counties view engineering as a career choice, how formal programs and access to professionals may influence the perception of engineering as a future career, and what barriers inhibit their ability to envision engineering as a future career.

The presentation of results is outlined below and illustrated in Figure 4.1. As shown in the outline, before describing results associated with the three categories, section 4.1 describes how participants view their community, and section 4.2 describes attributes participants hope their future career will provide. While participants in all three

categories have different visions of engineering, they have similar pasts and desire similar future attributes. Sections 4.3, 4.4, and 4.5 then present results associated with each category, describing how participants in each category perceive engineering as a future career choice.

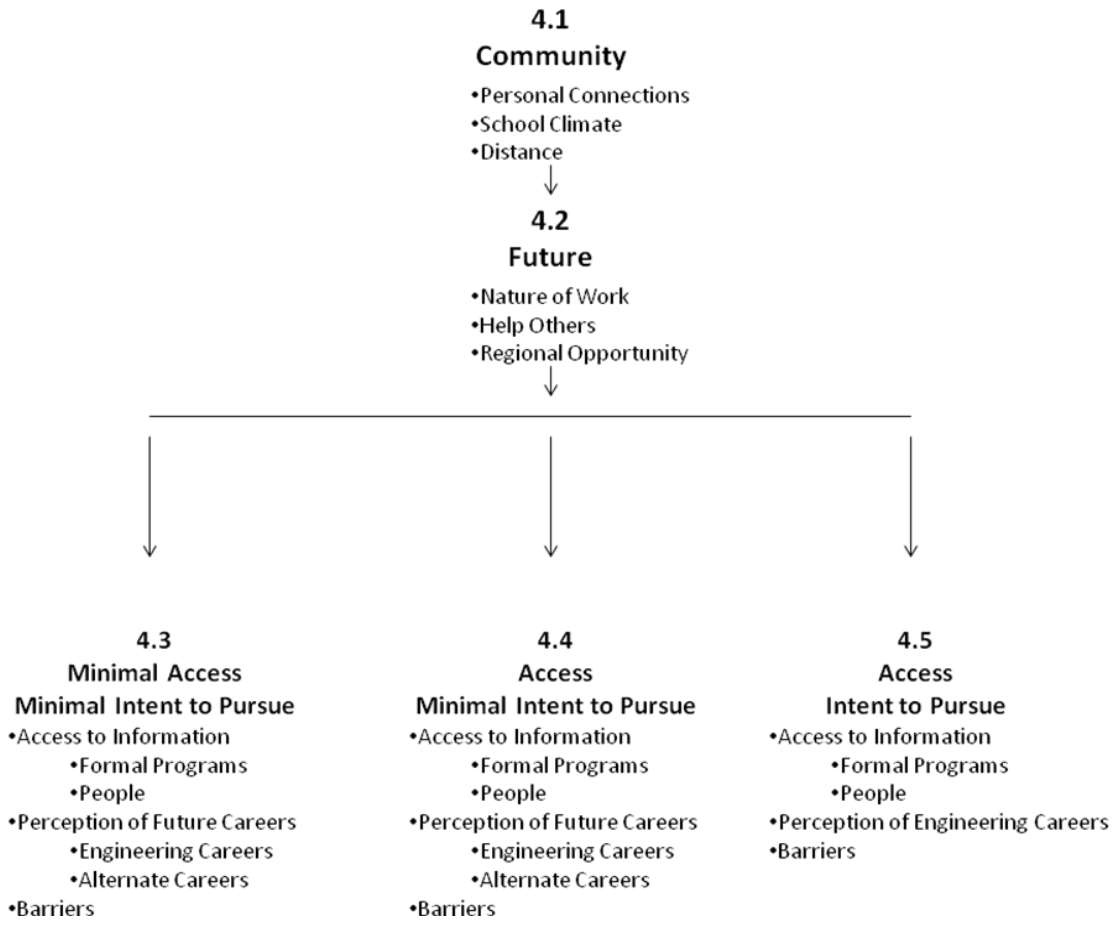

Figure 4.1 Outline of Results Presentation

4.1 Community

As described in Chapter 3, participants for the study consist of high school and college students from rural areas of the Cumberland Plateau in Tennessee. While their future plans, career exposure, and access to mentors vary, their descriptions of the community are remarkably consistent across all counties. These descriptions of community are also consistent among high school and college students as they describe their community and its impact on their future career. Key aspects salient to participants

that define what community means include family, church, community, and school climate, but also distance from resources.

4.1.1 Personal Connections

Overall, the participants interviewed present a very positive picture of their home community that centers on very close personal connections among people. A common phrase participants used is "everybody knows everybody." For example, Makayla, a high school senior who hopes to remain in the area, describes her home and community as follows:

> We don't have neighbors, so I like where we live. We have a pond and we farm a lot. We grow about 25 acres of corn, and I really enjoy the lake and I just like the small town atmosphere where everyone knows everyone. [Makayla-H.S.]

Part of this sense of closeness is linked to the fact that many participants have large families in the area. For example, when William was asked about having family in the area he replied, "oh, yeah…pretty much our whole family…most of them live just right here in our little, little circle." Similarly, Jackson describes his family in the area: *"*It's just me, my mom, and dad. Besides like aunts, uncles, cousins and grandparents*."* He then explains that one set of grandparents does not live "close," but instead live *"*more like toward [the neighboring town]*."* Jackson's town and the neighboring town are separated by approximately twenty miles, but Jackson did not identify this area as local to his community. His comment highlights the way in which, for many of the participants, the radius of community can be quite small, an issue that became critical to the "location" component of participants future self as described in section 4.2.

In addition to having large families in the area, participants describe a strong connection to church, which creates a second source of community, as Makayla's and Jackson's comments suggest:

> I'm Church of Christ and we go… you can see our church from the house. When we were little, we used to walk to it and that's a very big aspect. It's one of those things; you don't question what you're going to be doing on Sunday morning, Sunday night, Wednesday night. It's just a part of it. [Makayla-H.S.]
>
> I help with my friend's church, the church I go to, and then, um, the church my grandparents go to, like, if they need any help doing anything or like activities, like planning something for kids, I help with that. [Jackson-H.S.]

Participants generally view church, or "Christian values," as a part of their community and lifestyle. Alyssa adds that individuals in her community have Southern values, which she associated with good manners. Both sets of values extend beyond church and into descriptions of the community as a whole. Destiny captures the essence of how these values permeate the community:

> Overall, I think it's a nice community because they're just, they're generally nice people around here. But, um, and like they're supportive of what you're going to do and if you ever have community things or if somebody's having problems, everybody will pitch in and try to help. [Destiny-H.S.]

4.1.2 School Climate

While descriptions of academic preparation varied, participants generally describe their schools in terms similar to those used for their communities - that is, small and personal. Steven, a college engineering student, states that an advantage to his hometown

is the teaching system, where the small size of the school allows teachers the flexibility to *"*focus more upon the students." College students, like Steven, often reflect on the absence of this personal focus in their large college classes. He also described high school teachers as very interested in his success, explaining that *"*when I succeed I think they would see part of themselves as succeeding*."* Students used to this connection between teachers and peers, and often described difficulties with the transition from their small local high schools to large universities:

> First of all, the [college] teachers, most of them, they care, but not as much as like high school. They are not as close to you and stuff; for the most part, they help you out a little bit and the class sizes are huge, which I don't really like.
>
> [Makenze-College Non-Eng]

As Makenze's comment suggests, this small personal nature of the high schools creates a supportive educational environment, but makes the transition to a larger, more impersonal university difficult for students from rural areas of the Cumberland Plateau. This transition may be particularly difficult for first generation college students who rely on exposure from teachers and mentors outside the home for support of higher education.

4.1.3 Distance

While the school climate provides both opportunities and challenges, one common thread participants describe as a negative aspect of their rural community is the distance to school, shopping, and conveniences. Many students describe this distance as a simple inconvenience, but for others, the distance can create a barrier to extracurricular activities, shopping, and exposure to future education and career options. Adam, a high school senior, lives in a rural part of his county approximately thirty minutes from his

school. This distance proved to be a financial barrier for Adam given the cost of gas in recent years. At times he had to stay with friends for transportation to football practice. Adam explains that this barrier causes him to value money differently:

> Around here everything is kind of smaller. You have to actually go out to places if you want to get to anything, like Wal-Mart. I feel like I kind of value money a little bit more around here. Gas is really overpriced and I just can't get anywhere, so you can spend your money on like something you don't really need or [on] gas. You've got to weigh the options and opportunities. [Adam-H.S.]

Distance also limits students' exposure to other experiences. For example, Lauren, a freshman in college, describes the learning curve associated with traveling to a larger town for college. She talks about the adjustment to college as difficult because she had little prior experience with larger towns beyond traveling to Nashville a few times to visit the hospital. As a result, her transition to college involved more than simply academics or student-teacher relationships. For Lauren, even the transition to driving in a larger town was a challenge:

> I never came to [college town] until my junior year. I really didn't know what railroads do. And cars - I'm still terrified to drive here. [Lauren-College Non-Eng]

Even for students who have traveled, this transition is difficult. Wesley, a college junior, describes numerous experiences traveling to larger towns, attending college sporting events, and even international travel during his youth. Still, he described his transition to college as a large adjustment because of the loss of community:

> [College Town] I don't know anyone. So that was a big difference going from knowing almost everyone. [Wesley-College Non-Eng]

Wesley goes on to note that, as a result, his transition was more difficult than that of his peers from larger towns:

> They were in Knoxville, Nashville, or Memphis so they didn't have that big adjustment…to the city, like traffic, all these different things and I had to get a little bit used to… [City] is a pretty safe place, but one of the first things I learned is the areas you don't want to go after 11 o'clock, and you know, in [Hometown] we don't have that. It was just that first semester I had an adjusting period. [Wesley-College Non-Eng]

For students who have grown up in a rural community where "everybody knows everybody," the transition to a university in a large town can be challenging, and thus can create a barrier to higher education broadly as well as to specific majors.

4.1.4 Summary

Positive descriptions of home and community are consistent across all three categories of participants. These positive descriptions of community and close family connections are linked, as the following sections suggest, to participants' desire to remain in their local communities or within the area. At the same time, the rural context and absence of interstate systems limits students' exposure to more metropolitan communities, which in turn creates difficulties in transitioning to larger cities and larger, more impersonal, universities. These perceptions and patterns recur across all three categories of participants, although, as sections 4.3-4.6 suggest, their impacts show some notable variations.

4.2 Future

Similar to their description of community, high school and college students throughout the study area share common desired attributes in association with their future career. These attributes emerge across the study area and career choices. Attributes these participants desire their future career to provide include: 1) work that provides job stability and financial security, 2) work that is not physically demanding, 3) work that has variety 4) work that helps others, and 5) local or area employment.

4.2.1 Job Stability/Financial Security

Across the study area, participants share the common desire to achieve financial security and job stability. While many participants express this as a desired attribute of their future career, some also provide indications as to why these issues matter. Several described family difficulties created from their parents' job loss. These lost jobs seem to be centered around manufacturing, reflecting the area's changing economy described in Chapter 2. Makenze's mother reflects the typical career path of previous generations:

> Like momma said, like pretty much when you were growing up that is where you were going to work when you graduated high school. Like, nobody really planned to go to college then because they had [clothing factory] and they made really good money. [Makenze-College Non-Eng]

Brooke also mentioned the town's struggle after the clothing factory closed adding that:

> I think a lot, a lot of people were without jobs for a while, lots of unemployment. It's hard to find another job in a small town that's like not a gas station. [Brooke-College Non-Eng]

The difficulty of finding a job in the area, particularly without higher education, and the financial struggles this creates, seems to instill a desire for job stability and financial security among these participants, as the following representative comments suggest:

> I want to be able to survive with some money. [Lauren-College Non-Eng]
>
> A good income, an opportunity to help people that need it…just something that pays well that I can provide for a family. That's really important. [Wesley-College Non-Eng]
>
> They [pharmacists] make good money, and I've grown up not having a lot of money, so I think that pushes me to want money when I grow up 'cause like how hard my mom had to struggle, and I don't want to do that. [Kaylee-College Non-Eng]

For Kaylee, the desire for a career in pharmacy stems from growing up "not having a lot of money."

Students often reflect on their parents as encouraging higher education as a means to achieve financial security, as illustrated by Makenze's description of the support her parents provided:

> My mom and dad have always like talked me into it [occupational therapy], they didn't really talk me into it, but they both talked about how good the pay is, and that helped out a lot. [Makenze-College Non-Eng]

In other cases, participants describe the support their parents provide as helping them develop a future they hope to avoid. Some participants describe parents as providing this future to avoid through presentation of their perceived mistakes, difficult work, or financial struggles. Typically, these parents are described as supporting higher

education as a pathway to a better future. This pathway is particularly salient among parents without higher education experience, who often presented higher education as providing a more financially rewarding career. Christian's mother is currently unemployed and his father works for the city support services. Christian provides an example of how powerful this future to avoid can be:

> There have been times where we've fallen and had to sell things and get rid of things we actually, you know, didn't want to, but I mean there are still bills hanging over our heads. My mom, from when I was little, I mean, she would, I, we'd get to where I wouldn't want to do my homework or you know, it would be too hard and she would always sit me down and just tell me to do what I could and not be like, she says for me not to be like her. She says that she wants me to finish school and not drop out…I guess that's pretty much carried me through. [Christian-H.S.]

Christian is a top student, with his lowest grade mentioned as a 96, and his determination to attend medical school seemed very strong. Christian represents the perceptions of multiple participants across categories who credit their parents with presenting their struggles and perceived mistakes as a future to avoid.

While financial and job security are viewed as important attributes associated with future careers across participants, this desire developed in different ways. For participants like Wesley, whose father is a dentist, the desire for financial stability is linked to providing for his future family. Other participants, like Christian, hoped their career will provide them with the financial means to avoid the struggles of their family.

Avoiding family struggles seems to resonate across the counties, as many families have faced difficulties with the recent decline in manufacturing.

4.2.2 Nature of Work

In addition to achieving financial and job security, participants have expectations regarding the nature of their future work. For participants in these study counties, this includes: work that is not physically demanding, helps them avoid previous struggles, and provides variety. As previously described, these attributes are often encouraged by family members as they describe their career experiences. Participants often describe their parents and family as offering education as a way to avoid career challenges, in turn, leading to a brighter future. For example, Leslie's desire for higher education is related to an easier life:

> It's rougher if you don't go to college, 'cause my Dad didn't go to college, but my mom went to college. Like, he don't make as much as my mom and they're just like, it's an easier life if you just go to school. [Leslie-H.S.]

Similarly, Logan's grandfather provided him experience with building and designing cabinets, but pushes Logan to pursue higher education as a pathway to avoid the physical demands of his career.

> My grandpa would tell me, I liked to build cabinets with him, and he said there's not much money because he didn't graduate high school. He told me I didn't need to be doing that, I need to go to college and make the easier money instead of slaving. [Logan-College Eng]

Leslie and Logan, like many other participants, also illustrate the ways a key mentor, regardless of their career, can strongly influence students toward higher education as a

means to avoid the physical struggles and difficulties associated with many of the careers common to the area.

For Leslie, Logan, and many other participants, these key mentors are supportive individuals in the participants' life. This is not true for all participants. For some, higher education and the career it provides are a means to avoid negative cycles described in association with their families.

Lauren and Kaylee demonstrated very clear examples of feared futures from struggles within their family. When asked about people that were an influence to Kaylee, she mentions her dad and sister as influences:

> Well, they are not very good people. Like, my sister's 25 and has [x] kids, and she's been on drugs since she was 15…and then my Dad was in prison for like [x] years because he was always on drugs and like when you go see your dad once a month [x] hours away you just know you don't want to end up like that or my sister. I don't want to be anything like them. [Kaylee-College Non-Eng]

Lauren shares a similar experience when asked about things she is afraid of becoming:

> Um, well my mother, ugh, she graduated high school and didn't go any farther or anything. Didn't try. Um, my entire life she either sat at home until the divorce. Then she had to work at Wal-mart. But to me, I don't want to work at Wal-mart the rest of my life. I want to get out there and do something productive. [Lauren-College Non-Eng]

For Lauren and Kaylee their parents' choices created a clear path to avoid in their future. Avoiding this path involves higher education and a career associated with this education.

Abigail intends to enlist in the Navy to pursue her nursing credentials, as this pathway will allow her to break the cycle of her family and provide her with a future career that she desires:

> A lot of kids here just follow in the footsteps of their parents…It's been a family tradition in my family, you know, like none of my family has ever went to college, you know, and they just all stayed here. It's like my grandpa was a drunk, and then my dad ended up being on drugs and my mom was on drugs, and it's just kind of like that. And the grandparents, you know, families that, you know, my friends, that their grandparents raised them. I guess it's the way of life here…I just want to get, I want to break the, I guess chain in my family and get out of here and explore, you know, see what the world is like. [Abigail-H.S.]

The difficulties these participants face within their families provide them with a clear path to avoid in their future. For many participants, higher education is viewed as a pathway toward a brighter future. Participants describe higher education as a pathway toward a career they desire and the ability to break negative family cycles that they hope to avoid.

In addition, participants hope their careers will provide variety in their future. Joseph and Steven describe jobs they have that encouraged them to seek careers in fields that are not as monotonous and tedious.

> I wouldn't like to sort eggs in chicken houses for the rest of my life. I wouldn't like that. You know, I do it on the weekend - I have to just to earn some money, but I wouldn't like to sort eggs in chicken houses all my life. [Joseph-H.S.]

> There's no way I want to go back and be a stock boy. I mean, there's parts of it that I really liked, but I don't like waking up every day and putting items on the shelf and making sure they're fixed just right and hoping the little old lady finds something. [Steven-College Non-Eng]

Ella puts the issue in more positive terms, hoping that a career as a physical therapist will provide her with work that has variety.

> I've been in there a lot and really liked it…you didn't get a particular age group, you get from like I think the youngest one I've seen there was 14 maybe, you got from 14 to 85. [Ella-H.S.]

For Ashley, speech therapy will provide that variety:

> So, I had a speech teacher and I started thinking, you know, they help older people, stroke victims, younger kids, you know, and they never have the same day. It's always different. [Ashley-H.S.]

For many participants, like Ashley, the desire for variety in their work is encouraged by their parents:

> My dad just didn't want me to end up like him. He's just like, you know, I don't want you to end up like working in a factory. And my mom, she's always, 'You're getting a master's degree, you are!' but I mean, my dad just don't want me to be like him. I mean he's, he's a good guy, he's a hard worker, it's just the fact that if he could do things differently, he said he'd probably go to college and get him some type of degree. [Ashley-H.S.]

Ashley shows, similar to other participants, that factory work is presented as tedious and boring, a future attribute she hopes to avoid with her career.

4.2.3 Help Others

In addition to breaking negative family cycles, though, participants also want careers that help others and make a difference. Participants associate this attribute with a variety of careers, including engineering, but helping is most commonly tied to the medical field. For example, when describing Stanley, a gentleman in physical therapy recovering from an accident, Ella said:

> I just think it's cool 'cause he couldn't walk and then they helped him walk. [Ella-H.S.]

For Ashley, a career in speech therapy will allow her to help others as it helped her:

> I like helping adults. I like helping kids. I like teenagers. I like helping anybody I can…when I was little I used to have like a stuttering thing, and I couldn't, not really stutter, I just couldn't pronounce certain words right. [Ashley-H.S.]

Similar sentiments were expressed across all participants:

> I want to help people. That's something I have always wanted to do. [Lauren-College Non-Eng]
>
> You get to help other people, especially orthodontics, you get to help kids, I like working with kids. [Wesley-College Non-Eng]
>
> Like if someone is sick I will be able to help them get better, and, like, being on the other side of it with my dad being sick, it's really scary and you want to be reassured that everything is going to be ok, and I just want to help people I suppose and this is my way of doing that. [Brooke-College Non-Eng]

Steven, who does not want to stock shelves for a career, hopes that a career in engineering will make a difference through advances that help people:

> I would like to help everything in general, mainly the area… I would like to help develop any and every region the general good of people by developing…new equipment for deep within the Earth's core or crust or exploration equipment for the oceans…something that could be applied to help for our advances in science. [Steven-College Eng]

For Steven, making a difference is accomplished through a desire to advance science in a way that helps people. Participants have different visions of how future careers can make a difference, but for many participants, helping others is essential.

4.2.4 Area Opportunity

Finally, participants across categories generally hope their career will provide them with the opportunity to remain in the area. William, like many participants, hopes to remain close to his family:

> I'd like to be based at home because there is nothing like home. I wouldn't mind, you know, be gone, you know a month or whatever has to be done for my job. I wouldn't just up and leave my home to go make $50,000. That wouldn't be nothing I'd be interested in. I mean you would just be away from everybody. And it wouldn't be home, because you would be all the time homesick and stuff. Yeah, I wouldn't, I wouldn't ever think about moving permanently away from, you know, my home. [William-H.S.]

Many participants shared this desire for their future. Makayla, a high school senior, is undecided about her future career options, but does hope to remain local. When asked if being able to live locally influenced her career choice, she mentioned that it might keep her from choosing a "different" career. For many students, such as Makayla

and William, their desire to remain in their local community may limit their future career choice. Ashley has her eyes on becoming the speech therapist for her local school system after college. In these rural areas, specialized careers have limited opportunity, so she hopes the current therapist will retire:

> We have a speech teacher, but I'm thinking she's probably going to retire in the next couple years, so I'm hoping I can get that position and that way I can also coach. And then I can have two in one. I can do the coaching, I can do the helping. I can do stuff on the side with speech pathology and just, live life. [Ashley-H.S.]

Even students who plan to move "away" for their career typically do not plan to leave the area, and hoped to remain in a rural community or small city. Participants typically mentioned a 2-3 hour radius as an acceptable distance to be from their home and family. This "area" presumably includes the geographic area of Tennessee, which includes Nashville, Knoxville, and Chattanooga as seen in Figure 2.2. Makenze, for example, is not sure where her path may take her, but she is partial to the small town way of life.

> I want my children to be raised in a small town. If it's not [home] then it will be a small town. [Makenze-College Non-Eng]

Brooke, who plans to become an anesthesiologist, discusses limited career options in her hometown.

> There aren't really a lot of jobs that I would say pay a lot where I'm from. I don't plan on moving back home. [Brooke-College Non-Eng]

She goes on to explain her father's reservations about her career choice as a result:

> My dad doesn't want me to be in school that long, plus I would have to go a whole lot farther away for med school. There's not one close to here so that's a big factor too….Mom doesn't want me to be far away either, but I know that I need to succeed so they're just going to have to deal with it I guess. [Brooke-College Non-Eng]

But even though she doesn't "plan on moving back home," Brooke plans to stay close to her family, hoping that her career will lead her to a medium size town within a 2-3 hour radius of her hometown. The medium size town is motivated by her career choice in that Brooke knows that she will need to work in a town with a hospital that performs surgery. To balance her desire to remain near family, her parents' request for her to stay local, and her desired future career, Brooke plans to pick a medium size town close to her hometown. Almost no participants describe wanting to move any further away.

4.2.5 Summary

Participants in rural areas of the Cumberland Plateau, regardless of their chosen career path, seem to have common attributes they desire in a future career. These include job stability and financial security, physically undemanding and varied work, linked to helping others, and work located in the area. A variety of reasons appear to influence these attributes as participants describe them, but limited career opportunities and a decline in manufacturing jobs in the area clearly influence the desire for financial and job stability and interesting work. Close family and communities create the desire for these participants to remain in their local area and close to families. The value system of the community also reinforces the desire to help others as an attribute of their future career.

The following sections will show the importance of associating these attributes with their future careers as participants make decisions related to their future career.

4.3 Category 1: Minimal Access-Minimal Intent to Pursue an Engineering Career

Table 4.1 summarizes the participants in the minimal access – minimal intent category. As the table suggests, participants in this category have little exposure to engineering through formal programs or access to professionals. This category adds value to the study as it presents how participants, without any exposure to engineering through formal programs, perceive engineering as a future career. While these participants provide limited detail regarding engineering, they do describe desired attributes of future careers that align with those discussed in Section 4.2, along with careers that are visible within the study area and aligned with these desired attributes. These participants all represent high school students. Criterion sampling limited college participants to those either with access through a formal program or professional, or those currently pursuing an engineering career, so no college students in this category were included in the sample.

Table 4.1 Minimal Access–Minimal Intent to Pursue an Engineering Career

Category 1 Minimal Access-Minimal Intent					
Pseudonym	**Category**	**Formal Programs**	**People**	**Future Career**	**Reasons**
Jacob	H.S.	N/A	1 Friend in Engineering	Secondary History Teacher/Baseball Coach	Help Kids Learn/Fun/Easier Work than parents
Austin	H.S.	N/A	1-Engineer	Law Enforcement	Steady Pay/Good Retirement
Emily	H.S.	N/A	N/A	Veterinarian	Likes Animals/Financial/Help/Avoid Mom's struggles
Emma	H.S.	N/A	N/A	Dentistry	Financial/Variety
Mary	H.S.	N/A	N/A	Nursing Oncology	Financial/Parents-Better Job through Education
Savannah	H.S.	N/A	N/A	Military or Dental Hygiene	Financial/Military-Pathway around low ACT score
Christian	H.S.	N/A	N/A	Surgeon or Neurologist	Interesting Work/Help Others/Avoid Parents struggles
Landon	H.S.	N/A	Sister-PLTW/Encouragement from Father/Knows 2 Engineers	Business owner or Engineer	Local Career
Noah	H.S.	N/A	Friend-Electrical Engineering Student/Encouragement from Mother	Diesel Mechanic or Engineer	Financial/Hands on Work
William	H.S.	N/A	N/A	Welding	Financial/Area Career/Likes to Build
Ethan	H.S.	N/A	N/A	Physical Therapist	Financial/Interest in Body/Help
Taylor	H.S.	N/A	Sister PLTW/Sister Civil Engineering student	Veterinarian	Financial/Meaningful Work
Makayla	H.S.	N/A	N/A	Undecided/Medicine	Financial/Local Career
Abigail	H.S.	N/A	Brother-Electrical Engineering path-Navy	Nursing	Financial/Help/Get away from family struggles
Hannah	H.S.	N/A	Grandfather mentioned Field	Nursing	Help
Madison	H.S.	N/A	Uncle-OBGYN	Nursing-Labor and Delivery	Financial

4.3.1 Access to Information

Participants in this category have minimal access to information related to engineering as a career. They do not mention any form of formal program related to engineering; the closest association with engineering, if any, is a loose connection through people, including college engineering students, students with previous exposure, and engineers. Not surprisingly, participants in this category are predominantly from counties that have no engineering courses offered through the school system.

However, participants in this category do describe access to information about other fields. These career paths were not investigated as thoroughly during the interview process, but information emerged as participants discussed their future plans. The information suggests that other fields are more visible, thereby providing more access to information within this study area. These visible careers included medical fields, education, law enforcement, and welding - careers students might come in contact with in day- to-day activities.

4.3.1.1 Formal Programs

As noted above, formal programs related to engineering are minimal among these participants, as illustrated by Noah and Makayla. Noah reflects on his experience with building in agriculture class, an experience that could connect him to engineering, while Makayla articulates her lack of exposure to engineering and how this gap limits her ability to make an informed career choice. Noah is one of the few participants who expresses interest in an engineering career, an interest he attributes to his enjoyment with

building and understanding electricity. He associates engineering with his experiences building picnic tables in his agricultural course in high school:

> Today we built picnic tables. Like just all the wood laying there doesn't mean nothing. But once you like put it all together, you know, you can actually use it for something. [Noah-H.S.]

Noah relates engineering to building, and reflects on activities such as building in his agriculture course.

While some participants, like Noah, stretched to describe engineering exposure to answer the question, Makayla reflects on lack of engineering exposure. When asked about engineering, she reflects on her limited exposure to the field:

> I'm just really ignorant when it comes to, I know what basically a, you know, a bridge engineer does but like, I don't even know a lot of the careers that come with engineering. [Makayla-H.S.]

However, she has been exposed to a variety of other careers; her mother is a school administrator and local attorney, her sister is studying to become a trauma doctor, she has multiple college educated extended family members, and she mentions very high grades and ACT scores. As a result, Makayla recognizes that her exposure to engineering is limited. As the comment above indicates, through exposure to other careers, she realizes that engineering is more than simply "bridges." Thus, while many students with limited exposure simply stop their description at "bridges" or "engines," Makayla understands that engineering may hold many other opportunities that she is not familiar with.

Like Makayla, many participants in this category do have formal exposure to other careers, included nursing, dentistry, veterinary medicine, and welding. These

experiences generally come through Career Technical Education (CTE) courses such as health science, agriculture, and welding. For example, Emma, Abigail, Hannah, and Madison participated in a formal program providing exposure to the medical field through a CTE health science course, which in turn influenced their career choices. Madison, who hopes to become a nurse, says the class "really opened the doors and taught me a lot of stuff," and continues:

> Mrs. [Instructor] she was in the medical field, and she told us some stories and stuff….she went over, like, everything, like from baby and delivery to working in the ER. And, so, it kind of like showed all kinds of different fields that were options...there was a dummy there, and we had to learn, like, give IV's, draw blood. It was really hard to do, but, like, after trying, it was for a grade and I made a 100, so I was really proud of that. [Madison-H.S.]

Abigail provides a similar description of the same course, and relates this experience to the possibility of developing an interest in engineering if exposure were available:

> We had, like, a hospital bed and a dummy we got to really take blood out of…just knowing I did really well in those classes and knowing, you know, I can do this because I enjoy it. If I had taken engineering and I did well, you know, and I understood, then, you know, I don't know. [Abigail-H.S.]

That is, she could see how the course helped her envision a future in medicine.

Hannah and Emma also took the health science course with similar results. For Emma, the course provided exposure to dentistry, along with better understanding of the fields' vocabulary. Hannah took her exposure to a different level by pursuing outside training after her health science course. As a teenager, taking care of her grandmother

prompted her to become a Certified Nurse Assistant. She sought training through a local nursing home at the age of 16, as she explains:

> With me taking care of my Granny, I just thought that I needed to go ahead and get my CNA since I was going to go all the way through the medical field to get my RN, and I found out that you can get your license when you turn 16, and so I went the year, or that summer that I turned 16 and got them… I just started looking into it, calling nursing homes, seeing how you can get your CNA license. The program that I went through is just three weeks. Two weeks in school and then one week of clinicals, and then they send you and pay to have your state boards test took if you get hired at [Nursing Home], so that's how I went about that. [Hannah-H.S.]

CTE courses are also credited with exposure to other careers. For example, Taylor developed a love for animals growing up on a farm. This enjoyment was strengthened through her involvement with the CTE agriculture program in her school, where she took "livestock, intro to ag, advanced ag, and leadership." In addition, she received state level certifications. This coursework strengthened her enjoyment, which in turn reinforced her desire to pursue a career in veterinarian medicine. Similarly, William found a CTE course in high school that aligned with welding, an activity that he enjoys:

> Well, um, I guess it started whenever my papaw's front-end loader broke in two, and I welded it up. I saw that I liked it and I was doing pretty good at it. When I got into high school, I was a freshman, that was the first thing I wanted to take was welding. [William-H.S.]

His welding class then exposed him to career opportunities that he plans to pursue.

> My welding teacher, he's kind of, he's kind of taught me a lot about welding that I didn't know. He's helped me a lot figuring out what I want to do in life…which way I should go and what's better for me. [William-H.S.]

For Taylor and William, as for many students in this category, high school courses provided exposure to careers that aligned with activities they enjoyed, and thus opened up career paths.

4.3.1.2 People

In addition to limited formal programs related to engineering, participants in this category do not have a strong connection to people with engineering experience. Austin is one of only two students that mention knowing an engineer. This person is a friend of his mother, and has a degree in engineering. However, Austin notes:

> He doesn't do it because his family owns a logging company, so he ended up not doing his degree. [Austin-H.S.]

Thus, the one engineer he knows does not practice engineering. Landon, the other student who knows an engineer, has some interest in the field, but cannot describe what engineers do. Although he knows an engineer, further questions make it apparent that his relationship with this individual has not resulted in an understanding of the engineering field.

> I know [engineer]…I think he's a civil engineer. And, I think that's about all I can think of at the moment. [Landon-H.S.]
>
> I kind of don't want to go into civil because bridges don't interest me as much, but the electrical engineering, I've grown up with Dad, and he's always fixing things so that's the part that interests me. [Landon-H.S.]

Landon then replies that he does "not really" know what an electrical engineer may do. Other participants in this category know engineering students, but as with Austin and Landon, these relationships do not seem to provide a deep understanding of the career. For example, Noah's friend, an electrical engineering student, showed him a circuit board from one of his courses:

> He brought home like a little circuit board like with LED lights on it and like a switch with batteries and stuff and he was just showing me how all that worked and I think that's what got me interested in it. [Noah-H.S.]

This exposure helped Noah develop an interest in the field, but has not led to a strong vision of what a future career in electrical engineering might look like. While Noah does provide evidence of some exposure to the field, his exposure is limited and it seems, throughout the interview, that his true passion is associated with auto mechanics, the field he will likely pursue.

As with formal programs though, participants in this category do describe people as very influential regarding career choices outside of engineering. Christian, for example, hopes to attend medical school in the future, a goal inspired by a visit to the neurologist with his mother.

> I'm looking at neurology too because I went with my mom once. She has some nerve problems in her legs and I went with her, and her, the neurologist, what he was talking about it, and it just… I don't know, I was just mystified by it. [Christian-H.S.]

For William, a family friend who works for the railroad helped him envision a future career in welding:

> I have known him since I was a baby. We rode horses together and weld together and stuff like that…He started showing me a little bit and teaching me and stuff, that is how I came to like it. I just knew it was a job for me. [William-H.S.]

In addition, William mentioned several family members who work for the railroad and a family friend with "pull" to help him get a welding position after high school. Similarly, Austin, whose dream job is to be "James Bond," connected with his father and a family friend. His father worked with drug enforcement through the military and runs a training company with the friend. Austin seemed very interested in this work, and he describes his father's friend helping him determine a path to his desired career in law enforcement.

Overall, then, participants in this category generally connect with people in visible careers. This connection may provide some explanation for the heavy emphasis on medical careers across the category. Many participants mentioned their physicians, nurses, teachers, or therapists as professionals in the field who helped then envision a future career. In contrast, the lack of connections to professionals in fields such as engineering may provide insights into why the participants don't pursue engineering careers.

4.3.2 Perception of Future Careers

Little intent to pursue engineering as a career emerges among these participants. Their limited exposure and interest makes discussion of engineering as a career choice difficult for these participants. Their perceptions of the field, described below, thus provide a kind of baseline to explore common perceptions of engineering among students in the rural Cumberland Plateau. At the same time, their perceptions of alternate careers

illuminate the attributes participants in the study counties associate with their future careers.

4.3.2.1 Engineering Careers

Determining how participants in this category view engineering as a future career is difficult, as noted above. Landon and Noah are the only two participants who mention an engineering career as a future possibility, but their limited exposure to information and professionals limits their perception of an engineering career. Instead, participants are able to describe other future careers in more detail. For example, Noah provides much more evidence about how auto mechanics aligns with his current interests and what that career may look like in his future.

> Like mechanic, it's just working with like vehicles and stuff…and I don't really, I don't really know what all electrical engineering…like what all you work on and stuff…honestly think like it would make more money, but I feel like you're going to go to school a lot longer. I know that would pay off in the long run but I don't really know if I would enjoy doing it as much as I would becoming a mechanic. I just, I really haven't made up my mind about it yet. [Noah-H.S.]

When asked to describe the difference between a career as a diesel mechanic and an engineer Noah states:

> Well, the same I think, I think it's going to be a lot of hands-on stuff. Which like I said I really enjoy. The difference, I mean, like mechanic, it's just working with like vehicles and stuff and I don't really, I don't really know what all electrical engineering is…like what all you work on and stuff. I don't know, Just like I said, it's really interesting to me. [Noah-H.S.]

Landon shares a similar story with Noah. He expressed some interest in an engineering career and has a sister with exposure through a formal program, but cannot describe what a future career in engineering may look like.

Participants who did not mention any type of exposure or interest in engineering as a future career simply could not give any description of the field, though some, like Noah, make associations between engineering and auto mechanics:

> Like when I think of engineer, I think of a mechanic. [Emma-H.S.]
>
> I'm not good at that stuff. I'm not going to lie. I wish I was able to, but…I mean I could work on a weed eater engine. That's about it. As far as a car engine, though, I can't do that. [Austin-H.S.]
>
> Like I think of engines and stuff like that whenever I think of engineer. [Emily-H.S.]

Many participants in this category thus express no interest in the field and present no evidence of social connections that allow them to understand what a future career in engineering may look like. This case is illustrated by Emily as she is asked to describe engineers that she personally knows:

> I don't really know any engineers…Like I know [name] he works at the car dealership and he works on cars too…He helps paint them and stuff. I think he is the only one I know. [Emily-H.S.]

It seemed that often students associated the word "engine" with "engineer," correlating this word with automobiles and careers associated with automotive repair.

4.3.2.2 Alternate Careers

To demonstrate the characteristics these participants hope for in their future careers, this sections presents the participants' desired careers, outside of engineering, and the attributes they associate with these careers. As shown in table 4.1, attributes that participants in this category hoped for in their future include work that provides job stability and financial security, work that helps others, and local or area employment.

These attributes clearly resonate across the category and seem particularly salient to medical careers. Eleven of sixteen participants in this category are interested in a career in a medical related field; other careers of interest include education, law enforcement, business owner, auto mechanic, and welding.

For William and Makayla, like many participants in this category, a future career based in their hometown that provides financial security is a primary focus. William says, "there's always nothing like home," and explains why he does not want to move away permanently:

> I wouldn't say moving permanent because you'd be away from your family. I mean, and you'd just be away from everybody. And it wouldn't be home, because you'd be all the time homesick and stuff. [William-H.S.]

William hopes that a career in welding with the railroad will allow him the opportunity to be based at home. In addition, he hopes the career will provide him with financial security:

> The best benefits, like insurance…and just money. I mean, that's what I'm going for, is just …I've been brought up to make the most money you can make. [William-H.S.]

Makayla also mentions financial stability and location as desired attributes of her future career. She is analyzing careers to determine which one will allow her to return to her hometown after college:

> There's always needs for, you know, we've got dentists and stuff like that, you know. I could never see myself being a dentist, so I don't think I would enjoy that, but you would just have to weigh your options about what could be here. [Makayla-H.S.]

In addition to financial stability and location, "helping" is an attribute many participants in this category hope their career will provide. Christian hopes that a degree in neurology will allow him to "help people that couldn't help themselves." Hannah describes how becoming a Registered Nurse aligns with her desire to help:

> I like helping others. Everybody here thinks that I am just a big mom figure because I have to listen to everybody's problems and I help everybody a lot…I just love being able to feel like I can help somebody that needs my help. [Hannah-H.S.]

Taylor also hopes her career will "help." She hopes to become a veterinarian. For her, a future career involves "helping" animals by "finding new medicines and treatments and stuff."

One commonality across these careers, in addition to aligning with desired attributes, is their visibility in rural areas of the Cumberland Plateau, as noted earlier. Many participants in this category describe individuals in their local community who work in these professions. The medical field, in particular, seems highly visible as

participants mention their personal visits to a doctor, physical therapist, or veterinarian as exposure to the field.

4.3.3 Barriers to Engineering

As suggested by previous sections, the most obvious barrier toward engineering as a career choice experienced by participants in this category is lack of exposure through formal programs and limited access to mentors in the engineering field. These participants often struggle to provide perceptions of an engineering career. Participants that do present perceptions of an engineering career often present misconceptions as they associate engineering with auto mechanics; other participants simply indicate their lack of interest, without the ability to describe what an engineering career may hold in their future. For example, Makayla worries that her ACT score of "only"26 in math may limit her abilities with calculus if she chooses this path. Noah and Landon mention engineering as a future possibility, but lack the background experiences necessary to describe how an engineering career may fit within their future.

4.3.4 Summary

Participants in this category show that without access to formal engineering programs and professionals, students in rural areas of the Cumberland Plateau are not likely to envision a future career in the field. Many participants without access associate engineering careers with auto mechanics and don't typically link the field to attributes they desire in a future career. With minimal access, participants may associate financial stability with an engineering career, but they cannot describe additional details of the career. Attributes that participants do desire in their future careers include work that

provides job stability and financial security, work that helps others, and local or area employment. While students present multiple career options, the medical field is most often associated with providing these attributes in association with a future career, possibly relating to high visibility of these careers in the area.

4.4 Category 2: Access-Minimal Intent to Pursue an Engineering Career

As Table 4.2 shows, participants in this category have access to formal engineering programs and/or access to people in the field. These connections provide participants with exposure to the engineering field. Even with exposure, however, these participants plan to pursue an alternate career. While participants typically described their exposure as positive, variations exist in how these participants view engineering as a future career. For some, their exposure led to an informed choice, but others seem to be left with perceived barriers to engineering career choice.

Table 4.2 Access-Minimal Intent to Pursue an Engineering Career

Category 2 Access-Minimal Intent to Pursue					
Pseudonym	**Category**	**Formal Program**	**People**	**Future Career**	**Reasons**
Ella	High School	N/A	Father-Physics Engineering Students	Physical Therapy	Had PT/Financial/Help/Sports
Ashley	High School	Camp/Physics	N/A	Speech Therapy	Had Speech/Help/Variation/Local Career
Lydia	High School	PLTW	Dad Electrical Engineer/Brother ag Engineer	Soil Science	Work Outside/Make a difference/Financial/Involvement with ag
Lauren	College	PLTW	Cousin-Computer Engineer	Family Therapist/School Counselor	Had Counseling/Financial/Make a Difference/Help/Productive Person
Kaylee	College	PLTW	N/A	Pharmacy	Financial/Help/Grandmother Encourages Field/Avoid Factory
Makenze	College	PLTW	N/A	Occupational Therapy	Family Friend/Work with People/Financial/Interesting Job/Avoid Factory
Brooke	College	PLTW	N/A	Anesthesiology	Help/Father's Illness Inspiring
Wesley	College	PLTW	N/A	Dentist	Strong Income/Help Kids/Provide for Family/Be Own Boss

4.4.1 Access to Information

With respect to access to information about engineering careers, almost all of these students have exposure through a formal program in common. Six participated in a PLTW course in high school (offered in two counties in the study area), and Ashley attended a summer engineering camp at a local university and took a physics course with an engineering emphasis. Ella is the only one who does not have exposure through a formal program, but her access to people allows her to envision a career in engineering (unlike participants in the previous section).

4.4.1.1 Formal Programs

Formal programs related to engineering were reported through three experiences: a course utilizing the PLTW curriculum, a physics course, and an engineering camp experience. Wesley provides an overview of the activities he recalls from the PLTW course. He describes his experience in the course as a combination of academics and hands-on projects:

> We did some basic engineering work, like introductory computer software drawing, just drawing on a gridded notebook. And then we did some basic math and a little bit of elementary level physics that would be used in the engineering field. Then we did some projects… We built a boat out of cardboard, and a lot of little labs. We did some programming, with little… I forgot what they were called… little blocks that connect, and we had computers that program, and we could work on more electrical engineering, and we did a project over different fields of engineering. And so, we got familiar with different areas of engineering; we got to do a lot of hands-on projects that were really good. [Wesley-College Non-Eng]

Wesley also describes how this exposure helped eliminate some preconceptions about the engineering field. Prior to the course, Wesley related engineering to math:

> I knew there was a lot of math in engineering you had to be good at. You know, that's the only thing you hear, if you like math, that's something you go into is engineering, but that's about all I knew. [Wesley-College Non-Eng]

Lydia, from a different county, describes the course in a similar way. She also describes her enjoyment of the class:

> I really, really, loved that class. I loved building stuff and doing hands-on projects and things like that. [Lydia-H.S.]

Similarly, Lauren describes the cardboard boat project:

> We just took cardboard and plastic and we had to put it together to make a boat, and our boat actually had propellers. We were the only ones that really got technical with it. [Lauren-College Non-Eng]

Lauren goes on to describe taking the boat to a local university and winning a race. Importantly, Lauren, had traveled very little prior, and she describes the trip as helping her choose to pursue higher education at a university.

> That was my first trip to [university]. I was planning on a smaller one [college] but it kind of took the fear out of it…It showed that you can try to do your best and not worry about all the people, 'cause I do not like crowds. It really helped. [Lauren-College Non-Eng]

As a function of recruitment methods, the PLTW course is most often cited among students with formal exposure. However, a physics course at one of the schools served a similar purpose. Ashley describes physics as one of her favorite courses and links the activities to engineering:

> In physics, we've built solar panel cars. We built this roller coaster out of like, kind of like Lego stuff. It took us forever to build that because there's only 3 people in my physics class…We just try to figure out how engineers, like what they do. Like how they build, like what they have to take into consideration in order to create what they…how if something goes wrong they go back and reconstruct and stuff. [Ashley-H.S.]

In addition to her physics course, Ashley also attended an engineering camp for one week at a university. She credits her physics teacher with encouraging her to apply to the camp. Similar to Lauren, Ashley's experience with the engineering camp was her first time away from home:

> It was, I got there and it was kind of scary 'cause I hadn't been anywhere for a week like that. [Ashley-H.S.]

She reflects on the engineering camp experience:

> We stayed in the new dorms…We made water rockets, made a windmill, cardboard boat, we had classes, we did something with rocks…sediments... [Ashley-H.S.]

Formal exposure to engineering can thus occur through a range of experiences including not only a course that introduces engineering using the PLTW curriculum, but also a physics course and an engineering camp experience at a local university. Participants credit these experiences as eliminating some preconceptions about engineering, exposing them to the field, and for some participants, exposing them to a university.

4.4.1.2 People

Only three of eight participants in this category mentioned access to engineering professionals: Ella, Lauren, and Lydia. Ella presents a unique case as she is able to provide a description of engineering as a career through her access to people. Lauren and Lydia mentioned family members in the engineering field, and also has a clear perception of engineering as a career.

For Ella, people are her only exposure into the field of engineering. Her exposure to engineering comes through her father, a physics professor, and her two sisters, who

have boyfriends in engineering school. Ella responds quickly when asked if she has considered a technical career. She replies:

> He's [Father] trying to talk me into it, and I was like, no, not for me. [Ella-H.S.]

Ella makes it clear that she is not interested in an engineering or technical field. However, through her two sisters' boyfriends, she is able to describe engineering as a career:

> [Sister's] boyfriend is going into civil engineering. And he's told me the he designs buildings and bridges and works with the road and stuff like that. And then [other sister's] boyfriend is in computer engineering and he does a lot…like he said he would go to a company and design how their machines make stuff in the most efficient way. [Ella-H.S.]

Lydia and Lauren, who did have formal exposure to engineering through PLTW, also each have family members in the engineering field. While this access provided an additional level of exposure for these participants, math emerges as a deterrent for both. Lydia's father is an electrical engineer, and her brother is an agricultural engineer. She notes this as strange since there are not many engineers in the area.

> My brother's an ag engineer. I've been around engineers, which is weird because there's not really a lot around here. It's how it is. [Lydia-H.S.]
>
> My dad's an electrical engineer. Forever, I had the little thought in my head that I wanted to be like daddy and be an electrical engineer. Of course, that ain't gonna happen, I like engineering, [but] I'm not a math-oriented person. [Lydia-H.S.]

Lauren not only had exposure through a formal program and access to a professional, but she also enrolled in computer engineering as a college freshman, pursuing a path similar to her cousin:

> My first cousin's a computer engineer…'cause that's what I was going to go into…I'm good with computers but I couldn't do calculus.
>
> [Lauren-College Non-Eng]

However, Lauren determined prior to her freshman year that math would become a barrier due to her self-described "disability with math:"

> Well, when I started, when I got accepted to [University], I was a computer engineering major. But I have a disability for math and you kind of can't be an engineer without the math. I'm good at science; it's just math.
>
> [Lauren-College Non-Eng]

For Lauren, then, formal exposure and people led her to a career choice, but math became a barrier.

Overall, then, access to people with engineering experience is limited across participants in this category. Ella, Lydia, and Lauren have access to professionals, but do not display an interest in the field or experience barriers that change their career choice, as discussed in greater detail in section 4.4.3

4.4.2 Perception of Future Careers

Participants in this category can describe engineering as a future career. However, they do not intend to pursue an engineering career in their future. Their perception of the career varies between an informed choice to pursue an alternate career and a perception of barriers that may deter pursuit of an engineering career. The following section

describes their perceptions of engineering careers, along with their perceptions of alternate careers, to understand why participants in this category choose not to pursue a future career in engineering.

4.4.2.1 Engineering Careers

Interviews with participants in this category provided differing levels of information regarding perception of engineering as a career choice. Although their comments typically focus on perceptions of their desired career paths rather than engineering, they also describe how their exposure to engineering strengthened their intended career path, as well as how math, science, and perceived work environments influence their decisions.

For example, Wesley demonstrates an appreciation for engineering and indicates his exposure through a formal course strengthened his passion for math and science. Wesley describes how this exposure reinforced his desire to become a dentist:

> [Engineering] was something I looked at, but it wasn't exactly for me…it [PLTW] definitely helped encourage me to a math or science field…it's something I could have saw myself doing, but ultimately not what I decided... I like the math and science, so that was another one of the things that encouraged me in math and science. [Wesley-College Non-Eng]

Associating engineering with a heavy emphasis on math and science is common among participants in this category. For Lydia and Kaylee, the association with math deters them from pursuing this career. Lydia perceives a future in an engineering career to include "sitting" and doing "stereotypical" engineering things including math:

> I like engineering. I'm not a math-oriented person, but I can do math. I don't want to have a future in engineering…Well, like I said, I'm going to be doing stuff related to engineering, but I don't want to sit down and just be an engineer and do certain math problems and build bridges and stereotypical engineering things. [Lydia-H.S.]
>
> Even though I'm kind of good at math, I would say, but I don't think I would enjoy it. [Kaylee-College Non-Eng]

Ashley perceived engineering to be "difficult" in a more general sense. Throughout the interview, she describes enjoying activities associated with engineering, but perceives a career in the field to be very complex on a day-to-day basis:

> It's just so, I mean everything you do is going to be difficult. I mean nothing's easy. [Ashley-H.S.]

Makenze also mentioned math but, like Ashley, associates engineering with "difficulty." She describes her inability to "figure stuff out" as a barrier because engineers may solve complex problems on a daily basis. Makenze also mentions a desire to work with people in her future, an attribute she does not associate with an engineering career:

> I just don't like the math stuff and I'm not good at like, I don't know, I'm just not good at like figuring stuff out, like, I don't know, I'm just more like, and I like to deal with people and I guess most engineers don't really deal with people that much; they just do their own thing. [Makenze-College Non-Eng]

For Makenze, exposure through her formal course provided her with a vision of an engineering career that clearly didn't align with how she viewed her future:

> When I got exposed to it, I knew that I definitely didn't want to do that.

[Makenze-College Non-Eng]

Timing may also play a role for some participants. For example, Lydia explains having to make a career decision in 8th grade:

> The day before it [field of study selection] was due, I decided I was going to go into ag, just because my brother did and I thought it was something I would like to do too. Before I was ever exposed to engineering, I had to make my choice. You know, in high school…Every year you have an elective you have to take in that area of study. Last year I was fortunate enough to take the engineering class along with my ag classes, and I really liked it. I don't know, if I had been approached when I was younger about engineering, like maybe if I had some kind of engineering class freshman year that might have made me want engineering a little more. [Lydia-H.S.]

Her comments suggest that the timing of exposure may be critical, although, as noted earlier, Lydia also rejected engineering because of the math and her perceptions of "stereotypical engineering things."

Overall, participants in this category perceive engineering in ways that steer them toward another career. These participants strongly associate engineering with math and science, and generally associate the career with a high level of difficulty. In addition, participants also believe that engineers may not regularly interact with people on the job. These perceptions speak to exposure through a formal course as providing informed choice, but gaps in students' perceptions may also be important as a finding. These participants failed to associate engineering with attributes of a future career presented in

section 4.2. There is little discussion across the interviews of how a career in engineering might align with the participants' desired future attributes.

4.4.2.2 Alternate Careers

Instead of engineering, the desired career paths among participants in this category include occupational therapy, psychiatry, speech therapy, physical therapy, dentistry, pharmacy, anesthesiology, and soil science. Given the number of participants interested in the medical field, it is important to identify common threads supporting these choices, including family support of the career path and alignment with attributes such as stability, income, and ability to help others. In addition, many of these participants describe access to professionals in the field.

First, career path decisions start at home, with all students in this category mentioning parents and family as primary support. All eight participants mention at least one family member as a primary support in their career decision process. This support varied among participants, but may provide some evidence to explain seven students' choice of a career related to the medical field. While parental education levels and career experience varied, one common trend emerged across advice participants received: participants consistently report a parent who described a healthcare related field as providing job security and sufficient income.

For example, Makenze's mother has a friend that is an occupational therapist. This relationship provides Makenze with access to a professional and she describes her parents as supportive due the financial aspect they perceive with the career:

> I've just always, like, one of my mom's friends is an occupational therapist, and like my mom and dad have always, like, talked me into it. They didn't really talk

> me into it, but they both talked about it, and how good the pay is, and that helped out a lot. [Makayla-H.S.]

Kaylee tells a similar story of family encouragement toward a medical career. Kaylee credits her choice of a career path toward pharmacy to her grandmother and her desire for financial security:

> I didn't know what I was going to do forever, and every time we see somebody she knew was pharmacy, she'll be like, Oh there's so and so and they're a pharmacist, I think-I think that's what you need to do…They make good money, and I've always grew up not having a lot of money, so I think that that pushes me to want money when I grow up 'cause like how hard my mom had to struggle, and I don't want to be like that. [Kaylee-College Non-Eng]

Wesley hopes to become a dentist. His father is a dentist, providing him with direct access to a professional in the field. He describes his father's encouragement to explore other career areas, rather than selecting dentistry simply to follow in his footsteps:

> He didn't want me to do it simply because he was a dentist. [Wesley-College Non-Eng]

Ultimately, however, Wesley did decide on dentistry, crediting exposure through a biology course in school as aligning the field with something he enjoys - gum disease:

> We had to do a disease project for an advanced biology class…It was over gum disease…I thought that was interesting, that was the first thing that really woke it up. If I think this is interesting, and a lot of other people don't think it's interesting, maybe this is something I could do. [Wesley-College Non-Eng]

In addition, Wesley views dentistry as providing financial security, the ability to help others, and work he enjoys. This is evident as he describes what he hopes his career will provide:

> A good income, an opportunity to help people that need it, and something that I don't dread going to every day. I don't want to do something I have to dread waking up in the morning like I don't want to go to work today. So just something that pays well that I can provide for a family. That's really important. [Wesley-College Non-Eng]

Wesley is not alone in aligning a medical career with helping others. Brooke hopes her future career as an anesthesiologist will allow her the ability to help others as well:

> I don't know, I, like if someone's sick I will be able to help make them better and like being on the other side of it with my dad being sick it's really scary and you want to be reassured that everything is going to be okay and I just want to help people I suppose and this is my way of doing that. [Brooke-College Non-Eng]

Overall, these participants describe the medical field as providing attributes they desire in a future career. Participants do not typically describe the duties of the job, but spend more time focusing on what the career may provide in their future. These participants discuss work that provides job stability and financial security, work that has variety, work that helps others, and local or area employment. This perception is supported at home, as many of these participants describe high levels of family support related to these careers. This perception may also stem from connections to medical professionals in the local community, given that participants report high access to professionals in the field.

4.4.3 Barriers to Engineering

As indicated in section 4.2, although participants in this category have access to information about engineering as a career, they have chosen not to pursue the field. Barriers that led to their decisions are often related to the perceived skills necessary to be an engineer, including, but not limited to mathematics as noted earlier. The following quotations illustrate such perceived barriers:

> Well, when I started, when I got accepted to [university] I was a computer engineering major. But I have a disability for math and you kind of can't be an engineer without the math. I'm good at science it's just math.
>
> [Lauren-College Non-Eng]
>
> I'm good at computers, but I couldn't do calculus. [Lauren-College Non-Eng]
>
> I did not like the drawing aspect of it. I'm not an artistic person.
>
> [Wesley-College Non-Eng]
>
> I thought it was very interesting and it takes a lot of skill to be an engineer, skill that I don't think I have but I think, I don't know, it's an important job.
>
> [Brooke-College Non-Eng]

Ashley offers perhaps the articulate descriptions of these barriers. She enjoys building and creating, and is fascinated with engineering. However, her image of the field seems out of her reach:

> I mean everything you do is going to be difficult. I mean nothing's easy…I try to make everything perfect. Like and I doubt myself a lot so I mean, I get, you know, a perfect building and then I'd come back to it like a week later and reconstruct it or something. I mean, I never have a final result. I never get anything done…

> I like designing stuff, I mean, I can visualize it in my head and then try, it's just trying to construct it. I'm not very much of a constructor by myself…It's just trying to get the first steps. That's when it's difficult…I'm creative….It's just the very first steps, I can't, I can never do…Like building a building, I mean that, that'd be, I'd be afraid I'd crash it or something. [Ashley-H.S.]

As the comments suggest, Ashley places a lot of responsibility on the engineer. She views the field as very difficult and sees the responsibility for designing an entire building from scratch as falling to a single engineer. This level of responsibility, and the fact that "nothing would be easy," presents a barrier to her ability to see an engineering career as part of her future self.

In other cases, the barrier is more nebulous, and may link to a lack of understanding that persists despite formal exposure. For example, Kaylee had exposure through a formal course in high school, but never aligned engineering with an actual career choice.

> Well, I took a class in high school…I don't know if that's like really what I want to do. I wouldn't really know exactly what kinds of engineering to do or what kind I would even want to do. [Kaylee-College Non-Eng]

While not specifically stated in the interviews, Kaylee's barrier may be common to these participants. Participants in this group never link an engineering career with desired attributes of their future. They make strong comments about the perceived abilities necessary to become an engineer, but do not discuss attributes such as finances, job stability, location, or helping others that seem important as they discussed their chosen career path. In this context, it is important to note that only three of these

participants describe knowing people associated with engineering, although all eight know people associated with their desired career choice and could link their choice to desirable future attributes.

4.4.4 Summary

The eight participants in this category describe exposure through a formal program and/or access to people who have helped them develop some understanding of engineering as a career choice. Participants indicated three formal experiences that produced exposure to engineering: PLTW courses, a physics course, and an engineering camp experience. One participant, Ella, is included in this category even though she has no formal exposure because she is able to describe engineering careers in some detail based on her connection with people. Only three participants describe having both exposure through a formal course and access to professionals in the field. Although these participants can describe engineering careers, they are all choosing to pursue other careers, predominantly in the medical fields. In making these choices, all participants discuss people as prominent influences toward their chosen career. Participants were also able to articulate how their chosen career aligned with attributes they desired in their future career, while their descriptions of engineering typically focused on skills gaps that prevent or discouraged their entry into the field.

4.5 Category 3: Access-Intent to Pursue an Engineering Career

Table 4.3 summarizes the participants in the Access – Intent to Pursue Category. As the table suggests, most participants in this category have been exposed to engineering through a formal experience *and* personal connections. They then typically pursue the

field because of a combination of financial stability and personal engagement. This personal engagement usually involves links between activities these participants enjoy and perceptions of engineering careers. This realization often occurs through formal programs and access to professionals who help participants perceive engineering as a possible career in their future.

Table 4.3 Access–Intent to Pursue an Engineering Career

Category 3 Access-Intent to Pursue					
Pseudonym	**Category**	**Formal Program**	**People**	**Future Career**	**Reasons**
Summer	H.S.	PLTW	N/A	Marketing/Communication or Engineering	Financial Security/Help Others/Creativity
Adam	H.S.	PLTW/ Technology Course	Friend-Music Industry Computer engineer-Railroad	Computer Engineer	Financial/Retirement/Interesting/ Avoid Family Struggles
Leslie	College	PLTW	Uncle-Civil Engineer	Environmental Engineer	Financial/Help Environment/ Education=Brighter Future
Jackson	H.S.	PLTW/CTE Agricultural Courses	3-Engineers/Uncle-Engineer	Engineering/Building	Financial Stability/Education=Brighter Future/Likes to Build
Joseph	H.S.	CTE Agricultural Courses	N/A	Engineering	Financial Stability/How Things Work
Logan	College	PLTW	Grandfather-Cabinet Maker	Civil Engineer	Financial/Less Labor Intensive Career/Like to Build
Parker	H.S.	Camp/PLTW	N/A	Engineering or Medical	Financial/Meaningful Work/Building/ How Things Work/Math and Science
Alex	H.S.	PLTW	Father-Works with Engineers	Chemical or Nuclear Engineer	Financial/Math/Education=Job Opportunities
Haley	H.S.	PLTW	Aunt draftsman @ engineering co., unpaid internship-met "real" engineers	Nuclear Engineer	Help Others/Math and Science/ Area Opportunities
Destiny	H.S.	Physics Course	Father-Engineer, Uncle-Engineer, Mom & Stepmom in medical field	Biomedical Engineering	Financial Stability/Meaningful Work/ Help Others/Make Things Better
Alyssa	College	PLTW	N/A	Chemical Engineer (Biomolecular)	Stable Income/Math and Science/Help Others
Eli	College	CTE Electrical Course	Father-Electrician/Mother-Computer Science/ Dinner with Engineers	Electrical Engineer	Financial/Job Opportunities/Math Ability/ How Things Work
Micah	College	N/A	Grandfather-Civil Engineer	Civil Engineer	Financial/Job Opportunities/Math Ability
Steven	College	PLTW	Father-machinist/1-Engineer	Mechatronics	Financial/Math Interest/Help Others/ Make things Better/Create
David	College	Camp/PLTW	Local Farmer with ag Engineering Degree	Ag Engineering	Local Career/Interest/Financial Stability/Help Others

4.5.1 Access to Information

As shown in Table 4.3, this category represents participants who have had exposure through a formal program and/or access to professionals and plan to pursue engineering as a career. Formal programs include: the Project Lead the Way (PLTW) curriculum offered in two of the school systems, science courses, Career and Technical Education (CTE) courses, and a summer engineering camp experience at a local university. Participant experiences with each of the courses vary, and all information reported here reflects participant perceptions of the exposure rather than course content or instructor.

In addition to formal programs, many of these participants also have informal exposure to engineering through professionals, ranging from degreed engineers to local individuals with engineering-related experience. Participants typically linked to these professionals through connections with family and friends.

4.5.1.1 Formal Programs

As in the previous category, formal programs for these participants include coursework through the PLTW curriculum, science courses, and CTE courses, as well as a summer engineering camp experience at a local university, with access varying by county. Two school systems offer engineering courses through PLTW and another offers a physics course that seems to provide some exposure to engineering. Across schools, participants also credit CTE courses with providing engineering related experiences. Students in this group credit these experiences with providing their first look at an engineering-related career, linking things the participants enjoy to an engineering career. For example, Alyssa, a college sophomore in chemical engineering, initially planned to

major in pharmacy, a common choice among college-bound participants in this study. She describes her engineering course as her first experience with engineering, which then changed her career path. Much like participants without exposure through formal programs, Alyssa "didn't know anything about engineering until that class." She described the course as a combination of hands-on activities and coursework:

> I took a class senior year called Introduction to Engineering, Principles of Engineering, we just talked about the different, various types of engineering, and like, what they're composed of and what they study and you know, and I really became interested in chemical engineering because I like chemistry and math, and just any kind of science and that just really sparked my interest to engineering… We made model rockets, we did a cardboard boat race where we created cardboard boats that we had to race at the [University]…We worked with hydrogen powered cars…so it really linked it together. [Alyssa-College Eng]

Haley shares a very similar experience. Many members of Haley's family have careers in the medical field, and her initial intent was also a major in pharmacy. She then describes how a PLTW course resulted in her desire to major in nuclear engineering:

> They [teachers] teach you things that really interest you. Like I said, before I came to this school, I was going to go into the medical field. I thought pharmacy. But then I came here and I started gathering a love for math and for science. Like I had a college math class…That's the first time I really loved math was when I got into the harder stuff and I was challenged with it. That's what I liked. And I liked chemistry. Because I could tell how things worked and I could do things that most people couldn't do and I liked that. I understood it and was good at it….I

> took my engineering class and then that's when I knew I wanted to be an engineer…I like engineering because it embraces science and math and it's something you can learn, but it's something that has to make sense to you. You have to be able to see it, and that's something I can do and I like that I can do that. And I like that it's challenging. Like everything doesn't come naturally, but I can learn it…If I had never had the engineering class, I would probably want to go into pharmacy. I would be looking at a totally different skill set and totally different outlook. I would be going to a different school for different things. I wouldn't have been as open to other ideas about that. It made me do my own research, like I was set on pharmacy, I knew that's what I wanted to do, but I was wrong. So, without the engineering class, I wouldn't have had the love of physics that I have, I would have had just a love of math and that kind of thing. [Haley-H.S.]

Both Haley and Alyssa describe math and science as subject areas they enjoy. Haley adds that she has the ability to "tell how things work." And as the excerpts above suggest, they both credit the engineering class with providing a link between the things they enjoy and a future career.

Other participants in this group also relate their interest in engineering to things they enjoy. These include a desire to build, fix, design, understand how things work, a love for math and science, and creativity. For Logan, a freshman civil engineering major, the engineering course that provided his first experience with engineering "just sounded like something I'd like to do." This experience then aligned engineering with his interest in building and designing that he developed working in his grandfather's cabinet shop.

Similarly, Alex describes his interest in building, along with his interest and ability in math, as reasons for entering the engineering course.

For a number of participants in this group, their enjoyments were linked directly to rural cultures. Many students from rural areas along the Cumberland Plateau associate with, and have experience, in farming and agriculture. Agriculture courses are credited by David, Jackson, and Joseph as introducing engineering as a possible career choice. Joseph describes his enjoyment with understanding how things work. He relates this interest to his life at home where he is usually "helping with animals or feeding or working on something broke down helping Dad fix it." He describes his long-term enjoyment in understanding how things work:

> I'm really, I like how, to see how things work and how to understand things. When I was a kid, I always built, like took stuff apart and see how it worked and put it back together…I really like all kinds of ag stuff and mechanical things and stuff like that…How things work and stuff. [Joseph-H.S.]

He goes on to describe how his CTE agriculture class introduced engineering as a career that aligns with these things he enjoys:

> We do stuff all the time in ag, you know, motors and stuff like that. Build and stuff, things like that in nature. We take things apart, see how, see what's wrong with them you know, engineering kind of stuff in ag Engineering. [Joseph-H.S.]

Eli, a sophomore electrical engineering student, attended high school in a county where an engineering course was not an option. For him, an electrical course through CTE reinforced his existing desire to major in electrical engineering by providing the hands-on experiences he enjoyed.

> I enjoyed working with the wiring, I enjoyed working with the electricity, and I particularly enjoyed whenever I got something wired up watching it work. [Eli-College Eng]

Eli's initial interest in an electrical engineering career came through personal connections, as discussed in the next section, but the CTE course reinforced his desire to pursue his electrical engineering degree.

Destiny also attends high school in a county without a formal course in engineering, but was exposed to the field through her high school physics course. The course combines hands-on activities with academics.

> We'll do book work, then we'll do actual hands on stuff. We built a robot arm in there. We just put all the pieces together…I thought it was so neat we got to do this. [Destiny-H.S.]

Destiny describes several other activities from her physics class that linked to her interests in how things work and how design can improve functionality. When asked about her future career, she refers to an activity from her physics class:

> Actually, physics class kind of sparked my interest in what I wanted to do. We watched a video over how prosthetics and stuff work..like doing that stuff and designing that stuff. I thought that was so interesting. I just think it's really interesting to design stuff and figure out how stuff is going to work. I actually started looking at stuff and I got interested in biomedical engineering and I just really want to pursue that and that's what I'm going to do. I applied to the University of Tennessee and that where I'm planning on going in the fall. [Destiny-H.S.]

As these students' experiences suggest, a range of different formal settings can provide access to engineering in a way that engages them. Haley and Alyssa provide evidence that engineering exposure can capture students with a strong interest in math and science. Logan's attraction centers around building and designing, while Alex credits building and math. Engineering exposure can also capture students like Summer, who desires a career where she can apply her creativity; Adam, who's path began with a strong interest in computers; Eli, who is interested in electricity; Steven, who is majoring in mechatronics; Destiny, who is interested in biomedical engineering; and David, who associates engineering with agriculture. For each of these students, a formal setting provides the means to clearly connect their own interests to potential engineering careers. Importantly, while PLTW is most often noted among students as providing exposure, students also credit science courses, technology courses, CTE courses, and a summer camp program in engineering with providing experiences. This diversity of paths is particularly salient in this rural environment where formal education may be the only exposure students receive, but limited school resources can limit the types of experiences available.

4.5.1.2 People

Although formal programs are very important in helping students construct a future self that includes an engineering career, access to mentors appears equally important as students in this group navigate toward that future. One thing participants in this category have in common is support from their family. Regardless of family members' experience level with the engineering field, or even higher education, these families support their students' pursuit of higher education. Of the fifteen participants in

this category, only four students are from families where neither parent holds a bachelors degree, and only two, Alyssa and Steven, have parents without any college experience.

Participant reflections on how people influence their future career choice show that enhancing exposure with access to mentors provides participants with a very real and clear image of the career in their future. For example, Alex developed an interest in nuclear engineering through his PLTW course. His father is a salesman for an automotive robotics company and works with engineers, which provided Alex with access to several professionals in the field. Alex reflects on his interaction with these engineers:

> My dad actually works with many engineers. I've met them and talked to them. They actually helped me with one of my homework questions from advanced algebra and trig...They helped me through, it and I was actually the only one that came to school the next day with that problem finished and had to explain to the whole class how to do it, so I felt kind of cool just talking to an engineer. The guys he works with are really smart and really cool. [Alex-H.S.]

When asked if he talks to them about engineering, however, Alex indicated:

> "I don't talk to them about I guess engineering per se; I just talk to them normally. I mean I guess I could talk to them about it if I wanted to it would be okay. [Alex-H.S.]

Notably, Alex sees these engineers as "smart and cool," but also "normal" and thus accessible. Therefore, Alex notes that when he talks with them they don't just talk about engineering. This relationship with "real" engineers allows Alex to envision an engineering career in the future and realize that they are approachable people he feels comfortable with.

Haley shares a similar experience. She describes significant exposure to the medical field in her family, and notes that prior to her PLTW course, she intended to major in pharmacy. PLTW, however, exposed her to nuclear engineering as a career option. Her aunt's position as a draftsman at an engineering company then provided a personal link. Exposure to engineering through her course prompted Haley to pursue a two week unpaid summer internship with her aunt. This internship allowed her to meet and talk with multiple engineers; during her internship, she spent time with two different engineers every day, exposing her to multiple professionals in the field. Her reflections on the experience show that meeting the "real" engineers took some fear out of her career path.

> I gained a lot from that experience. I got to see what that side of engineering was like. The side of engineering that the people who work in an office building. Working on drawings and going places. And I mean, I would rather work in a lab than an office. I knew that much but it was still nice to see what they did on a daily basis…I think it helped me a little bit 'cause I knew what I would be going into. I knew that it wasn't as terrifying as I thought it was going to be. I knew that it wasn't going to be as strenuous, it was going to be more, I mean a lot of those people, they weren't straight A students or anything but they were good at what they did. So that gave me confidence, so I knew I could do it. [Haley-H.S.]

Like Alex's "normal" conversations, this internship helped Haley view an engineering career as something she could achieve. Access to professionals appears to have helped both students perceive their own future in an engineering career. For Alex, his association with engineers helped him see that they can be very personable and solve

the problem for his course. For Haley, her association with engineers helped reduce the fear that engineers have an ability that she does not possess. By realizing that they were not (A) students, but were still engineers, Haley gained confidence that she could become an engineer.

Destiny's story repeats this pattern. Her choice to pursue a career in biomedical engineering results from a combination of exposure to healthcare through her mothers' career, exposure to engineering through her fathers' career, and exposure to biomedical engineering in her physics course. When asked about her parents' careers, she describes their influence:

> I think that had a big influence on me. 'Cause my dad would talk about what he does now, and I thought that was very interesting. My mom, she'll like, she'll say go into healthcare. I know it's kind of like a combination of what my parents do. My dad just talked about it and got me interested in it first, then I had my physics class and that got me interested in it. And, just my mom, like, I really want to be able to help people and stuff. When I get out of school and hopefully that's a way I can. 'cause I don't know, I just like, I like helping people…I think that's why I want to do that. I think it's really interesting. [Destiny-H.S.]

While Alex, Haley, and Destiny all credit a degreed engineer with their exposure to a professional in the field, for other students, other participants found that access through professionals in related fields. Eli, Logan, and Steven credit family members with helping them develop engineering as a future career choice. These family members have careers as a cabinet maker, an electrician, and a machinist. Logan credits his enjoyment with building and design to his time working with his grandfather building

cabinets. Eli credits his father, an electrician who works at a nuclear power plant, with most of his knowledge of an engineering career:

> I was talking to my dad because he was there [at a CTE electrical competition] with me, and I was talking to [electrical teacher] and I was saying you know, this isn't a bad thing, a bad job. I could do this, you know, be an electrician, be a tradesman and whenever I got to talking about that they were both right together in what they said. They said look, if you've got the ability to…go and get a professional degree. Don't go for a labor job…at that time I was thinking about going for a technician…They said once you have been doing that for 30 years and your hands feel like they're being stabbed with daggers and your back feels like it's being stabbed with daggers you'll think, 'back when I was 18 years old I could've gone to college and got a degree and be telling these people what to do'…I mean I enjoyed working with the wiring…I particularly enjoyed whenever I got something wired up watching it work…they told me that it would be a good idea for me to just go for a degree, for an engineering degree.
>
> [Eli-College Eng]

Similarly, Steven credits his father, a machinist, with his interest in a mechanical engineering career:

> I would say my biggest influence would be my parents, they always wanted me to succeed and my father being a machinist and mechanic…every child wants to be like their father in a sense so I was like…I'll be a mechanical engineer.
>
> [Steven-College Eng]

In each of these cases, the student's make a connection to a hands–on trade and, with support and even urging from the trade professionals, develop a perception of a related engineering career.

As the participants demonstrate, access to professionals is important as participants describe their career path. This access helps students perceive their future in an engineering career. Access to engineering professionals helped Haley and Alex alleviate the fear that engineers have abilities beyond their reach. For Eli, Logan, and Steven, access to people with relevant experience supported their exposure to engineering. Such findings suggest that professionals like Steven's father, a machinist with relevant experience in manufacturing, can be very important in promoting exposure in this area that has an economy heavily influenced by manufacturing.

4.5.2 Perception of Engineering Futures

Section 4.2 established that throughout the area, participants hold similar views of attributes they hope their future career will provide. Participants in this category differ from the previous groups because their access to formal programs and professionals has helped them develop perceptions of engineering as a future career that includes these attributes. These participants generally perceive an engineering career as connecting things they enjoy (building, fixing, how things work, science, math, and creativity) to desired attributes of a career (work that provides job stability and financial security, work that is not physically demanding, work that has variety, work that helps others, and local or area employment). The following section provides examples of how these participants perceive engineering as a future career.

Financial stability emerged across participants in all categories as an important attribute of their future career. Participants in this category associate a future in an engineering career with the ability to provide adequate financial support for themselves and their future families. As shown in section 4.2, families support education as a pathway to financial stability, and for these participants, families, regardless of their prior experience with engineering, positively associate the field with job opportunities and financial stability. Micah illustrates this pattern when he discusses parental influence:

> They always…wanted me to do well…My degree (Civil Engineering) it's a major that I will actually find a job for…you know, don't go into music or something like that. It's really hard to find a job when you get out…something that pays well, has a lot of opportunities. [Micah-College Eng]

Micah's mother is an attorney, his father is a detective, and his grandfather was a civil engineer, and all support a career in engineering as a pathway to financial security. This support emerged for other participants as well. Adam, who mentions his financial struggles throughout the interview, also views an engineering career as a path to financial security. Adam's mother works at a chain restaurant and his father is unemployed. When asked what an engineering career may provide, Adam replies:

> I want it to provide me with what I need…I don't want to make an excess of money like Bill Gates or anybody…I want to be able to provide for myself while having an enjoyable job and just food, money, shelter, take care of my affairs, that's about it. Have enough saved up when I want to retire I can actually live comfortably. [Adam-H.S.]

Through his research, Adam found that in computer engineering the salary range varied from "$75,000 - $160,000" per year. When asked how this compared to careers in his area he replied:

> I know how it compares to my mother and that's a big increase. The minimum of that is about 12 times better than what she makes a year, almost. [Adam-H.S.]

Table 4.3 shows that participants across this category view a career in engineering as a path that will provide adequate financial support in their future.

But while financial concerns are important, an association with activities the participants enjoy is also very important in how participants perceive a career in engineering. Many of these associations can be seen in participants' comments around their formal exposure. Summer provides a unique perspective as she hopes a career in engineering will provide a balance between her interest in arts and creativity and her desire to have a stable career. When asked about the difference between her interest in engineering and art, she indicates that "they sort of meld together when you think about it. 'Cause engineering is sort of being creative and to be creative you have to engineer things." She goes on to describe how she views the role of creativity in an engineering career:

> In engineering they're trying to solve problems and fix things and to fix things you going to have to think outside of what you were doing. I heard someone say before, you can't fix a problem the same way you thought about making it….You have to find a way to build upon your creativity. [Summer-H.S.]

Summer views a career in engineering as an opportunity for creativity. Her outlook regarding how she can blend her interests into a career focuses on robotics and computer programming.

> When you build a robot if you want to make it…instead of making it your classic 80's Chucky robot, how to make it more humanistic is what your looking for. Or when you're doing…when you're working with the computer graphics side of things, like you know when you're engineering a new program, but how to make that program easier for a person to use…more simplistic, but easy to understand. [Summer-H.S.]

Creativity is one of many attributes participants in this category believe their engineering career will provide in their future. More broadly, participants believe their engineering career will provide meaningful and varied work. Destiny hopes a career in biomedical engineering will allow her the opportunity to "learn new things and discover new things while you are in your job." Her research into the field has shown that a biomedical engineering professional can do research on new methods and products or actually be involved in their construction. Destiny's desire to learn on the job is common to other participants as well.

For several participants, "meaningful work" is linked directly to helping people through an engineering career, echoing the rural values around community. Alyssa, Haley, and Destiny each had an interest in the medical field prior to their engineering exposure, in part because of its reputation as a "helping" field. Through their exploration of engineering, they each realized that a career in engineering can also provide the ability to help in their future. For Alyssa, she hopes her degree in chemical engineering with a

bio-molecular emphasis will allow her to research cancer in the future. Haley hopes she can one day contribute to society through research around nuclear energy. Destiny reflects on how exposure to biomedical engineering allowed her to envision helping in a different way in her future:

> I just like, just how, I love actually, looking at how things work and figuring out how they go together. I'm just really interested in that and like I want to do something in healthcare too. So, I just thought it was a good fit. At first I kind of wanted to be a dentist. I wanted to go for that and then I kind of figured out that I'm not really…being in somebody's mouth and stuff like that. So I'd rather not do that…so I wanted to do something where I could actually help, but in a different part of it. [Destiny-H.S.]

Similarly, Alyssa desires to give back to society through cancer research as a result of her education in chemical engineering.

> It'd be cool to work in a lab, just researching cancer…cancer is a big issue…a lot of people have been affected by cancer…I mean, it'd just be really cool to work on and to know that you're contributing to that 'cause. [Alyssa-College Eng]

Other participants make similar statements:

> I'm excited to make a difference. Because you know if you work in researching nuclear technology, it's going to help someone somewhere down the road. If you make the tiniest discovery, it's going to change everything after that. You design an invention that will revolutionize some little thing in life, it's going to help somebody somewhere. People will remember you…maybe not by name but

> they'll know, hey this is a handy tool. In your heart, you'll know that that's because of me. [Haley-H.S.]
>
> I'm going to school for learning science and applying that in developing for the general good of people. For instance, I could make a robotic system that could function in places where people could work to obtain new materials…That would help everybody out…I would like to help develop any and every region for the general good of people by developing like my new equipment for deep within the Earth's core or crust or exploration equipment for the oceans or something. That could be applied to help for our advances in science. [Steven-College Eng]

As described in section 4.2, however, another critical issue for students, with respect to future careers, is location. On this issue, participants who hope to become engineers in the future have very mixed opinions ranging from a fear that the area has engineering opportunities, to an open mind around relocation.

Mentions of careers that may provide opportunities in the local community are typically related to agriculture. David, a freshman in agricultural engineering, described his choice to major in agricultural engineering as aligning with his desire to live in his local community. His experiences with agriculture range from his work experience on a local farm owned by an agricultural engineer to his high school CTE agriculture courses. David's desire to live in his local area, combined with his interest in agriculture, made his career choice easy, given that agriculture is "how we make our livings."

Other participants describe feeling fortunate that many opportunities are available for them within the area. Eli hopes he will be able to work in Chattanooga in Southeast Tennessee. This location would allow him the option to "live here and commute to work

or I could live in Chattanooga and it wouldn't be that far of a drive for me to get back to my family." Other students would be happy to settle in the area within an easy commute of home and family. Haley sees it as fortunate that nuclear engineering has an abundance of opportunities in Tennessee, noting Oak Ridge National Labs in East Tennessee. She realizes that her career will not likely allow her to remain in her local community, but will allow her a rural lifestyle close to family.

> I like that Oak Ridge is close enough to here that I can come back and see my family and my friends…I am fortunate that nuclear engineering has a strong foundation in Tennessee 'cause we have Oak Ridge, we have a number of nuclear plants - like Tennessee has more nuclear plants than most states. And we have the Tennessee Valley Authority, which allows us to have those. And we have a good foundation in nuclear technology. [Haley-H.S.]

However, not all participants are as positive regarding the outlook for careers in their local community. Some students who desire to remain local have some concern regarding opportunities in their local community and even their area. Alex, a high school student, is not sure where he may want to live in the future, but he does want the option to live in the local area. While he is open to relocate, he hopes that engineering will provide him with many options regarding location in his future:

> I don't want to get stuck in [hometown] or middle Tennessee. I want to have the options to move, but I don't, I want to have the options to move, but I don't want to have to move. I want to be able to have a choice of staying at home…There's a couple of small firms in Nashville that might give me a job, but that's probably about the only option I've got if I was going to stay in middle Tennessee.

[Alex-H.S.]

The perception that a career in engineering is not viable in the area was mentioned by several participants in this category. College students, reflecting on their future career, see their peers relocating for jobs nationally and globally. Micah reiterates the perception held by David that agriculture is the only engineering profession that may provide a local career:

> It depends on what you want to go into I guess, engineering, it would be hard to find anything here. If I had to guess, anything agricultural you can stay here pretty well, I guess. [Micah-College Eng]

Alyssa sees her peers venturing to other states and countries for engineering opportunities. These moves concern her greatly because she hopes to remain close to her home and family:

> I'm going to try to get a close job. I hope that there will be some available in the like, the area. That's one of my biggest fears, I think, is not having a job close at home…You hear a lot of people that talk about their co-op's- Oh, it's in Texas, it's in another country, it's like, oh, I don't really, I'm not prepared for that yet…I want to be close to my family and somewhere I'm familiar….I want, just a medium, I don't want it to be too small, but I don't really want to live in a big city like Nashville, but I wouldn't mind the drive, commuting there. If it wasn't like too long. So, I don't want to go to another state or a country.
>
> [Alyssa-College Eng]

Participants' level of exposure to other areas, parental experience, and support seem to influence perceptions of their future location. Alex and Micah seem open to

relocate. Both have college-educated parents and describe experiences traveling during their youth. Alex and Micah provide positive descriptions of their home and community, but share an open mind regarding living in a city in the future.

> Personally, I've always wanted to move into a bigger city and see what its like. I want to plan on doing the co-op program. I've always thought about moving out to a bigger city just to see what its like. [Micah-College Eng]

Alex specifically mentions that his mother encourages him to experience life in a city.

> I want to live in a big city at least once. And that's what my mom said to do, live in a city once. That way you know what it's like, and if you like it stay and if you don't like it you can come back. [Alex-H.S.]

Participants across the category thus have varying ideas about available engineering careers in their home communities. Overall, however, participants in this category seem open to a career within the area that will allow them to remain within an easy commute to home and family, but are generally reluctant to relocate too far away.

The desirable attributes these participants linked to engineering careers (financial security, helping others, future location, etc) are common attributes participants in the study counties link with their future career. These participants differ from their peers in other categories because their exposure has helped them link these attributes to a future career in engineering. For participants in the study counties, financial security is essential, and is reinforced by families and the community likely because of struggles faced throughout the area as manufacturing and other industries are in decline. Participants in this category seem very aware of engineering careers as a way to achieve that stability. At the same time, community values and relationships seem to support the

idea that participants want to help others in their future career. These participants have found that engineering careers can provide this attribute in various ways. These relationships also create the desire for the participants to remain close to home. While the area offers opportunities in engineering, the perception of location associated with engineering careers varies across participants. These attributes are critical to these participants as they consider engineering careers in their future. The ability to link these attributes to engineering separates these participants from those in other categories.

4.5.3 Barriers to Engineering as a Career Choice

Participants in this category typically have very supportive and involved families. When discussing attributes of a future self that includes barriers or fears, these participants do not have strong images of parents or close family who display attributes they hope to avoid. The participants in this category typically have a strong desire to succeed and are driven to take advanced courses in their high school curriculum and difficult subjects as college students, but not as a hedge against a feared future. Still, participants in this group do identify some barriers, including lack of exposure to engineering, limited access to professionals, financial barriers to college attendance, and difficult transitions from high school to a university.

Access to engineers in rural areas of the Cumberland Plateau is limited, and several of the college students articulated this gap:

> There weren't too many people I knew that actually had one [engineering degree] except for my mother's employer at one of the sawmills, who recently passed. He was also a mechanical engineer. [Steven-College Eng]

You aren't introduced to a lot of things. As many things as other people. Uh, big colleges, like, jobs, I guess. 'Cause everybody works right here.

[Leslie-College Eng]

I mean, you don't get to hear people talk about jobs, like big jobs, in like engineering like in other states. Like million dollar jobs and stuff.

[Leslie-College Eng]

Financial considerations for college may also provide students with a perception of a barrier. This concern is mentioned by many participants. While financial aid and scholarships often alleviate the concern, participants and families may lack the knowledge and understanding of the process to acquire assistance.

What's difficult is maybe money, a financial situation. I might not have the money to pay off college and my parents have already paid my sister off and they might not have enough for me. [Joseph-H.S.]

Other barriers mentioned include the perceived lack of preparation that students have received in their local school. The perception that college is difficult has Joseph nervous about his success in engineering in college:

People tell me all the time how hard college is and maybe that I won't be able to do it, but I'm pretty confident that I will be able to do it. [Joseph-H.S.]

Similarly, Alyssa and Leslie reflect on the difficulty level of the engineering path in college. Alyssa sees this difficulty as her primary barrier:

I mean it's just hard, but I mean, it's engineering, it's going to be hard. I don't really know of any obstacles that, I mean, just adjusting to college was the biggest one. [Alyssa-College Eng]

Alex shares a similar concern. His exposure to engineering through a course in high school has proven to be more difficult than he anticipated. The course showed him that engineering is more than an interest in math and building:

> The engineering class right now has actually turned out to be pretty hard so I'm wondering if I'm actually up to it, to get an engineering degree. I mean I like math and I like building and everything, but that doesn't mean I'd make a good engineer, so I'm pretty sure I can get it, but there's that one chance that, I mean there's always that chance that I couldn't get it. [Alex-H.S.]

Leslie attributes a portion of the barrier to her preparation level in high school mathematics:

> That's the only thing I'm really worried about is math…Like in high school it's like all rigged where it works out perfect. But when you get to college, it isn't rigged and you have to figure out how to get it to that point so you can then work it out. [Leslie-College Eng]

Finally, for some students, the transition to college itself is a potential barrier. Haley's decision to attend an in-state university for her bachelor's degree is a result of her perceived preparation level in her high school and her childhood in a rural area. Her dream includes a degree from MIT. To her, however, the jump from her rural community and education to MIT provides a perceived barrier to her success. Haley hopes instead to make baby steps from her local community, to an in-state university, and then obtain her Master's degree at MIT.

> I was looking into MIT for my Bachelor's degree but I was so, I felt like I'm so underprepared here that if I jump from here to Ivy League Boston it would be too big of a jump and I couldn't handle it. [Haley-H.S.]

In terms of academic preparation, actual barriers exist as some students hope to enter engineering in college. Destiny faces an ACT score that will not allow direct acceptance into a college engineering program. She hopes to enter in a general major and work for entry into biomedical engineering. This barrier has a slight negative influence on her confidence level.

> I'm pretty confident that I can do it. I'm going to have to go around it because my ACT score is not the highest, it's like 24 and that's why I'm going into UT as Arts & Sciences and when I take classes and stuff, I'm hoping I can go around it in a different way. [Destiny-H.S.]

Overall, however, these participants do not share many of the barriers to engineering career choice demonstrated by participants in the other categories. Their access to information, including formal programs and professionals, has helped them navigate past many of the typical barriers. Instead, their primary barriers typically involve academic issues. These participants can envision a career in engineering, but fear that the higher education involved will be a barrier to their success, specifically in terms of finances, transition away from home, and academic coursework in college.

4.5.4 Summary

For students in this category, exposure through a formal program helps students align activities they enjoy (building, fixing, how things work, science, math, and creativity) with an engineering career. In addition, access to professionals provides the

experience necessary to align the career with desired future attributes (work that provides job stability and financial security, work that is not physically demanding, work that has variety, work that helps others, and local or area employment), and typically reduces perceived barriers associated with ability. Formal experiences that introduce engineering include coursework through the PLTW curriculum offered in two of the school systems, science courses, CTE courses, and a summer engineering camp experience at a local university. Access to information varies between counties; however, as all school systems do not offer formal programs to engineering.

Access to professionals supports students' vision of engineering careers by alleviating fears that engineers may possess qualities or traits they do not have. This exposure and access to professionals also helps some participants realize that career options are available in the area. The perception of limited career opportunity is a critical concern for many participants in this category. Participants who perceive engineering as a career with opportunity in the area present a generally positive outlook toward a future engineering career. Participants that do not perceive engineering as providing opportunities in the area fear the career will remove them from home and family.

Notably, these perceptions vary among students. This variation could be influenced by proximity to a larger town (Cookeville, Chattanooga, etc.) as participants perceive more populated areas as providing more career opportunity. Participants within Bledsoe and Jackson counties seemed to describe more opportunities than their peers in Clay and Pickett counties, presumably due to their geographic proximity and access to larger towns. Even though all counties are rural and do not have interstate access, Clay and Pickett counties are farther removed from interstate access.

4.6 Conclusion

The results presented in this chapter inform the study's research questions and thus future engineering opportunities by presenting participants' perceptions of engineering careers across the three categories. Outside these categories, participants demonstrate commonality regarding descriptions of their community and desired future. The three categories, separated by access and intent to pursue, demonstrate differing perceptions of engineering careers. Participants in Category 1 typically have difficulty describing an engineering career as they have limited access to formal programs and professionals. Participants in Category 2 are able to describe perceptions of an engineering career based on their exposure through formal programs. However, these participants generally do not describe access to professionals, do not align the career with desired attributes, and perceive barriers to entry into the field. Participants in Category 3, however, often provide clear perceptions of an engineering career and align the career with desired attributes of their future profession. Typically, these participants report exposure through formal programs and access to professionals. Chapter 5 provides a synthesis of these results across the study's research questions.

Chapter 5: Discussion

This chapter synthesizes the results presented in Chapter 4 to address the research questions associated with the study.

RQ1 How do high school and college students from rural areas of the Cumberland Plateau perceive their future career?

RQ2 How do these students perceive engineering as a career?

RQ3 What supports these students in envisioning and pursuing a future self that includes an engineering career?

RQ4 What inhibits these students from envisioning and pursuing a future self that includes an engineering career?

To address these research questions, sections 1-4 provide a detailed discussion of each research question. Section 5.5 provides a summary across the questions. Before turning to the research questions, however, table 5.1 presents the results across the three categories described in Chapter 4. Table 5.2 then presents a brief overview of how participants in each category perceived engineering, as well as the supports and inhibitors to the development of a future self that includes engineering. This table establishes the basis of the chapter as the results associated with each research question better explain how access to both formal programs and professionals helps students develop a perception of an engineering career in their future and mitigate perceived barriers that inhibit entry into the field.

Table 5.1 Results by Category

Results Across By Category				
Category	**Participants**	**Access**		**Intent to Pursue**
		Formal Programs	**Professionals**	
1	16	0	1	0
2	8	7	3	0
3	15	13	11	15

Table 5.2 Engineering FPS Development by Category

Engineering FPS Development by Category			
	Category 1 Minimal Access- Minimal Intent	**Category 2 Access- Minimal Intent**	**Category 3 Access- Intent**
Engineering Perception:	None or "Engines"	Enjoyable Activities	Enjoyable Activities & Desired Career Attributes
Supports	N/A	Formal Programs	Formal Programs and Access to Professionals
Inhibitors	Lack of Understanding	Perceived Ability Gaps	Math

As the tables show,

- 39 participants are included in the study.
    - As described in Chapter 3, high school and college students shared common experiences regarding their career choice which, resulted in categorizing these participants together.
- Participants in Category 1:
    - Have little access to formal programs or professionals
    - Are inhibited by a limited understanding of the career
    - Do not intend to pursue engineering as a future career
- Participants in Category 2:

    - Have access to formal programs
    - Have limited access to professionals
    - Align engineering with activities they enjoy
    - Are inhibited by perceived gaps associated with academics and ability
    - Do not intend to pursue engineering as a future career
- Participants in Category 3:
    - Have access to both formal programs and professionals
    - Align engineering with activities they enjoy and desired attributes of their future career
    - Access has mitigated many of the perceived gaps associated with the ability necessary to become an engineer
    - Intend to pursue engineering as a future career

These results suggest that both formal programs and access to people with experience, including degreed engineers and professional trades aligned with engineering, support participants' pursuit of engineering as a future career. Participants with exposure through both formal programs and professionals are able to provide a more concrete description of an engineering career in their future, to align things they enjoy with an engineering career, and to view this career as providing them with outcomes they desire in their future. The remainder of this chapter uses the results of the study to address each of the research questions.

5.1 Perceptions of the Future

RQ1: How do high school and college students from rural areas of the Cumberland Plateau perceive their future career?

To understand how participants from rural areas of the Cumberland Plateau perceive their future career, it is important to look across participants, including those with and those without exposure to engineering. Generally, participants with and without exposure to engineering have similar desired attributes associated with their future careers. As described in section 4.2, participants hope their future career will provide 1) work that provides job stability and financial security, 2) work that is not physically demanding, 3) work that has variety, 4) work that helps others, and 5) local or area employment. As the FPS framework suggests, these attributes directly linked to the social, economic, and cultural traits of the study counties as the following discussion shows (Oyserman, 1995). Within this study, the Social Constructivist perspective was particularly important in highlighting this link between community norms and desired futures because this study design explicitly allowed the influences of participants' experiences within their community and cultures to emerge in association with their future plans. Previous studies, such as those by Goode (2007) and Holmes (2012), typically utilize frameworks that focus more on past and present experiences and conditions rather than future desired attributes and may not have captured these connections.

The attribute of a future career that seems most salient across participants is the desire for financial stability, including the ability to provide for their future families. In many cases, this desire emerges from feared futures as participants describe their parents'

stories of career struggles and layoff. Previous studies show that having these feared futures, or futures to avoid, can provide additional motivation in the development of a future self (Oyserman, 1990b). This effect is evident for Brooke, for example, as she describes her parents' career paths from high school to work at the local clothing factory, when, as they told Brooke, they saw no need to pursue higher education. The local factory provided satisfactory income with a high school diploma. But the clothing factory relocated to Mexico during Brooke's childhood, leaving her parents in a struggle to find employment. This scenario is common among participants across the study counties. Data for the four study counties show that 19% of individuals in the study counties fall below the poverty line, with an average household income of only $32,000 (Appalachian Regional Commission, 2013a). And this problem is not unique to rural areas in the Cumberland Plateau. The ARC reports that during the period of 2000-2008 farming, forestry, manufacturing and utilities saw large declines throughout Appalachia (Appalachian Regional Commission, 2013a). Thus, family experiences and employment struggles in the rural counties shape how participants come to view job security as a primary concern associated with a future career. Without the focus on localized issues that these students face, this important finding might have been missed. These findings reinforce the need for localized, empirical research called for previously (*Raising Public Awareness of Engineering*, 2002; Valla & Williams, 2012).

In addition to job security and financial stability, participants have specific desires related to the nature of their career. For these participants, this includes work that is not physically demanding and provides variety. Historically, valued work in the Appalachian region has been physical rather than technical and professional (Bennett, 2008). But data

from this study shows that family members who have worked many years in manufacturing and other careers requiring physical labor now give these participants a sense that such work is often monotonous and taxing, and thus a future to avoid. As a result, many participants hope that higher education will provide them with career paths that are not as strenuous and are more varied. Typically, participants reported that their parents support higher education as a path toward work that is less physically demanding. Prior FPS research shows having futures to avoid can be very beneficial in inspiring the pursuit of a hoped for future by providing balance and additional motivation (Oyserman, 1990b).

Participants also hope their future work will be meaningful. For participants in the study counties, this meaning seems to have a strong connection with giving back and helping others through their career, a value linked closely to their descriptions of the local cultures. Participants often described their communities as being very supportive with a strong sense of security. This strong connection with community and family appears important among other underrepresented groups as well, particularly those in other rural settings (Marshall, 2008; Young, 1997). Among these students, the close relationships and connections with helping others transfer into desired futures for careers that allow them to give back and help - a desire that is not typically associated with other underrepresented populations. For example, both Goode (2007) and Holmes (2012) present the importance of intervention and mentors as underrepresented students (female, racial minority, etc), navigate toward STEM career, but do not focus on external influences such as community or the desired nature of students future work. However, previous studies utilizing the FPS framework do present results regarding the desired

nature of students' future work, including components such as caring or making a difference (Marshall et al., 2011; Young, 1997).

Finally, the cultures within much of rural Appalachia provide strong family and community ties, lower crime rates, close friendships, and highly supportive communities (Bennett, 2008). Prior research suggests that Appalachian individuals have a strong desire to remain close to home because of connections to the area, support from family and friends, and relatively high satisfaction with life (Bennett, 2008). The same is true with this group of participants. Similar to previous research regarding Appalachia such as that by Bennett (2008), participants in these study counties described their communities in very positive terms, and many participants have a large family base in the area. As a result, many participants hope their career choice will provide them with a very local job, while others will accept employment within the area provided it still keeps them close to home. Given the economic conditions previously described, they often realize that their career may take them away from their rural community.

Participants seem to accept the idea that their career choice may not provide them with local work, but they have an acceptable range within which they are willing to commute or relocate. Acceptable commuting distances seem to be approximately 1-hour for these participants. This includes career opportunities in Chattanooga for students in Bledsoe County and Cookeville for those in Jackson, Clay, and Pickett. Some participants in Jackson and Clay counties described their parents' careers in Nashville, indicating that Nashville may be within commuting distance for participants on the western edge of the study counties.

The acceptable radius for relocation among these participants varies, but typically includes a 2-3 hour drive from their home. Presumably, this encompasses cities they are familiar with, including Nashville, Knoxville, and Chattanooga. Based on the findings in this study, jobs within this 2-3 hour radius can be considered area opportunities. Notably, Young (1997) found similar results in rural Australia where the support of family and friends, career location, and a reluctance to leave home had a large impact on career choice. Young (1997) found that these rural students understood the benefit of higher education, but realized that associated careers were not available in their rural area, similar to findings among these participants. This study utilizes the FPS framework and provides evidence that students in rural parts of Australia, similar to participants in this study, recognize that many careers associated with higher education may require leaving home. Given the importance of being "close to home" for rural students, it is critical for both education and industry stakeholders to understand what constitutes a viable geographic range in order to effectively target outreach and economic development opportunities, as discussed in more detail in Chapter 6.

In considering these desired attributes, one thing worth noting is the attraction to medical related careers, including nursing, pharmacy, dentistry, therapy, counseling, and veterinary careers. Eighteen participants, almost half, indicate a medical related career as their future career choice. Such careers match all of the desired attributes. They are highly visible in the study counties, offering both financial security and local opportunities. In addition, participants often indicate that the medical field will provide them with varied work and the ability to help others. Participants seem to have a high level of exposure to these careers, and their families support them as careers providing

financial security. This support may be related to the recent trend noted by Smith (2012) in which educational services, healthcare, and social assistance jobs have moved ahead of manufacturing and now account for a higher percentage of jobs in the area. This shift is significant because findings from previous studies suggested that career choice is heavily influenced by personal interest and social supports, which might explain the concentration of medical careers (Dick & Rallis, 1991; Lent et al., 2002). Also, it is noteworthy that female participants interested in medical careers did outnumber the male participants in this study. However, as previously noted, high school participants were recruited by stakeholders within their schools and participation was voluntary. Moreover, the analysis did not seek to make gender inferences regarding engineering or other career choices. As a result, more research would need to be done to determine the trustworthiness of this pattern. The study findings do indicate, however, that students often describe access to both formal programs and professionals in the medical field.

This finding is supported by the FPS framework, which shows that a future possible self is developed through models and images presented through social experiences (Markus, 1986). Similarly, research shows that within rural areas, individuals' lack of exposure to career options which limit their range of future possibilities (Robinson, 2003; Shepard, 2003; Shepard & Quressette, 2010). The high visibility of medical careers to students and parents, coupled with the limited range of career options in these rural communities, may provide some insight into the high number of participants who see themselves as a medical professional in the future. This finding suggests one key path forward (discussed in more detail in Chapter 6) for future efforts to

support engineering FPS development in the study counties, and other areas featuring similar challenges.

5.1.1 Summary

Participants from rural areas of the Cumberland Plateau perceive several desired attributes of a future career including; 1) work that provides job stability and financial security, 2) work that is not physically demanding, 3) work that has variety, 4) work that helps others, and 5) local or area employment. Several of these attributes align with previous research into career choice in Appalachia and with demographic and cultural patterns of rural Appalachia, and specifically, patterns reported by participants in the study counties (Ali, 2006b; Bennett, 2008). However, the shift away from physical work found in this study represents a deviation from past studies, though it is clearly linked to the local economic conditions. This connection, aligning the participants' culture and desired attributes of their future, are unique findings made possible by the lens of the FPS framework. These findings show that participants' socio-cultural experiences within their communities shape similar desired attributes of a future career. In this case, participants' desired future attributes align closely with their experiences growing up in a rural area of the Cumberland Plateau:

- Job stability and financial security are often linked to struggles associated with the decline of manufacturing in the area.
- Mentors encourage participants to seek work that is not physically demanding in reaction to the historical focus on physically demanding work and manufacturing related careers that have disappeared.

- The desire to help others is strongly associated with descriptions of supportive family and community values.
- Participants typically hope to remain close to family, creating a desire for opportunities within the area.
- Medical fields seem to resonate as careers that align with these desired attributes, likely due to their high visibility, which provides participants and families with the experiences necessary to align these careers with their desired attributes of a future career.

5.2 Perceptions of Engineering

RQ2: How do these students perceive engineering as a career?

To understand how these students perceive engineering as a career, it is important to separate these perceptions across participants with exposure to engineering through formal programs and access to professionals, and those without. Participants in Category 1 have little to no exposure. Lack of exposure to a full range of career options is common in rural Appalachia, and has been previously described as limiting career choice options (Ali & Saunders, 2009; Spohn & Crowther, 1992). In other rural areas, studies utilizing the FPS framework found similar results, indicating that a lack of exposure to career options limits an individual's number of occupational selves (Robinson, 2003; Shepard, 2003; Shepard & Quressette, 2010). These limitations are evident among participants in Category 1. Of the participants in this category, only one describes access to a professional, reflecting the limited visibility of the field within the study counties. When asked what an engineer is, participants in this category often state that they do not know,

eliminating the possibility of envisioning engineering as a future career choice. Other participants, when asked, refer to an engineer as an auto mechanic, as described in section 4.3.

Participants in Category 1 who have some social access to engineering through peers tend to associate the field with bridges, electricity, and building but still lack a clear vision. For example, Noah, who mentions a friend in electrical engineering, enjoys building and construction. He makes associations between this interest and engineering and describes his mother as supportive of a career in electrical engineering, as the future career will provide financial stability. Even with his mother's support and some connections to building, construction, and electricity, however, Noah simply admits that he is not sure what electrical engineers "build" and he has no plans to pursue an engineering career.

Overall, then, participants with minimal exposure through formal programs typically have a very limited perception of engineering as a career. These participants may be able to link engineering to certain skills or interests such as math or building, but do not indicate any vision of a future career in engineering. Most importantly, other than Noah's connection between engineering and the attribute of financial stability, these participants do not typically associate engineering with the attributes they desire in a future career.

In contrast, those participants in Category 2 begin to develop a perception of an engineering career in their future as their experiences with formal programs help them align the field with activities they enjoy. Participants often describe their formal program as one that helped them to associate engineering with their enjoyment in building, fixing,

how things work, science, math, and creativity. As the FPS framework suggests, for participants to develop a future self that includes engineering they must have the experiences necessary to align the career with activities they enjoy. This access through formal programs represents a form of intervention, and prior FPS research has shown that interventions can be very effective in enhancing students' vision of their possible selves (Oyserman, 2002, 2006, 2007). Previous research with underrepresented groups also supports classroom activities as an important support structure for STEM careers (Goode, 2007; Marshall, 2008). For participants in this study, classroom and other formal activities supported the development of a future that includes engineering by aligning the career with activities they enjoy. However, these participants often describe perceived gaps associated with academics and the general ability necessary to become an engineer and do not link the field to attributes they are looking for in a career, as seen in Section 4.4.3.

Participants in Category 3, with exposure through formal programs and access to professionals, do associate engineering with desired attributes of their future career particularly when they plan to become engineers in the future. The perception that an engineering career aligns with activities participants enjoy is important to begin the exploration of a future career in engineering, but it is not sufficient. As section 4.5 demonstrates, participants who envision their future in engineering also view the career as aligning with desired attributes of their future, often as a result of a relationship with professionals who act as mentors. In addition, these relationships typically helped to mitigate participants' perceived gaps associated with the ability necessary to become an engineer. Relying on the advice of mentors is common among students interested in an

engineering career, as they typically rely on these socializers more than their peers (Dick & Rallis, 1991).

The finding that students in these study counties need experiences that link careers to both activities they enjoy and attributes they desire in their future career is key to understanding how to help more students in the area envision engineering as a possible career, and thus expand their access to career choices. Both Destiny and Logan, for example, clearly associate engineering with both activities they enjoy and desired attributes of their future career. For Destiny, a degree in biomedical engineering does both by aligning her interest in how things work with her desire to help others in the future:

> I just like, just how **I love actually looking at how things work** and **figuring out how they go together**. I'm just really interested in that, and like, I want to do something in healthcare too. So, I just thought it was a good fit. At first, I kind of wanted to be a dentist. I wanted to go for that, and then I kind of figured out that I'm not really…being in somebody's mouth and stuff like that. So I'd rather not do that…so **I wanted to do something where I could actually help but in a different part of it**. [Destiny-H.S.]

For Logan, his perception of engineering aligns with his interest in building and designing that he developed making cabinets with his grandfather:

> My grandpa would tell me, **I liked to build cabinets with him**, and he said **there's not much money** because he didn't graduate high school. He told me I didn't need to be doing that. **I need to go to college and make the easier money instead of slaving**. [Logan-College Eng]

Logan's grandfather helped him perceive how a future career in engineering would align with his interest in building and designing, but provide him a more financially rewarding and less physically demanding career in his future.

5.2.1 Summary

The synthesis of findings presented in Research Question 1 show that participants across all categories demonstrate similar desired attributes of a future career based on their experiences growing up in rural areas of the Cumberland Plateau. These participants differ, however, in their perception of engineering as a result of their previous exposure to engineering through formal engineering programs and professionals. Without exposure to engineering through formal programs and professionals:

- Participants often cannot describe their perception of an engineering career.
    - Some perceive an engineering career as an automotive mechanic or other such technical career.
    - Some describe a perception limited to one specific topic such as "bridges," "electricity," or "building."
- The only attribute typically associated with engineering is financial security.

With exposure to engineering through formal programs:

- Participants are able to provide a perception of engineering as a career choice in their future.
- Participants link this perception to activities they enjoy.
- Participants typically demonstrate perceived gaps between their ability level and that necessary to become an engineer.

With exposure to engineering through formal programs and access to professionals:

- Participants are able to align a future career in engineering with the desired attributes of a future career.
- These relationships often mitigate perceived gaps in the ability necessary to become an engineer.

5.3 Supports

RQ3: What supports these students in envisioning and pursuing a future self that includes an engineering career?

Drawing on the findings from the first two research questions, this section describes supports that help students envision their future self as an engineer. To frame supports to engineering career choice among these participants, it is important to reflect on how participants view their future career. Recall that participants in the study area, regardless of career choice, display similar desired attributes in their future. The FPS framework indicates that possible selves are made salient through socio-cultural and historical context and developed through social experiences. (Markus, 1986). Not surprisingly, then, participants' desired future attributes align with their description of community and previous career related experiences. But while all participants in this study share similar experiences with cultures and community, thereby developing similar desired future attributes, the same is not true for engineering related experiences. These participants provide evidence that the supports necessary to develop a perception of an engineering career in the future include both access to formal engineering programs and access to professionals.

5.3.1 Access to Formal Programs

Access to formal engineering programs through a course in school or an engineering camp experience provided students with experiences that support their ability to envision a future in the engineering field. Previous studies utilizing the FPS framework with underrepresented groups found that such interventions influence participants perceptions of their future career and life paths (Kao, 2000; Oyserman, 1995, 2002; Oyserman, 2004b; Oyserman, 2006, 2007; Oyserman et al., 2002). The same is true among participants within this study. Table 5.1 shows that as participation in formal programs increases, so does the number of students planning to pursue engineering careers in the future. With limited access to engineering careers within the study area, this access to formal programs emerged as a dominant support to engineering career choice; only one participant who did not participate in a formal program plans to pursue an engineering career, and this participant has strong access to the field through a close family member. Formal engineering exposure has been shown to affect career choice in previous studies as well, with both teachers and classroom activities playing important roles (Goode, 2007; Marshall, 2008).

The findings from this study complement previous work by demonstrating how effective formal exposure links engineering to activities the participants enjoy. Young (1997), referred to these activities as personal interests and also found that students in rural Australia were more likely to pursue an engineering career if they made these associations. Activities participants in the present study enjoy and associate with engineering include building, fixing, how things work, science, math, and creativity. Among this group of participants, formal programs typically provided participants with

the experiences necessary to associate engineering with these activities, helping them develop a perception of an engineering career in their future.

While previous research does not typically identify attributes associated with engineering as this work does, it does point to formal academic programs as important in students' pursuit of engineering careers. These academic programs are often in the math and science fields showing that students success in these courses can be an indication of future engineering or STEM related careers (Dick & Rallis, 1991). Studies also show that without early intervention, students lose interest in math and science, which, in turn, limits entry in to STEM fields (Faud, 1995; Gooden et al., 2010; Hanesian et al., 2004; Valle & Steen, 1989). The qualitative methods used in this study allowed students to express in more detail how such coursework influenced engineering career choice. This detail, in turn, resulted in more specific findings related to the activities students in these study counties may enjoy, rather than simply focusing on "success" in math and science courses. It also helps explain how these activities relate to engineering career choice and how the formal programs linked the two together. The findings indicate, moreover, that these links were made not only by a formal PLTW course, but also through existing coursework in the school such as physics and CTE courses, as well as out of school through an engineering camp experience at a local university.

5.3.2 Access to Professionals

In most cases, however, formal exposure alone does not account for participants' ability to envision a future in an engineering career. As Markus (1986) explains, social experiences are important in the development of possible selves. While formal programs provide social experiences and interaction with teachers, access to professionals provides

additional support in the development of an engineering career as a future possibility. Work that has been done regarding vocational choice within rural Appalachia also shows that supporting role models are key variables that students need to value and envision future careers not often found within rural Appalachia (Ali, 2006a, 2006c; Bennett, 2008; Chenoweth, 2004). Role models prove to be a support that helps students envision a future career in engineering in this area as well. Table 5.1 also shows this relationship. Participants in Category 3, those who intend to pursue an engineering related field, demonstrate a higher connection with professionals than participants in the other categories. Importantly, this study makes it clear that these professionals need not be engineers; they can be participants who work with engineers or whose work in trade professions links them to engineering work.

One of the ways access to professionals supports students' visions of their future engineering self is explained by Haley's description of her internship:

> I think it helped me a little bit 'cause I knew what I would be going into. **I knew that it wasn't as terrifying as I thought it was going to be**. I knew that it wasn't going to be as strenuous, it was going to be more, **I mean a lot of those people, they weren't straight A students or anything, but they were good at what they did**. So that gave me confidence, so I knew I could do it. [Haley-H.S.]

Haley's access came through an unpaid internship at an engineering firm she secured after her exposure through a course in high school. Upon meeting the engineers, she realized that the career is one she can succeed in. Valle and Williams (2012) support the idea that without such exposure, students underestimate their abilities and develop misconceptions about the type of people who achieve STEM careers. This sense of

confidence resonated with findings from Marshall (2008) as she found classroom activities important, but access to mentors was critical in developing science related possible selves. For Haley, and many other students, this access to professionals was a critical factor in mitigating misconceptions about the type of person who achieves an engineering career. Participants without access to a professional often described a barrier associated with a perceived gap between their ability and that necessary to become an engineer. In strong association with these students' close-knit connections within their community, a close connection with a professional seems to be critical for students as they begin to consider engineering as a future career choice. This connection appears to mitigate the perceived gaps associated with the ability necessary to become an engineer.

Similar to the way socio-cultural experiences within these communities supported participants' development of attributes they hope for in a future career, access to professionals provided participants with the experiences necessary to make associations between engineering careers and these desired future attributes. Typically, participants relate engineering careers with financial security; however, as demographic data presented in section 2.3 shows, access to engineering careers may be limited within the study counties. Participants with access to professionals in engineering and related fields often began to understand the availability of engineering opportunities, and begin to associate other attributes, particularly "helping" with the engineering field.

As noted above, while the professionals are often degreed engineers, professionals in trades aligned with engineering can also support the development of engineering as a future career possibility. This is an important finding within this area as access to engineers can be limited. Steven and Eli discuss their fathers, an electrician and

machinist, as instrumental in their decision to pursue engineering as a career choice. Similar to findings on first generation female students by Trenor (2008), whether the support came from an engineer or a mentor with experience related to the engineering field, it is clear that access to professionals supports students' ability to envision themselves as an engineer. Trenor (2008) described these mentors as providing the social capital necessary to aid a student's pursuit of an engineering degree and profession. Similarly, for these participants, these relationships seem to provide the social capital necessary for the development of engineering as a future possible self.

5.3.3 Summary

Findings from this study show that access to both formal programs and professionals support the ability to envision a future self that includes engineering. Participants with access to formal programs and professionals demonstrate a set of socio-cultural experiences that support their ability to envision themselves as an engineer in their future. The following list further explains these supports:

- Formal programs mentioned as supporting engineering include a PLTW course, a physics course, CTE courses, and an engineering camp experience at a local university.
- Formal programs help students align activities they enjoy with an engineering career.
    - These activities include building, fixing, how things work, science, math, and creativity.
- Access to professionals helps students align an engineering career with their desired attributes of a future career.

    - These attributes include work that provides job stability and financial security, work that is not physically demanding, work that has variety, work that helps others, and local or area employment
- Access to professionals also helps participants navigate beyond misconceptions about the type of person who becomes an engineer, mitigating perceived ability gaps.

5.4 Barriers

RQ4: What inhibits these students from envisioning and pursuing a future self that includes an engineering career?

As explained in the previous section, students planning to pursue a future career in engineering describe support in two areas: 1) exposure through formal programs, and 2) access to professionals. In contrast, as table 5.2 shows, participants in Category 1, without access to formal engineering programs and professionals, are less likely to envision an engineering career in their future. This lack of exposure limits these participants' engineering FPS as they simply don't have a concrete perception of engineering as a career. This finding supports prior research, showing that a common barrier to career choice in rural Appalachia is a lack of role models with post-secondary education and professional careers (Ali & Saunders, 2009; Spohn & Crowther, 1992). Similarly, previous FPS research in rural areas shows that pervasive lack of exposure to multiple career options limits individuals' occupational future selves (Robinson, 2003; Shepard, 2003; Shepard & Quressette, 2010; Young, 1997).

However, two other barriers emerged that also align with prior research: 1) the perception that participants may lack the ability necessary for success in engineering school, which is linked to Social Cognitive Career Theory, and 2) the perception that engineering may not provide a local career opportunity, which is linked to previous work around career choice in rural communities (Marshall et al., 2011; Young, 1997). While additional barriers do exist among these participants, such as financial considerations for college, these barriers are not specific to engineering career choice and are not addressed as part of this study. The section below discusses each of these barriers in association with access to formal programs, access to professionals, and the perceived ability necessary to become an engineer.

5.4.1 Access to Formal Engineering Programs

Research Question 3 describes exposure to engineering through formal programs as a primary support to engineering career choice among these participants. Participants in Category 1 do not describe such access. During the interview, these participants struggled to articulate a perception of an engineering career. Previous research on engineering and STEM career choice supports this barrier, demonstrating that without early intervention, students begin to lose interest in math and science related subjects (Faud, 1995; Gooden et al., 2010; Hanesian et al., 2004; Valla & Williams, 2012). This intervention becomes a higher priority among underrepresented groups as, similar to this area, students often lack a full range of career exposure in their local community (e.g., Ali & Saunders, 2009; Bennett, 2008; Chenoweth, 2004; Goode, 2007; Young, 1997).

For these participants, lack of access to formal programs leaves participants without the experiences necessary to describe an engineering career or link engineering

with activities they enjoy. As previously described, these experiences are critical in the development of FPS (Markus & Nurius, 1986). Without these experiences, participants typically articulate no perception of engineering as a future career, misconceptions about the career, or only abstract descriptions of engineering activities. Makayla demonstrates that her lack of exposure limits engineering as a career choice in the future:

> I'm just really ignorant when it comes to… I know what basically a, you know, a bridge engineer does, but, like, **I don't even know a lot of the careers that come with engineering**. [Makayla-H.S.]

While Makayla is able to articulate her lack of understanding, many participants demonstrate misconceptions regarding engineering careers, such as associating engineers with auto mechanics. Emily demonstrated this misconception as she described engineering, "like, I think of engines and stuff like that whenever I think of engineer."

As Makayla and Emily demonstrate, access to formal engineering programs is critical among these participants, where of the 16 participants in Category 1 without access to a formal program, only 2 had any potential interest at all in the field. Even these participants who demonstrated some interest were unable to concretely articulate a perception of an engineering career in their future. Without these experiences, participants did not have the background necessary to develop a perception of engineering in their future, eliminating the possibility of an informed decision related to engineering as a career choice.

5.4.2 Access to Professionals

As demonstrated by Research Question 3, access to professionals supports the development of a future self that includes an engineering career. As shown, this support

aligns with previous research and the FPS framework (Ali, 2006a, 2006c; Bennett, 2008; Chenoweth, 2004; Markus & Nurius, 1986). Limited engineering opportunities within these rural communities can create a barrier for students as they lack access to professionals working in engineering careers. This barrier is most evident among participants with exposure through a formal program presented in Category 2. These participants begin to describe their perception of engineering, but without access to engineering professionals typically do not associate engineering with desired attributes of their future career. Often, these participants describe their intent to pursue alternate careers, citing the professionals they know in that career as key drivers. In addition, participants without access to professionals typically describe more barriers to entry into the engineering field than their peers with access to both formal programs and professionals. Barriers commonly identified include a perceived lack of ability and a fear that career opportunities are not available.

5.4.3 Ability

Participants without access to professionals often describe misconceptions regarding the abilities necessary to become an engineer. Valle and Williams (2012) present a similar finding describing that, without intervention, students hold misconceptions about the type of person that may become an engineer. Participants tend to describe engineers as possessing a general "ability" and/or high competency in mathematics that is beyond their capability. This is true for Ashley, for example, as she described the work engineers do as being difficult every day. She provides the following quote when discussing this ability that she does not possess:

> Like building a building, I mean that, that'd be, I'd be afraid I'd crash it or something. [Ashley-H.S.]

Like many participants, Ashley's description of this "ability" is vague, but she holds the perception that an engineering career is beyond her capabilities. Brooke describes this as "skill:"

> I thought it was very interesting and it takes **a lot of skill to be an engineer**, skill that I don't think I have, but I think, I don't know, it's an important job. [Brooke-College Non-Eng]

Both Ashley and Brooke describe how their formal program helped them develop an appreciation for the field, but neither student mentions access to a "real" engineer. While both participants plan to become professionals in the medical field, they perceive engineers as possessing abilities or skills beyond their capability.

While access to professionals typically eradicates the barriers associated with this general "ability," the perception that engineering requires a high competency in math, and that engineers "do math" is a barrier that is often seen among participants, regardless of exposure levels, and is even described by college engineering students. Lauren and Lydia both have exposure through a formal program and access to professionals. Neither student plans to become an engineer, and both cite math as a deterrent to a future career in engineering. Lauren describes her disability with math as a barrier to computer engineering:

> Well, when I started, when I got accepted to [University], I was a computer engineering major. But I have a **disability for math** and you kind of **can't be an engineer without math**. I'm good at science, it's just math.

[Lauren-College Non-Eng]

Looking across previous research, a common theme regarding engineering success is competency in math- and science-related subjects. While this competency may provide an indicator of success in engineering programs, this relationship may also reinforce perceived ability gaps. Other studies show that teachers often do not have the knowledge necessary to inform their students about engineering (Ross, 2012). If teachers' knowledge of engineering is limited to the research showing that high marks in math and science are critical indicators for engineering success, teachers may, unknowingly, reinforce these perceived ability gaps and therefore track only high math- or science-achieving students toward engineering. This finding also points to one of the limitations of the study noted earlier, as stakeholders within the school typically recruited seemingly high achieving math and science students for this research.

Supporting the possibility that teachers and mentors may reinforce the link between math/science ability and engineering, and thus unintentionally limit engineering career choice, is the finding that almost half of the participants interviewed are interested in medical fields. While these fields also include an academically-intense focus on math and science subjects, participants did not describe the same academic barriers to these fields. That is, in contrast to engineering, participants did not typically mention concern about science or math abilities as limiting their pursuit of a medical career. Notably, medical fields are more visible in the study counties which may mitigate negative perceptions because both teachers and students know "ordinary" people who have succeeded in these careers. Higher visibility of medical careers in the area also increases students' social capital as they know individuals with medical careers. As shown by

Trenor (2008), social capital can provide initial exposure to a career, support navigation through higher education, and provide career opportunities in the future. In addition, many participants described formal programs linked to medical careers within the schools, which may also mitigate perceived barriers into entry.

5.4.4 Area Career Opportunities

In addition to a perceived lack of ability, the perception that an engineering career will require relocation is a common fear among participants in this area. Throughout rural Appalachia, individuals hold a strong desire to remain in their local area (Bennett, 2008). This is also true among participants from rural areas of the Cumberland Plateau. Specific to engineering, little work focused on this phenomenon, but Young (1997) found location to be a similar barrier in rural areas of Australia, where many were not willing to relocate for a career.

The perception that an engineering career may force relocation outside the area can inhibit engineering as a future career choice among these participants. The perception of engineering opportunities within the area varies among participants, but access to professionals seems to provide exposure to available careers in the area, thereby reducing this barrier among these participants. For example, Eli's exposure through his father, an electrician with the Tennessee Valley Authority, has provided exposure to a range of career options for electrical engineers within commuting distance of his home.

As shown in Chapter 2, opportunities do exist within commuting distance for those who hope to remain in the area; students hoping to remain close to home have access to numerous opportunities, as the study counties are within proximity of the metropolitan communities and opportunities that exist in and around Nashville,

Knoxville, and Chattanooga. However, these opportunities are not always visible or known. Access to professionals from the area can be an important intervention as they help students align engineering with desired attributes of their future career, particularly helping students see opportunities that exist with an engineering career.

5.4.5 Summary

Barriers identified in this study that are related to engineering career choice include a lack of access to formal engineering programs and professionals, misconception of the abilities necessary to be an engineer, and a perception of limited area career opportunity. The following list further explains these barriers.

- Without exposure through formal programs, participants typically lack the experiences necessary to associate engineering with activities they enjoy, thereby limiting their perception of engineering as a future career.
- Without exposure through professionals, participants typically lack the experiences necessary to associate engineering with their desired attributes of a future career, thereby limiting their perception of engineering as a future career.
- Regardless of exposure levels, participants typically associate high levels of competency in math with a career in engineering, limiting some participants' entry into the engineering field.
- Participants often associate engineering with a misconceived "ability" that they do not possess providing a barrier to entry into the field. Exposure to professionals seems to reduce this barrier.
- Participants often perceive engineering as a career that would require relocation outside of their community, which many participants are unwilling to do,

providing a barrier to entry into the field. Exposure to professionals seems to reduce this barrier.

5.5 Conclusion

This research shows that students in rural, non-interstate, non-coal counties along Tennessee's Cumberland Plateau are often not exposed to engineering outside of school. However, these participants' socio-cultural experiences provide them with attributes they desire in a future career. Without formal programs and access to professionals, participants lack the experiences necessary to link engineering to these attributes. Exposure through formal programs provides the experiences necessary for participants to align engineering with activities they enjoy, including building, fixing, how things work, science, math, and creativity. This alignment seems to spark the start of a vision of engineering as a future career choice. This vision is further supported through access to professionals who provide the social experiences necessary for participants to view an engineering career as providing attributes participants desire in a future career.

In addition to providing the experiences necessary to develop a perception of engineering as a future career, exposure through access to professionals is often critical to eliminating perceived barriers. Barriers include beliefs that engineers possess "ability" beyond participants' reach and that opportunities are not available within their area. Connections with professionals help participants view engineers as "real," eliminating the perception that they may not possess the ability to become an engineer. In addition, connections helped participants to understand that career opportunities do exist within the greater area, and that an engineering career may not remove them from their home and family if they desire to remain close. However, one barrier that access to professionals

did not eliminate is associated with math. Participants often fear their math skills will prevent entry into the engineering field in the future, a perception that exists across all categories, even among the college engineering students.

Supports to the development of engineering as a future career include exposure through formal programs and access to professionals. This exposure provides the experiences necessary for participants to develop a perception of engineering in their future and the ability to make an informed choice regarding entry into the engineering field. As shown throughout this chapter, exposure to formal programs matters, but aligning this exposure with access to people seems to matter most in the development of a future engineer.

Findings show that access to, and relationships with, professionals is a key to helping these students fully develop a perception of an engineering career in their future. This finding is also key to future intervention aimed at these study counties. This finding supports the need to study engineering career choice in localized regions to understand how geography and cultures impact students' access to engineering and their perceptions of the field. While formal programs are important, professionals help students mitigate barriers, and these connections solidify accurate perceptions of engineering futures. This finding informed the title phrase, "People not Print," to reinforce the finding that for students in these study counties, personal connections are the key.

Chapter 6: Implications and Future Work

The discussion presented in Chapter 5 shows that, across counties, participants display similar characteristics related to future career choice, with clear patterns in terms of engineering careers. Without access and exposure to formal programs and professionals, students in the area generally do not have a concrete perception of engineering as a career. This gap is likely related not only to limited exposure through formal programs, but also to limited access to professionals in the field, as few engineering careers exist within these rural counties. Participants with exposure through formal programs typically align activities they enjoy with a career in engineering. While this can spark the start of engineering career exploration, only participants with access to professionals also consistently align an engineering career with attributes they desire in a future career. Participants with exposure through formal programs and access to professionals are better able to describe engineering in their future. However, barriers to engineering career choice do exist in the study area, including the perceived academic abilities necessary to be an engineer and a perceived lack of career opportunity close to home. Among participants, those with exposure through both formal programs and access to professionals provide the clearest description of engineering as a future career and describe the fewest barriers specific to engineering.

Section 6.1 presents a visual model of these patterns. Ideally, this model could be used to increase access to engineering as a viable career choice in the study area by providing stakeholders with the information necessary to develop appropriate intervention for students. As a result, this chapter also provides suggestions for these

stakeholders that may provide students with the ability to make an informed choice regarding engineering as a career and future work aimed at further exploring engineering career choice in rural Appalachia.

6.1 Engineering Future Possible Self Development Model

Based on the results of this study, Figure 6.1 presents a model to describe how students in rural areas of the Cumberland Plateau develop the ability to envision their future self as an engineer. This study shows that, in general, students in this area often lack exposure to engineering, which creates multiple barriers. Students who intend to pursue engineering, in contrast, often describe formal experiences and access to professionals that help them gain entry into the field. The model visually represents both the barriers and the supports provided by formal exposure and access to professionals.

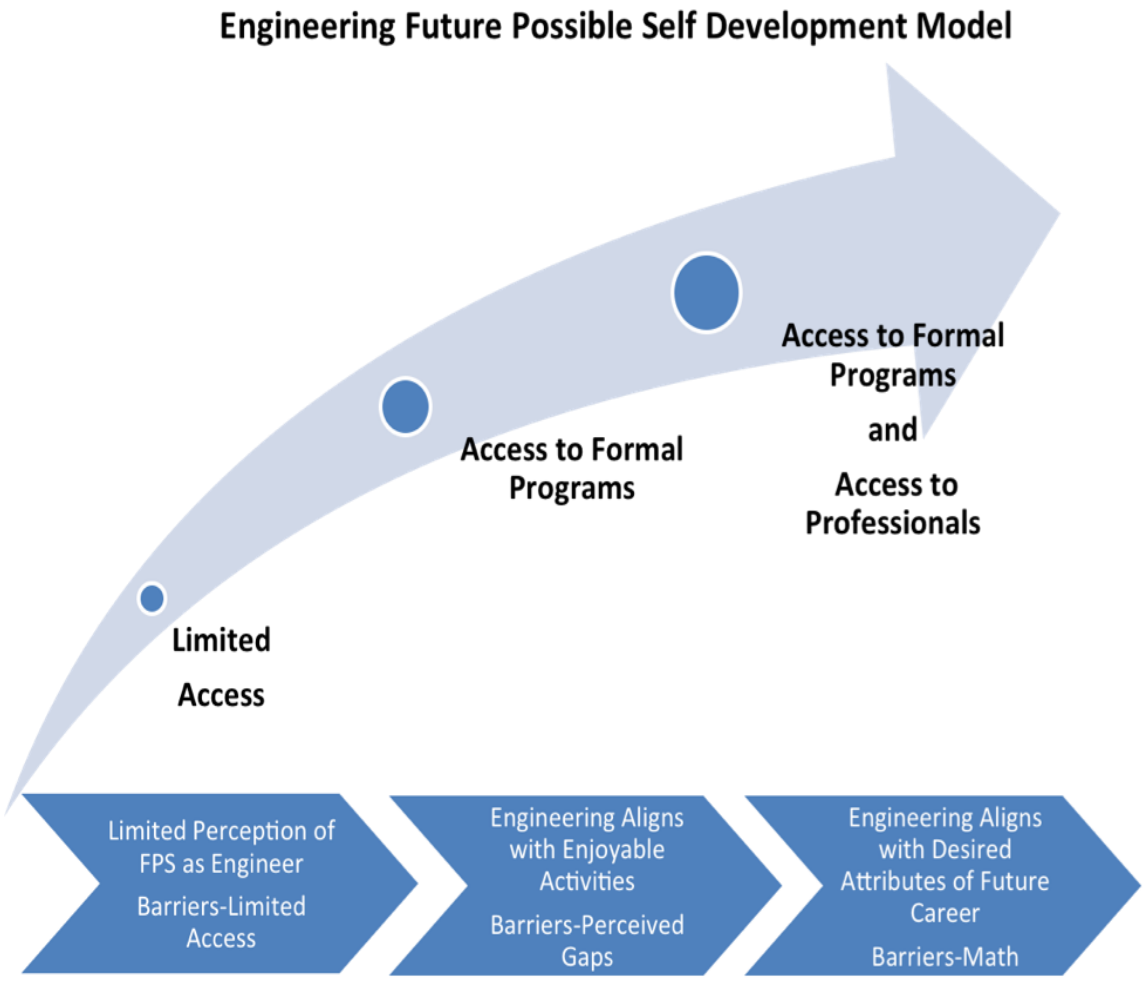

Figure 6.1 Engineering Future Possible Self Development Model

Based on results of the study, this model provides a visual representation of how students in rural areas of the Cumberland Plateau develop perceptions of a future self that includes an engineering career. These patterns became clear as results were synthesized across the four research questions of the study. The model can be divided into three categories, which represent phases of future possible self development identified by this study. These include limited access to formal programs and professionals, access through a formal program, and access through formal programs and to professionals. While this development may not be truly linear, the results of this study show that exposure through both formal programs and professionals provide students the experiences necessary to perceive engineering as a future career.

6.1.1 Limited Access

Students with limited access to formal programs and professionals demonstrate a limited understanding of engineering careers. Without this exposure, engineers, if perceived at all, are described vaguely in association with things such as “bridges” or via misconceptions conflicting engineers with auto mechanics. Through the lens of FPS, these students lack the background experiences necessary to properly develop a vision of an engineering career in their future. These students do, however, have socio-cultural experiences within their community that shape their vision of the future. For students in rural areas of the Cumberland Plateau, these experiences result in a set of desired attributes of their future career that include job stability, variety, meaningfulness, and area employment. However, these participants typically do not have the background experiences necessary to link these attributes to a career in engineering.

6.1.2 Access to Formal Programs

Formal programs identified by participants in this study include a Project Lead the Way (PLTW) engineering course, a physics course, various Career and Technical Education (CTE) courses, and an engineering camp experience at a local university. This type of exposure seems to spark the start of engineering FPS development by aligning engineering with activities students enjoy. Activities identified by participants of this study include building, fixing, how things work, science, math, and creativity. These experiences provide students with the ability to develop a perception of engineering as a career; however, these preliminary perceptions often include barriers. Common barriers include perceived gaps in the qualities necessary to be an engineer. These qualities include high levels of academic ability, particularly associated with math, and a general misconception that engineers possess a special "ability" or "skill."

6.1.3 Access to Formal Programs and Professionals

FPS describes social experiences as central to the development of future possibilities (Markus & Nurius, 1986). This was found to be true within this study as participants with access to professionals, which includes both degreed engineers and professional trades aligned with engineering, were most able to describe a perception of engineering as a future career and align this career with attributes they desire in their future. This access to "real" people who can provide insight into engineering provides the critical social connections described by the FPS model. This connection aligns engineering with students' desired attributes of a future career and helps eliminate perceived barriers to entry in the field, particularly those related to perceived ability. Within this study, however, the perception that engineers possess high levels of

mathematical ability and spend much of their time “doing math” remained in some participants with access to both formal programs and professionals, limiting their entry into the field.

6.1.4 Summary

The FPS framework describes an individual’s socio-cultural experiences as the background for their pool of future possibilities (Markus, 1986). The social and cultural experiences growing up in rural areas of the Cumberland Plateau result in a common set of desired attributes associated with a future career. Without exposure through formal programs and access to professionals, students typically do not have the experiences necessary to form a perception of an engineering career or align it with those attributes. Exposure through formal programs provides experiences that spark the start of this FPS development process by aligning activities students enjoy with engineering. Access to professionals, particularly those working in the area, provides a social connection linking students desired attributes to a career in engineering, reducing barriers to entry into the field.

6.2 Implications for Stakeholders

The findings from this study have direct implications for stakeholders in the study area who are interested in providing students with informed career choice related to engineering. Stakeholders who can benefit from these results include those in public schools, higher education, industry, and community leadership. Implementation of formal experiences within public schools and through higher education institutions proved to be effective in this study; however, as the title of the dissertation indicates; stronger

networking across these stakeholders must result in more meaningful personal connections between these students and engineering professionals. The following suggestions provide some examples of how these networks can be implemented to reach future engineers.

6.2.1 Public Schools

Early educational intervention has been shown to be imperative for students to develop engineering-related interest, as these students rely on advice from parents and teachers more than peers (Valla & Williams, 2012). Previous work shows that without this intervention, students can lose interest in math and science, limiting their career options (Faud, 1995; Gooden et al., 2010; Hanesian et al., 2004; Valla & Williams, 2012). School systems can utilize the results of this study not only to guide intervention for students, but also to better inform parents and mentors.

Teachers and classroom activities have also proven to be instrumental in providing exposure across other underrepresented groups (Goode, 2007; Marshall, 2008) The results of this study show that such formal programs are an effective way to introduce students to engineering and begin the process of developing a perception of an engineering career in their future. Activities shown to be effective in this study include a course guided by the PLTW curriculum, CTE courses, and a physics course. Participants described ways these courses helped them align engineering with activities they enjoy. Importantly, while the PLTW course provided one option, this course requires equipment, training, and takes a teacher away from other courses. Small, rural schools can struggle to find the funding and flexibility to implement additional coursework. The success of activities described by students in the CTE and physics courses show that the

schools can utilize existing coursework to introduce engineering. Thus in addition to considering a program such as PLTW, schools can seek and offer professional development for teachers that enables them to effectively incorporate engineering into their existing curriculum. Engineering activities have the potential to enhance courses such as science, math, CTE, and others and help students link engineering to activities they enjoy. In addition, as shown by the results of this study, barriers to an engineering career often include perceived gaps associated with academics. Professional development that helps teachers understand and address these gaps, particularly those associated with math, might begin to help students mitigate these perceived gaps.

To support informed career choice, however, schools also need to help students see engineering as a viable career option, which means linking it not only to enjoyable activities, but also attributes students consider important in their future careers. Providing teachers, counselors, parents, and other mentors with the model, along with resources and activities to engage students, and knowledge of engineering careers in the area, may allow schools to reach students without challenging their limited resources. Providing these mentors with information regarding engineering careers and the attributes associated with these careers may allow them to provide students with the experiences necessary to spark engineering FPS development. This information can be disseminated to students through formal programs, professional development for teachers, construction of a network of mentors, and community events that highlight engineering careers.

However, results also show that effectively reaching students requires not only activities through formal programs, but also access to professionals to develop an accurate perception of an engineering career in their future and mitigate perceived barriers. Public schools can enhance this access by building networks with engineering professionals. While counselors and teachers can provide exposure through programs and activities, they typically cannot offer these personal connections themselves. To offer this access, public schools can develop networks with professionals working in the area. By establishing this network, teachers and counselors will have a resource for students who show interest in the engineering field. This connection is shown to be important in helping students develop their engineering future self and can be particularly salient if the professional is from the area. Professionals from the area share common experiences growing up, allowing for more connection with students than professionals from other areas who may be seen as "outsiders." Technology today can allow access to these professionals, regardless of place, allowing the students to arrange times for questioning during the school day.

An important aspect of building this network may include some informal "training" for these professional mentors. Helping the mentors to understand how these students initially perceive engineering careers and the perceived gaps they may face will be important as mentors think about their approach. These students need to see the professionals as approachable and "normal." Participants' description of their community shows that building relationships is central to their culture and these relationships are important as they navigate their career choice. It is imperative that mentors build a relationship with students and establish connections through similar past experiences.

These connections will help students develop realities associated with the engineering field and the pathway to achieve the career as opposed to the perceived barriers presented by participants without these connections.

Upon building these networks, teachers and counselors can create events for students to connect with these mentors. Through these networks, students can have the opportunity to job shadow and see engineering opportunities within the area while developing a relationship with an engineer so that, as Alex put it, students can "just talk to them normally." In addition, public events at the school where students can engage in engineering activities with the support of professionals may also support mentors such as parents, teachers, and community members. Through public events that spotlight student activities, (an invention, straw bridge, solar oven, etc), present opportunities for engineers, and provide opportunities for students and families to interact with the engineering professionals, teachers and family may be able to better mentor and encourage the students regarding engineering career choice.

6.2.2 Higher Education

Universities with accredited programs in engineering exist throughout Appalachia, and in close proximity to these study counties. The location of these universities provides access to engineering education and engineering professionals for these participants. Towns with an accredited engineering program include Cookeville, Nashville, Knoxville, and Chattanooga within an easy commute for these participants. These universities, and the partnering community colleges, have the potential to provide not only formal programs, but access to professionals and information regarding area career opportunities. Through implementation of formal programs, training for teachers,

access to the campus, and networking opportunities for high school students, these institutions can assist public schools in providing effective engineering exposure.

Formal programs implemented or supported by a university are shown by this study to effectively influence engineering career choice among these students. The engineering camp experience and PLTW courses were associated with efforts from a local university. These programs proved to be effective in providing exposure to engineering, which can be seen throughout these results. Higher education could reach students through additional efforts to implement and support similar programs. These might include additional engineering camp experiences at the university, and direct outreach to students. This support could come through an outreach coordinator at the university who supports programs, identifies funding, organizes campus visits for the students and acts as a contact for students interested in choosing engineering as a career choice.

An additional support that universities could provide to students is training for public school teachers and counselors. As described in the public schools section, training teachers to implement engineering activities within their coursework was shown to be effective in this study. Examples presented in this study include those in a physics course and CTE courses. Training could support teachers in math, science, and CTE fields with methods to implement engineering into their classroom. This training might include hands-on activities that correlate with K-12 standards and a presentation of area opportunities for engineers. Effective engineering exposure will help students to associate engineering with activities they enjoy. For teachers, moreover, the connection with a university engineering department will provide a resource for questions and direction for

interested students, as well as more information about, and comfort with, engineering careers and how they align with opportunities in the area.

Associated with this teacher training is the need for teachers, students, and parents to have access to the campus. Participants in the research project described activities in association with their engineering class and an engineering camp experience as their first look at a college campus. Campus tours, engineering presentations, engineering design competitions, and other activities organized with the college of engineering will help students gain access to the university and become familiar with the campus and visualize the next educational steps to become an engineer. These activities should also include parents and mentors, as advancing their knowledge and familiarity with engineering will also influence students' career choice.

Higher education institutions also have the ability to provide support through access to professionals. In addition to coordinating formal programs, the outreach coordinator, previously mentioned, could also be a point of contact for parents, teachers, and students seeking an engineering professional. Engineering colleges have professors from a variety of disciplines who could connect with students. This coordinator might also connect these stakeholders with engineering students and graduates from their specific county to mentor the next generation. This coordinator could be a huge support to future engineers through development of a mentoring network for stakeholders within each county.

Universities have the potential to offer both formal engineering programs and access to professionals for students in this area. Through implementation of formal programs and access to professionals, universities have the potential to provide students

with the experiences necessary to develop a perception of an engineering career in their future. Providing students the experiences necessary to make an informed choice regarding engineering career choice has the potential to enhance enrollment numbers and strengthen the area's economy through local engineering talent. Such programs, however, also require resources, and the results of this study point to potential funding priorities for state and federal agencies, as well as opportunities for industry to provide targeted economic investments that can help them train and recruit a qualified workforce.

6.2.3 Industry

Industry that requires engineering talent typically lies in the more populated areas in and around the study area. Providing industry leaders with the results of this study may encourage outreach into these rural counties, which may in turn help strengthen the engineering talent in the future. Industry can support engineering by becoming a part of the support network for public schools. As public schools implement engineering into the curriculum, having industry engineers as contacts for parents, teachers, and students is critical. By working with stakeholders in the schools, engineers can provide a presence within the schools through activities described in the public school section. Through this presence, engineers should seek to establish relationships with the students and parents, helping these future engineers and their mentors feel comfortable approaching them with questions. This may occur through assistance with projects or a job talk with informal question and answer sessions to follow. Providing this presence at a public event might also begin communication with parents and mentors adding an additional support for the students. While these connections can be established through school visits, technology

will allow video conferencing with classrooms and individuals as they further explore the engineering field.

Industry professionals can also help students see concrete employment opportunities through job shadowing and industry tours for school systems. These opportunities can be support for students who are exploring engineering career choice by helping them see firsthand the location of engineering opportunities and the daily routines of different kinds of engineers. The findings from this study clearly show the importance of such access to professionals and knowledge of area career opportunities, which are the types of experiences that industry can provide.

Moreover, such opportunities need not be limited to students. Allowing math, science, and CTE faculty the opportunity to spend time in industry settings, to see engineering work, and to develop potential activity and project ideas for courses can provide simple, relatively inexpensive opportunities to help educators expand students' sense of career opportunities and help build the kind of interpersonal network suggested by the findings of this study. Further, financial investment in teacher training programs offered by local universities could enhance such efforts.

Industry within the area will benefit from these efforts as well. One aspect of recruiting students from the study area is the students' connection with community. Efforts to strengthen engineering in and around the study area will result in a future base of employees that are more likely to remain in these rural areas and establish stable, long-term employment. Unlike more metropolitan communities, local individuals who find employment close to home are likely to remain with the company, as they are eager to pursue employment near family.

6.2.4 Community Leaders

Beyond direct intervention provided by schools and companies, however, the study also suggests possibilities for community leaders. As shown in Chapter 2, much of the previous research on career choice in Appalachia has focused on coal producing regions, but the economy in the Cumberland Plateau's has historically emphasized manufacturing, which in recent years has been in decline. Recent trends urge innovation and entrepreneurship as key in developing new and sustainable industry (Energy Workforce Trends and Training Needs in Appalachia, 2011; Smith, 2012). With engineers recognized as entrepreneurial leaders, community leaders could utilize the results of this study to reach out to universities, public schools, current industry, parents, and other mentors, and organize support efforts to reach future entrepreneurs. These efforts may include multiple strategies aimed at connecting students with formal programs and professionals to help them gain the experiences necessary to make an informed choice regarding engineering as a future career.

Community leaders interested in diversification of the economy have the ability to strengthen engineering by providing a link between public schools, higher education, and industry. Community leaders can be another resource for teachers as they build networks to link students to professionals. One example of an activity to accomplish strengthening this network might be the coordination of job fairs that highlight area engineering and engineering education opportunities for students. Through this activity, parents, teachers, and students could connect with stakeholders in higher education and industry to strengthen the entire pipeline.

As more students begin to pursue engineering, community leaders can begin to recruit industry into the area through existing companies and incentives for local engineers to create companies in the area. As previously stated, strengthening engineering in rural communities, like those presented in the study counties, has the potential to provide industry with stable employees. These employees will be interested in remaining in the area helping industry to “keep” the investments made in “growing” these engineers.

6.2.5 Summary

Findings from this study provide results indicating that students in rural areas of the Cumberland Plateau are not receiving exposure to engineering careers outside of school. The model presented identifies supports and barriers to the development of a future self that includes an engineering career. Administrators, teachers, parents, universities, industry leaders, community leaders, and other stakeholders can utilize this information to provide students with the experiences necessary to make an informed choice regarding engineering as a future career. Results show that exposure avenues such as formal engineering courses, science courses, CTE courses, and camp experiences can be very effective means of engaging students in engineering activities and connecting to activities students enjoy. In addition, access to professionals can help students relate to a "real" person, aligning engineering with desired future attributes and reducing barriers related to the future career. This model can be incorporated into schools, regardless of their size and budget, as exposure can be implemented in a variety of ways. One very important way is the development of a network of engineers and higher education stakeholders so that teachers can connect students with professionals. In addition, school

systems, higher education, industry and community leaders need to work together to coordinate events highlighting engineering and the available opportunities in the area for students and parents to become involved in. Utilizing the strategies presented and the model to inform stakeholders may provide future engineers with the vision necessary to pursue their career and, at the same time, help to diversify the economy in rural areas of Tennessee's Cumberland Plateau.

6.3 Limitations and Future Work

6.3.1 Limitations

While this study provides results and suggestions that can directly influence stakeholders in the study area as they consider ways to increase engineering enrollment, the study does have limitations.

First, as described in Chapter 3, participants were recruited by stakeholders within each school system. It seemed the pool of participants recruited often represented high achieving students with supportive families. In addition to recruitment, this limitation could also be a result of the parental consent process, in which parents had to provide permission for researchers to "study" their child. In addition to recruitment, the consent forms contained the title of the study, which included the word engineering, which presumably excluded some participants. This limitation could impact the results of the study as a wider range of participants could provide a broader picture of engineering perception within the study counties.

Second, the limited number of formal programs that focus on engineering in the area limits the scope of available participants for Categories 2 and 3 with this access.

Two school systems were selected for study because they provide an engineering course through the PLTW curriculum. This limitation also meant that the pool of possible participants include students from my PLTW courses, and in fact the participant pool does include some former students. I have attempted to bracket my bias through use of multiple interviewers and coders, ongoing dialogue with the EIA team, and focus on the transcripts to ensure that the analysis focuses on participants' comments rather than my own understanding

Third, the patterns in the study point to topics that this study does not address. Included among these is the absence of participants with minimal access-who still intend to pursue an engineering career. In this study, no participants without some form of access expressed intent to pursue engineering as a career, eliminating the possibility of exploring this category of students from within this data set. However, two participants in Category 1 did express some interest in the field of engineering. These participants had minimal access, but when prompted by the interview team, could not provide a perception of an engineering career in the future and expressed only interest in engineering activities, not intent to pursue an engineering career. Still, more work remains to understand if and how rural students without any formal or social exposure find a path into an engineering career.

Fourth, these two Category 1 participants, along with a few other participants, had some characteristics of multiple categories, suggesting the need for further development of the categories. For example Ella, who appears in Category 2, did not have access through a formal program, but her access to professionals allowed her the ability to provide a perception of an engineering career and make an informed decision not to

pursue this career in the future. The general nature of a qualitative study creates some "fuzzy" boundaries between categories, which is a limitation of this study.

Finally, the study is limited in its inability to explain the source of math anxiety among these students. This anxiety appeared across all students, even appearing in college engineering students. It is unclear how participants developed this anxiety because the topic was not probed during the interviews but was instead highlighted only in the data analysis. Exploration and understanding of this topic could beneficial to inform future intervention.

6.3.2 Future Work

As suggested by both the limitations and the overall findings, this study lays the groundwork for several important directions. First, the four counties involved in the study represent only a portion of rural non-interstate counties along the Cumberland Plateau. To determine transferability of the results to these similar counties and address the limitations noted in Section 6.3.1, a survey could be developed from this data to provide a broader sample pool. While this survey could provide additional findings, another, possibly more direct approach, could be sharing the data with stakeholders throughout these counties to test their perception of the findings. As described in Chapter 3, stakeholder input was a key component in establishing the trustworthiness of the findings, and the close school community described in section 4.1.2 makes it highly likely that educators in these counties would have a strong understanding of how the findings would resonate for students in their schools.

Second, because this work is a portion of a larger study across Appalachia, data from rural Virginia counties can be analyzed to determine the transferability of results

from this area to other areas of rural Appalachia. Since data collection methods were identical within the Virginia study area, the People not Print codebook can utilized to code high school and college students transcripts of the Virginia participants. In addition, because the manual analysis method of this study developed the People not Print Codebook, additional coders can be trained and data be analyzed using a software package such as MAXQDA through the EIA project. Results can then be compared to determine transferability.

Third, given the implications for stakeholders described in this chapter, future work can and should examine effective methods of providing formal programs and access to professionals. Rural school systems in the Cumberland Plateau and across Appalachia often face limited resources to expand beyond the required curriculum. While 6.2 offered a wide range of options, their success depends on determining cost effective methods to provide students with meaningful exposure and access to professionals. Only methods that are both cost effective and successful can attract the necessary funding and prove beneficial in reaching future engineers in the study area. Section 6.2 offers some suggestions and ideas, but they should be tested to explore their effectiveness.

6.4 Contributions

This work contributes to several areas of research. This study has the potential to inform future research in Engineering Education, Appalachian Studies, and future studies utilizing the FPS framework. In addition, this research directly contributes to efforts to help diversify the future economy of this study area.

6.4.1 Engineering Education

This work contributes to engineering education research by providing a model to reach a previously underserved population and expanding the field's understanding of both who we might consider underrepresented and how we might reach those students. While this model is an important finding for people in rural areas of Tennessee's Cumberland Plateau, the methods used to study this rural culture provide an important model for research in engineering education that focuses on the particular socio-cultural contexts that shape students' knowledge of, and interest in, the field. This method has provided insight into how these students' home cultures and experiences growing up in the study counties influence their desired self, and the experiences necessary for these participants to develop a perception of an engineering career, and demonstrated how these insights can be used to design more effective outreach methods.

For engineering education, the findings of this study reiterate previous work on STEM recruitment that indicates the need for to localized empirical evidence (*Raising Public Awareness of Engineering*, 2002; Valla & Williams, 2012). This study provides empirical evidence for students from rural, non-coal, non-interstate counties along the Cumberland Plateau. For engineering educators, understanding how the connection of findings from this study relate to the specific geographical and cultural influences of the study counties reiterates the need to investigate effective methods of recruitment for all demographics within a specific service area of a university. As previously stated, no one-size-fits-all method of recruitment exists. The needs of students vary throughout the United States and around the globe. This study provides empirical evidence associated with one specific population. Transferring this investigation to other populations may

serve to provide future generations with more effective exposure strengthening engineering in their future. This study could be replicated around the globe to understand the unique socio-cultural factors that may influence career choice among countless other populations.

6.4.2 Appalachian Studies

Most previous career choice work in Appalachia focuses on the coal producing regions of Central Appalachia. Career choice work in Appalachia typically takes a general approach looking across a broad range of career options. This study expands investigation into a non-coal, non-interstate area of Appalachia, historically based in manufacturing, and shows that the decline of this industry does have an impact on career choice. As shown in Table 2.2, geographic and political boundaries of Appalachia often mask significant differences within these regions. This study shows the importance of redefining boundaries to understand career choice within specific areas of Appalachia, rather than seeking generalities that mask critical contextual differences

In addition, this study shows the importance of focusing on a specific career. Participants generally describe access to professionals and experience with medical professions, but without intervention, often did not describe access to engineering. This work shows that with appropriate intervention, students do have a more informed understanding of viable career options, and some are choosing engineering related careers. However, participants fear that limited career opportunities challenge their future career choice. Design and dissemination of this information to stakeholders within public schools, higher education, industry, and community leaders might assist efforts to diversify Appalachia's struggling economy.

Overall, the study shows the need to explore career choice throughout Appalachia to understand the perspective of students within more locally bounded areas because of the ways economic, geographical, demographic, and historical factors vary throughout Appalachia. This study provides an effective methodology to uncover these local career perspectives that can be transferred throughout Appalachia. Digging beyond the regional data to understand career perspectives in a localized context throughout Appalachia can enhance efforts to diversify the economy by providing stakeholders with appropriate information for specific areas of Appalachia.

6.4.3 Future Possible Selves Research

This study contributes to FPS research at the simplest level first by using the framework with a new population. While the framework originated through studies with inner city youth, this study shows how dynamic the framework can be by effectively expanding its use to provide a unique perspective on how the socio-cultural influences of growing up in a rural non-coal, non-interstate part of Appalachia influences engineering career choice. The following work provides more detailed examples of how the model may be utilized in the future to understand career choice perspectives elsewhere around the world.

Perhaps more importantly, though, by situating FPS in a larger Social Constructivist view the use of the FPS framework with this study uncovered attributes these students desire in association with their future career and linked these attributes to the participants' experiences growing up in the study counties. This deep socio-cultural perspective separates this study from previous work investigating engineering and STEM career choice that often only explored the participants' present experiences and

perspectives. The Social Constructivist views meaning as developed socially and historically. In addition, the focus is on the participants' view of their constructed meaning, or reality, and how this reality influences their lives. Adding FPS allowed emergence of a full picture showing how these participants past experiences within their community, and present experiences in school, influenced this reality, and how this reality influences their perspective of an engineering career in the future. This connection uncovered how the "close-knit" nature of these communities supports the need for these students to connect with a professional to fully develop a perspective of an engineering career in their future. This study demonstrates a model of how the framework can be used to account for cultural context and inform career choice literature about the unique needs of underrepresented populations around the globe.

6.4.4 Rural Cumberland Plateau Communities

The most direct contribution of this study is made to the future engineers growing up in rural, non-interstate areas of the Cumberland Plateau. Utilizing a qualitative study to examine supports and barriers to engineering career choice within these study counties has provided a model that can immediately inform interventions in the study counties to expand students' visions of their future possible selves. This model highlights the need for both formal programs and access to professionals. This knowledge can inform future intervention as public schools can inform teachers in math, science, and CTE subjects about the importance of incorporating engineering activities into their curriculum that introduce engineering and mitigate perceived ability gaps associated with engineering. In addition, it is critical that school systems, colleges, industries, and community development organizations work together to develop a network of engineering

professionals willing to provide mentoring to students in these study counties. As teachers introduce engineering to students, this network of professionals will help students link the career to desired attributes of their future, mitigate perceived gaps, and view engineering as a viable opportunity within their home area.

My work within this study area stems from my personal connections to Tennessee's rural Cumberland Plateau communities. Hopefully these results can be used in the future to inform intervention and begin to change the perception of engineering within these communities. It is my hope that the results of this study can be used to provide students in these rural communities the experiences necessary to make an informed choice regarding engineering as a future career.

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Appendix A
Oyserman's Future Possible Selves Questionnaire and Guidelines for Data Analysis

Possible selves citations, measure, and coding instructions

January 2004

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PUBLICATIONS using the open-ended measure (see below)

- Oyserman, D., & Markus, H. (1990). Possible Selves and Delinquency. *Journal of Personality and Social Psychology, 59*(1), 112-125.

- Oyserman, D. & Saltz, E. (1993). Competence, delinquency, and attempts to attain possible selves. *Journal of Personality and Social Psychology, 65*, 360-374.

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- Oyserman, D., Terry, K., & Bybee, D, (2002). A possible selves intervention to enhance school involvement. *Journal of Adolescence, 24,* 313-326.

- Oyserman, D., Bybee, D, & Terry, K. (2003). Gendered racial identity and involvement with school. *Self and Identity, 2,* 1-18.

- Oyserman, D., Bybee, D., Terry, K., & Hart-Johnson, T. (2004). Possible selves as roadmaps. *Journal of Research in Personality, 38,* 130-149.

PUBLICATIONS using close-ended measure (described in the publication)

- Kemmelmeier, M. & Oyserman, D. (2001). Gendered influence of downward social comparisons on current and possible selves. *Journal of Social Issues, 57,* 129-148.

Possible Selves Questionnaire

Who will you be next year? Each of us has some image or picture of what we will be like and what we want to avoid being like in the future. Think about next year -- imagine what you'll be like, and what you'll be doing next year.

- In the lines below, write what you expect you will be like and what you expect to be doing next year.
- In the space next to each expected goal, mark NO (X) if you are not currently working on that goal or doing something about that expectation and mark YES (X) if you are currently doing something to get to that expectation or goal.
- For each expected goal that you marked YES, use the space to the right to write what you are doing this year to attain that goal. Use the first space for the first expected goal, the second space for the second expected goal and so on.

Next year, I expect to be	Am I am doing something to be that way		If yes, What I am doing now to be that way next year
	NO	YES	
(P1) _____			(s1)_____
(P2) _____			(s2)_____
(P3) _____			(s3)_____
(P4) _____			(s4)_____

In addition to expectations and expected goals, we all have images or pictures of what we don't want to be like; what we don't want to do or want to avoid being. First, think a minute about ways you would not like to be next year -- t*hings you are concerned about or want to avoid being like.*

- Write those concerns or selves to-be-avoided in the lines below.
- In the space next to each concern or to-be-avoided self, mark NO (X) if you are not currently working on avoiding that concern or to-be-avoided self and mark YES (X) if you are currently doing something so this will not happen next year.
- For each concern or to-be-avoided self that you marked YES, use the space at the end of each line to write what you are doing this year to reduce the chances that this will describe you next year. Use the first space for the first concern, the second space for the second concern and so on.

Next year, I want to avoid	Am I doing something to avoid this		If yes, What I am doing now to avoid being that way next year
	NO	YES	
(P5) _____			(s5)_____
(P6) _____			(s6)_____
(P7) _____			(s7)_____
(P8) _____			(s8)_____

Coding Instructions for Next Year Possible Selves

A. CATEGORY LABELS

There are six main categories of Next Year Expected Possible Selves:

1. Achievement- relates to school and school interactions with teachers, achievement-related activities
2. Interpersonal Relationships- involves family, friends, relationships, and social interactions except with teachers
3. Personality Traits- relates to personality characteristics, self-descriptions of traits
4. Physical/Health-Related- relates to physical health, weight, height
5. Material/Lifestyles- relates to material possessions and living situation, including moving
6. Negative- includes all negatively worded responses

There are six main categories of Next Year Feared Possible Selves.

1. Achievement- relates to school and school interactions with teachers, achievement-related activities
2. Interpersonal Relationships- involves family, friends, relationships, and social interactions except with teachers
3. Personality Traits- relates to personality characteristics, self-descriptions of traits
4. Physical/Health-Related- relates to physical health, weight, height
5. Material/Lifestyles- relates to material possessions and living situation, including moving
6. Non-normative /Risky Behaviors- includes negative and illegal behaviors such as smoking, drinking, involved in fights, gangs, etc.

B. SUMMARY OF CODING

Categories of expected and feared possible selves are identical except that the sixth category for expected selves includes ANY negative reference (since the vast majority of expectations are framed positively) and the sixth category for feared possible selves includes behaviors or expectations that are either delinquent or risky behaviors (such as teen pregnancy or smoking). Each category includes subcategories that are listed below. These may be useful for analyses though in our work to date sample size has been such that we have focused on main categories only.

C. CODING AMBIGUOUS STATEMENS

1. CONSIDER AGE OF RESPONDENT -- When coding for possible selves, one must first consider the age of the respondent. The same response e.g. "getting my license" may be either a codable or noncodable response depending on they respondent's age (that is NEXT YEAR is this possible?). For example, when an eighth grader expects to be a doctor that response is not coded. In a very few instances, age may also determine which category the possible self is placed. For example, when a twelve-year old respondent reports that next year he/she would like to avoid smoking, this feared possible self is categorized as non-normative. For an older person (16 and above), this same feared self would be coded in the health category.

2. CONSIDER CONTEXT OF RESPONSE -- When a possible self is ambiguous because too little has been written, read through the strategy provided for that possible self to see if it provides clues for the content intended.

D. EXAMPLES OF NEXT YEAR POSSIBLE SELVES

Achievement

Expected selves

Job- working for extra money, finding summer job, working, help mom save for school, babysitting, having a job, part-time job

Activities in school- cheer team, basketball team at school, playing instrument, school band, extra-curricular activities, playing sports, on a team, a better basketball player, getting a driver's license

School- doing good in school, trying to do good in school, smart, getting good grades, going to the next grade, keep my grades up, not tardy or absent from school, more helpful in classroom, honor roll, good conduct, going to better/new school

Teachers- good relationship with teachers, getting along with teachers, respectful to teachers

Activities Not in School- basketball in neighborhood, guitar, deer hunting, reading a lot of books, boxing, (Note: Generally, if there is any doubt about activities put in school activities except for things not offered in school)

Feared Selves

Job-losing my job, without work

Activities in school- not on team, not making cheerleading

School- known as bad kid by teachers, a loser, dropout, flunking out of my classes, having bad grades, dumb, having bad schoolwork, not paying attention, not falling behind in class, in trouble in school, being a little punk, fighting in school, suspended, excluded, skipping, in same grade

Teachers- still getting trouble with teachers, back talking to teachers,

Activities Not in School-I don't want to be home all the time

Interpersonal Relationships

Expected selves

General- shy, silly, nice, respectful, better listener, funnier

Family- obedient, getting along with parents/relatives, helping around house, better person towards mother, see relatives, doing things with family, closer to family, being a good/ better son/daughter

Peers- having a steady boyfriend, getting along better with people, having lots of friends/same friends, making new friends, having lots of friends, hang with friends more, trying to be accepted at new school, being a better friend

Feared selves

General- as shy as I am, avoid being a recluse, mean person, rude, stuck up, mistrusted, stingy,

Family- having anything happen to our family, not listening to parents, being smart with parents, mean to sibling/relative, getting into arguments with parent/relative, without someone to turn to

Peers- enemies with other people, being a follower, being disliked by friends, not making friends, lying to people, boring, very talkative, breaking up with girl/boyfriend, bully, troublemaker, bad to my friends, without friends because of rumors, used just for my car-for rides

Personality Traits

Expected selves

Independence or Maturity- more mature, more responsible, more grown-up, helping her without complaining, A little more organized, Able to concentrate

Attitude- more serious person, being more open-minded, positive thoughts, positive attitude, to be a good person

Feared selves

Independence or Maturity- lazy, irresponsible, not trusted

Attitude- a bad attitude, silly, greedy, weak mentally, emotional mess, caring about nothing

Physical

Expected selves

General Body Descriptive-Hair looking different, as short as I am this year, taller, growing a few inches, Handsome, good-looking,

Physical Health- older, 15 years old

Feared Selves

General Body Descriptive- Getting my haircut, wearing dark lipstick like a devil worshipper, Short, I want to grow,

Physical Health- Sick a lot, so sick I can't attend school, On medication again, Slower physically, weaker than I am, overweight

Material/ Lifestyle

Expected selves

Lifestyle-Still living at home with my mom, moving to Canada, living somewhere, going places I have never been,

Material-own a car, living in better new house

Feared Selves

Lifestyle- Moving from this house

Material- In the situation of money, not money confused

Negative

Possible selves responses that are worded negative or suggest an expected negative outcome should be placed in the negative category. The response could be categorized from any of the 6 possible selves categories.

For example, students may respond "next year, I expect to still be involved in fights (negative-delinquent), or I expect to have few friends (negative-interpersonal relationships). However, these statements are sometimes worded in a negative form. For example, a student may respond "next year, I expect to be not fighting (negative-delinquent), or not to be getting picked on (negative-interpersonal relationships).

Non-Normative

Expected selves

Do not use for expected selves-Use Negative Category

Feared Selves

Non-normative- getting pregnant, cigarettes, being killed, hanging out with wrong people, troublemaker, having sex

Delinquent- shooting people, with gang members, getting involved in drugs, In a gang, gang banger, alcohol use, a druggie, drug dealer, jail

Instructions for Coding Strategies

When a strategy or strategies is/are given for each possible self, the strategy should be coded in the same category as the possible self. The categories are the same as the expected and feared possible selves categories: 1) Achievement, 2) Interpersonal relationships, 3) Personality Traits, 4) Physical/Health-Related, 5) Material/lifestyles, 6) Non-Normative, 7) Negative.

Examples of Strategies

Achievement
Working hard on assignments
Doing all my schoolwork
Paying more attention

Interpersonal Relationships
Doing what others tell me to do
Working with parents
Asking for help

Personality Traits
Controlling my attitude/actions
Trying new things
Disciplining myself

Physical
Lifting weights
Exercising
Eating healthy foods
Material/ Lifestyle
Working to save my money
Talking with parents about moving

Non-normative
Avoid being around negative/criminal people/activities
Walk away from negative pressure situations

Instructions for Coding Balance

Balance means having both a positive and a negative aspect of a future goal, that means having both an expectation (next year expected) and a matching concern (next year feared) that fit together or create a more coherent whole.

If the student writes an expected self and a feared self that corresponds then they have balance.

Examples of Balance:

Achievement/School —Next year I expect to be a great student and next year I want to avoid being a dropout/failing in school.

Interpersonal- Next year I expect to have new friends/ I want to avoid having no friends.

Personality traits- Next year I expect to be more responsible/ I want to avoid being lazy and irresponsible

Physical- Next year I expect to be eating better foods/ I want to avoid eating a lot of junk food.

Material/Lifestyle

Non-normative

Coding Instructions for Adult Possible Selves

There are five categories for Adult Expected Possible Selves:

Achievement- relates to school and school interactions (teachers), achievement-related activities

Interpersonal relationships- involves family, friends, relationships, social interactions

Personality Traits- relates to personal characteristics, self-descriptions

Physical/Health-Related- relates to physical health, weight, height

Material/Lifestyles- relates to material possessions, living situations such as moving

Negative- includes all negatively worded responses

For Adult Feared Possible Selves, there are the first five categories [Achievement, Interpersonal relationships, Personality Traits, Physical/Health-Related, Material /Lifestyles] plus a 6) Delinquent category, which includes negative and illegal behaviors.

When coding for adult possible selves, age of respondent is not a big factor as when coding next year possible selves. However, one must remember that respondent is speaking of future behaviors and this may determine category. For example, when a twelve-year old respondent reports that next year he/she would like to avoid smoking, this feared possible self is categorized as delinquent. When referring to smoking as an adult feared behavior, it would be coded in the health category.

When a possible self is ambiguous, one should first check the strategy provided for that possible self.

Examples of Adult Possible Selves

I. Achievement/School

Expected selves

Job- in a good job, have a good job, a well-paying job, working at a store or Restaurant, in a particular career, have job after high school

Activities in school- debate team, football, cheerleading, band

School- going to college, in college studying (subject), college graduate, smart, have a good education, dean's list

Teachers-good relationship with professors, getting along with professors, respectful to professors
Activities Not in School- basketball in neighborhood, guitar, deer hunting, reading a lot of books, bowling

Feared selves

Job-without work, unemployed, working at a gas station or fast food, in a particular career (not favorable to respondent)? Example= a cop, they're mean in real life and they lie

Activities in school-

School- a college dropout, stupid Teachers

Activities Not in School-

II.Interpersonal Relationships

Expected selves

General- kind, nice, cool to be around, helpful, compassionate, loveable

Family- married, being good husband/wife, happily married, have children, good parents, nice to my kids, good grandfather/grandmother, have a family, see my family, helpful to my family,

Peers- lots of friends, in contact with the friends I have now,

Feared selves

General- deceitful, mean, short-tempered, annoying, hard to get along with, heartless, snob, jerk

Family- abusive to my children or family, starting fights with family, bad husband/father/mother/wife, disrespectful to family members, divorce, separated from children, overprotective parent, bad kids, alone without family, neglectful

Peers- without friends, alone, follower,

III. Personality Traits

Expected selves

Independence or Maturity- self-supporting, mature, responsible, successful-provide for others and myself, prompt, a goal accomplisher, reliable

Attitude-

Feared selves

Independence or Maturity- doesn't stand up for rights, loser-doesn't accomplish anything, lazy, irresponsible

Attitude- very worried all the time

IV.Material/ Lifestyle

Expected selves

Lifestyle-living on my own, travel all over the place, having the freedom to do many things, Living with brother, Living in particular city

Material- have a car, nice car, rich, house, owning a collection of (certain items),

Feared Selves

Lifestyle- getting screwed by insurance costs, reckless driver, living at home, being on welfare, wasting money

Material- bum, homeless, no money, no home, not being able to get the things I want, poor, bad credit,

V. Delinquency

Expected selves

General- Responses that may seem to fall in this category should be placed in the negative category.

Feared Selves

General- shooting people, getting involved in illegal drugs, alcoholic, drug dealer, drug addict, don't want to go to jail, being killed, a murderer, hanging out with wrong people , having weapons around my house, thief, criminal, violent

VI. Physical

Expected selves

General Body Descriptive-Hair looking different, as short as I am this year, taller, growing a few inches, Handsome, good-looking, body piercings

Physical Health- older, healthy, physically fit, strong, sober, getting pregnant at about 25

Feared Selves

General Body Descriptive- Getting my haircut, wearing dark lipstick like a devil worshipper, weird clothing, Short, I want to grow,

Physical Health- Cigarettes, car accidents, diseases, Sick a lot, so sick I can't attend school, On medication again, Slower physically, weaker than I am, overweight

Negative

Possible selves responses that are worded negative or suggest an expected negative outcome should be placed in the negative category. The response could be categorized from any of the 6 possible selves categories. For example, students may respond "as an adult, I expect to still be involved in fights (negative-delinquent), or I expect to have few friends (negative-interpersonal relationships). However, these statements are sometimes worded in a negative form. For example, a student may respond "as an adult, I expect to be not fighting (negative-delinquent), or not to be getting picked on (negative-interpersonal relationships).

Instructions for Coding Strategies

When a strategy or strategies is/are given for each possible self, the strategy should be coded in the same category as the possible self. The categories are the same as the expected and feared possible selves categories: 1) Achievement, 2) Interpersonal relationships, 3) Personality Traits, 4) Physical/Health-Related, 5) Material/lifestyles, 6) Delinquent, and 7) Negative.

Examples of Strategies

Achievement/School Strategies

Working hard on assignments
Doing all my schoolwork
Paying more attention

Interpersonal Relationships

Doing what others tell me to do
Working with parents
Asking for help
Personality Traits
Controlling my attitude/actions
Trying new things
Disciplining myself

Material/ Lifestyle

Working to save my money
Talking with parents about moving
Physical
Lifting weights
Exercising
Eating healthy foods

Delinquency

Avoid being around negative/criminal people/activities
Walk away from negative pressure situations

Instructions for Coding Balance

Balance means having both a positive and a negative aspect of a future goal, that means having both an expectation (expected self) and a matching concern (feared self) that fit together or create a more coherent whole (from the same category).
If the student writes an expected self and a feared self that corresponds then they have balance. Example—as an adult, I expect to be a great college student and as an adult, I want to avoid being a dropout/failing in college. Balance can be in any category.

Appendix B
EIA Project Interview Protocols

Interview protocol –High School Students

The interview protocol below represents the type of questions expected to be asked. However, minor changes to the questions and the order of questions may change to enable the interview to flow. Highlighted sections indicate suggested transitions.

1. Introduction –
   - Thank them for taking the time to interview. Ensure they understand the purpose of the interview is to learn about their thoughts and their participation will help to understand how students make career choices.
   - Ask if they have any questions before getting started.
   - Verify it is ok to voice record.
   - Verify we have a signed assent and consent forms.
   - Introduce the interview including interviewer, interviewee, date, time, and location.

   Can we talk a little bit about what high school is like for you now…
   Tell me a little bit about your high school experience

2. What year are you in school?

3. Tell me what high school is like for you…
   a. Probes
      - What are your favorite part? Why?
      - What is your least favorite part? Why?
      - What do you wish was different?

   b. Purpose
      - Move to general thoughts about school. Hopefully gain insight on thoughts about some classes and importance of high school and areas of interest within school
        Note: Be sure to ask both sides, favorite and least favorite parts.

4. What are some of your interests?
   a. Probes
      - If only school ask if any outside of school and vice versa
      - Why do those activities interest you?
      - How confident are you in those activities?
      - Move to general interests and expand beyond just a school discussion.

   a. Purpose
      - Learn about their interests. Provide information to use later in the interview.

      So we have talked about … I want to follow up on that and talk a little bit more about what it is like living in your community.

5. Tell me what it is like growing up here?
   b. Probes
      - Family? Church? Neighborhood? Friends/Peers?
      - When you are not in school what do you do?
      - What are some of the advantages and disadvantages?
      - Can you tell me more about how (that) was an advantage/disadvantage or give me an example?
   c. Purpose
      - Learn something about their likes and dislikes of the area. Provide information to use later in the interview.

6. Who are some of the key people who influenced you in your life and why?
   a. Probes
      - If only school ask if any outside of school and vice versa
      - What is an example of them being a role model?
   b. Purpose
      - Understand who they consider role models without restriction to a particular context for the role model

7. What kind of jobs do some of the adults you know have?
   a. Probes
      - Can you give an example of what (person/job) is to make sure I understand that job?
      - Based on what you know about the jobs, which ones sound interesting to you and why?
      - Where do these adults work?
      - Educational attainment of these adults…
   b. Purpose
      - Understand what students perceptions of various jobs are and which interest them

We have talked a lot about the present and what your life is like now…I would like to talk about the future…

8. What type of job are you considering? Why?
   a. Probes
      - Ask them to describe the job…What about that is appealing to you?
      - Does the location of the job matter to you? Why?
      - How are people reacting to (just mentioned) job?
      - How confident are you in getting that type of job? Why?

   b. Purpose

- See if jobs or careers other than ones for whom they have a potential role model surface. Learn what influences interest in a job other than knowing someone with that type of job

9. Is there a job or a career that you wish you could pursue, but can't?
   a. Probe
   - Depending on how they answer, follow-up with: Have you ever thought about engineering or technical jobs as a career choice for you? or Why are you thinking of engineering or a technical job?
   - Why can't you?
   - What was your dream job when you were younger? Do you have a dream job now?
   - Is there a job you know you do Not want to have?

   b. Purpose
      - Find a place to get them to talk about roads not taken.

10. What are the next steps for you?
    a. Probes
    - Are you excited about graduating from high school?
    - Are you ready to graduate high school?
    - Are you applying for college (why or why not)?

    b. Purpose
       - Learn about the students planned career actions
       - Attempt to gain an understanding of the student's self-efficacy in terms of their career plans
       - Specifically see if they considered engineering

11. So, we have talked about your plans. Imagine yourself in 10 years…Describe what your life is going to be like?
    a. Probes
       - Who do you want to be?
       - What do you want your job or career to provide?
       - What do you expect to become?
       - What is most exciting about your future?
       - What do you want to avoid?
       - What scares you most about the future?
       - If asked for clarification indicate it can be related to money, status, to be rewarding, reputation, allow you to live in a particular place or a particular way

    b. Purpose
    - Gain insight on outcome expectations – what they are and why they matter – without bounding/assuming what they may be/ Investigate hoped for and feared future possible selves.

Note: Push people to be as clear and concrete as possible here.

12. How confident are you in your ability to get there? Why?

13. What are some of the things (or people) who are helping you to achieve what you want to do?
    a. Probe
       - Are there other things that are making it difficult or that you think are slowing you down?
    b. Purpose
       - Opportunity to learn more about supports and barriers
       - See what aspects of the student's life is brought out when they are asked about what they want to do (did they answer work related, hobby, family, helping others, etc)

Considering all of these things we have talked about today…

14. If you were asked to give advice to other students about high school, what would it be?

15. I've come to the end of my question list. I want to give you time to talk. I have told you a little bit about the current study. You have answered a bunch of questions. Is there anything else you want me to know?

16. Thank you very much for sharing your insights and experiences with us. Would you mind if we contact you again if we have questions about your responses?

Interview questions – College students

The interview protocol below represents the type of questions expected to be asked. However, minor changes to the questions and the order of questions may change to enable the interview to flow.

Introduction – thanking them for taking the time to interview. Ensure they understand the purpose of the interview. Ask if they have any questions before getting started. Verify it is ok to voice record. Verify we have a signed consent form.
Can we talk a little bit about what college is like for you now…
Tell me a little bit about your college experience

17. What year are you in school? What is your major?

18. Tell me what college is like for you…
    - What are your favorite part? Why?
    - What is your least favorite part? Why?
    - What do you wish was different?

Purpose: Move to general thoughts about school. Hopefully gain insight on thoughts about some classes and importance of school and areas of interest within school

Note: Be sure to ask both sides, favorite and least favorite parts.

So we have talked a little about where you are…Lets talk a little about how you came to pick this path…

19. How did you pick this college?
    - Were there some things about high school that influence your choice to attend college?
    - Who are some of the key people(adults and peers) who influenced you in your life and why?
    - Geographic Location
    - Qualities of the school, Size, etc…

Purpose: Get insights into the decision making process

20. How did you pick this major?
    - Were there some things about high school that influence your choice of this major?
    - Who are some of the key people(adults and peers) who influenced you in your life and why?
    - Geographic Location
    - Qualities of the school, Size, etc…

- How did people react when they heard you want to be an engineer?

Purpose: Get insights into the decision making process

So we have talked about … I want to follow up on that and talk a little bit more about what was like where you grew up.

21. Where did you grow up?

22. Tell me what it was like growing up there?
    d. Probes
        - Family? Church? Neighborhood? Friends/Peers?
        - What did you do outside of school?
        - What were some of the advantages and disadvantages of this area?
        - Tell me about your activities and interests growing up?
        - Can you tell me more about how (that) was an advantage/disadvantage or give me an example?
        - How did people react to your decision to go to college? To major in _____?

Purpose: Allow them to choose items they want to discuss. Learn something about their likes and dislikes of the area

23. *If people are already mentioned…*You mentioned _____. Are there any other key people who influenced you in your life and why?
    c. Probes
        - If only school ask if any outside of school and vice versa
        - What is an example of them being a role model?

Purpose: Understand whom they consider role models without restriction to a particular context for the role model

24. Growing up, what kind of jobs did some of the adults you know have?
    c. Probes
        - Can you give an example of what (person/job) is to make sure I understand that job?
        - Based on what you know about the jobs, which ones sound interesting to you and why?
        - Where do these adults work?
        - Educational attainment of these adults…

Purpose: Understand what students' perceptions of various jobs are and which interest them.

We have talked a lot about the past and present…I would like to talk about the future…

25. What type of job are you considering? Why?
    c. Probes
        - Ask them to describe the job…What about that is appealing to you?
        - Does the location of the job matter to you? Why?
        - How are people reacting to (just mentioned) job?
        - How confident are you in getting that type of job? Why?

    Purpose: See if jobs or careers other than ones for whom they have a potential role model surface. Learn what influences interest in a job other than knowing someone with that type of job

26. Is there a job or a career that you wish you could pursue, but can't?
    c. Probe
        - Depending on how they answer, follow-up with: Have you ever thought about engineering or technical jobs as a career choice for you? or Why are you thinking of engineering or a technical job?
        - Why can't you?
        - What was your dream job when you were younger? Do you have a dream job now?
        - Is there a job you know you do not want to have?

        Purpose: Find a place to get them to talk about roads not taken.

27. What are the next steps for you?
    c. Probes
        - What are your plans for after college?
        - Personal or Professional…

    d. Purpose
        - Learn about the students planned career actions
        - Attempt to gain an understanding of the student's self-efficacy in terms of their career plans
        - Specifically see if they considered engineering
        - Connect goals to choices

28. So, we have talked about your plans. Imagine yourself in 10 years…Describe what your life is going to be like?

c. Probes
   - Who do you want to be?
   - What do you want your job or career to provide?
   - What do you expect to become?
   - What is most exciting about your future?
   - What do you want to avoid?
   - What scares you most about the future?
   - If asked for clarification indicate it can be related to money, status, to be rewarding, reputation, allow you to live in a particular place or a particular way

   Purpose: Gain insight on outcome expectations – what they are and why they matter – without bounding/assuming what they may be/ Investigate hoped for and feared future possible selves.

   Note: Push people to be as clear and concrete as possible here.

29. How confident are you in your ability to get there? Why?

30. What are some of the things (or people) who are helping you to achieve what you want to do?
    c. Probe
       - Are there other things that are making it difficult or that you think are slowing you down?
    d. Purpose
       - Opportunity to learn more about supports and barriers
       - See what aspects of the student's life is brought out when they are asked about what they want to do (did they answer work related, hobby, family, helping others, etc)

Considering all of these things we have talked about today…

31. You've provided me with some great information. If you were asked to talk to some high school students, what advice would you give high school students concerning decisions about what to do after high school? How about advice while in high school?

    Purpose: look for areas they found most important and possibly insight into what they would do the same or different.

32. I've come to the end of my question list. I want to give you time to talk. I have told you a little bit about the current study. You have answered a bunch of questions. Is there anything else you want me to know?

    Thank you very much for sharing your insights and experiences with us. Would you mind if we contact you again if we have questions about your responses?

Appendix C
People not Print: Preliminary Codebooks

People not Print Preliminary Codebook			
Code	**Definition**	**Possible Findings**	**Justification**
Community	Participants description of home community	Understanding how the participant views their home and community, how this relates to future education/plans	Appalachian Literature
Family	Participants description of family/home	How family influence participants views and aspirations of the future	Appalachian, Engineering Career Choice Literature
Role Models	Individuals who have influenced the participant	How role models influence students career choice	Appalachian, Engineering Career Choice Literature
High School Experience	Description of high school (classes, social life, etc..)	How teachers, coursework, friends influence students career choice	Appalachian, Engineering Career Choice Literature
Family Education Levels	Description of students perceived education level of family or guardians	How this perception influences future education plans	Appalachian, Engineering Career Choice Literature
Community Education Levels	Description of perceived education level of community	How this perception influences future education plans	Engineering Career Choice Literature
Career Exposure	Description of participants exposure to career options	How available role models and perceptions of available careers influence career choice	Appalachian, Engineering Career Choice, and FPS Literature
Hoped For Future	Description of Hopes for the future	How students view themselves in the future (career, family, identity, etc…)	FPS Literature
Future to Avoid	Description of Fears of the Future	The future participants hope to avoid (career, family, identity, etc…)	FPS Literature
Future Education Plans	Education Plans for the Future	How the participants description of future involves higher education	Appalachian, Engineering Career Choice, and FPS Literature
Future Location	Description of where the participant hopes to live in the future	If future location limits career choice options	Appalachian Literature
Fears of College/Advanced Training	Fears including confidence issues associated with higher education	Participants confidence/self-efficacy associated with higher education	Appalachian, Engineering Career Choice, and FPS Literature

People not Print: Appalachia FPS Codebook		Timing				
		Culture	Personal Past/Present	Desired Personal Future	Feared Personal Future	Engineering Future
Qualities	Achievement	RQ3/RQ4 - Supports/ Inhibits engineering as future self	RQ3/RQ4 - Supports/ Inhibits engineering as future self	RQ1/RQ2 - Perceptions of Future Career	RQ1/RQ2 - Perceptions of Future Career	RQ2 - Perceptions of Future Engineering Career
	Interpersonal Relationships					
	Personality Traits					
	Physical/Mental Health					
	Material/Lifestyle					
	Negative					

Appalachia Future Possible Selves Codebook

	Code: Personal Past/Present Comments related to the participants personal attributes.		Examples
sub codes	**Achievement (Academic/Education related discussion)**	• Description of educational experience • Description of teachers, courses, school • Educational goals related to career	• Mr. Smith was an excellent high school math teacher
	Interpersonal Relationships (Includes description of reaction to chosen career path)	• Description of the person's relationships with family, friends, community, etc… • Description of mentors outside of an educational setting • Description of how relationships influence career choice • Support System/Mentors/Description of Supports	• Participant credits local nurse as introducing the field
	Personality Traits (Includes Self-Efficacy)	• Personal description of self. • Attitudes, behaviors, beliefs of the participant. Extracurricular activities such as sports, clubs, etc that describe the participants personality	• Very interested in math and science • I played basketball and baseball in high school • Likes to build, etc… • Like to help people
	Material/Lifestyle/ Employment	• How the participant describes material possessions and current economic condition • Lifestyle in home community • Indication of economic status growing up • Career related experiences, jobs, farming, and other career related exposure	• Growing up I always had plenty but we never had a lot of extra money for trips or extra things. • My parents have good jobs for the area where I grew up so I seemed to have it a little easier than my peers.
	Negative	• Negative responses not associated with other categories relating to self	• How to avoid negative and achieve desired, etc
	Non-Normative/ Risky Behaviors	• Includes negative and illegal behaviors such as smoking, drinking, involved in fights, gangs, etc. related to self	• I avoid drinking in an effort to avoid struggles with addiction within my family.

	Code: Desired Personal Future Comments describing the future the participant hopes to achieve including description of that future and steps planned to get there		Examples
sub codes	**Achievement (Academic/ Education related discussion)**	• Educational related activities of future career • Education related experiences exposing participant to career • Courses taken to prepare for career • College/education track choice to prep for career	• Health science course in high school introduced the nursing path
	Material/Lifestyle/ Employment	• Desired future career • Desired future material possessions. • How career influences this economic and physical position. • Desired future location.	• Going into education allows participant to remain near family, friends, and community
	Community /Location	•	•
	Interpersonal Relationships (Includes description of reaction to chosen career path)	• Description related to future relationships. • Hoped for relationships, goals to achieve future relationships • Description of how relationships influence desired career	• Individuals relationship with family increases desire to remain in the area • Relationship with local attorney influenced legal career path
	Personality Traits (Includes Self-Efficacy)	• Desired future personality traits. • How future career aligns with desired personality traits.	• Nursing aligns with goal to help people
	Negative	• Description of Barriers Associated with Desired Personal Future	• How to avoid negative and achieve desired, etc

Appalachia Future Possible Selves Codebook

	Code: Feared Personal Future Comments describing the future the participant hopes to avoid including description of that future self and steps to avoid that path.		Examples
sub codes	**Achievement (Academic/Education related discussion)**	• Educational related activities of future career • Education related experiences exposing participant to career • Courses taken to prepare for career • College/education track choice to prep for career	• Health science course in high school introduced the nursing path
	Material/Lifestyle/ Employment	• Desired future career • Desired future material possessions. • How career influences this economic and physical position. • Desired future location.	• Going into education allows participant to remain near family, friends, and community
	Interpersonal Relationships (Includes description of reaction to chosen career path)	• Description related to future relationships. • Hoped for relationships, goals to achieve future relationships • Description of how relationships influence desired career	• Individuals relationship with family increases desire to remain in the area • Relationship with local attorney influenced legal career path
	Personality Traits (Includes Self-Efficacy)	• Desired future personality traits. • How future career aligns with desired personality traits.	• Nursing aligns with goal to help people
	Negative	• Negative responses not associated with other categories relating to feared personal future	• How to avoid negative and achieve desired, etc
	Non-Normative/ Risky Behaviors	• Includes feared negative and illegal behaviors such as smoking, drinking, involved in fights, gangs, etc. • How participant plans to avoid risky behavior	• I avoid drinking in an effort to avoid struggles with addiction within my family.

	Code: Engineering Future Comments describing the future the participant hopes to achieve regarding an engineering career path including description of that future and steps planned to get there		Examples
sub codes	**Achievement (Academic/Education related discussion)**	• Educational related activities of future engineering career • Education related experiences exposing participant to engineering related career • Courses taken to prepare for engineering career • College/education track choice to prep for engineering career	• I was introduced to engineering in a high school course and have been interested in the career since then
	Interpersonal Relationships (Includes description of reaction to chosen career path)	• Description related to future relationships. • Hoped for relationships, goals to achieve future relationships • Description of how relationships influence desired career	• Individuals relationship with family increases desire to remain in the area
	Personality Traits (Includes Self-Efficacy)	• Desired future personality traits. • How future engineering career aligns with desired personality traits	• Engineering allows participant to use math and science in future career
	Physical/Mental Health	• Desired attributes of future physical/ mental health. • How engineering career influences future health concerns • Ex. Participant believes that engineering career will bring enjoyment in the future(positive mental health)	• As an engineer I will be able to use math and science which is something I enjoy
	Material/Lifestyle/ Employment	• Desired future engineering career • Desired future material possessions. • How engineering career influences this economic and physical position. • Desired future location	• Engineers work in the city which is where I hope to live in the future • Engineering is a lucrative career which should provide enough money for the lifestyle I hope to live
	Negative	• Negative responses not associated with other categories relating to desired engineering career •	• How to avoid negative and achieve desired, etc
	Non-Normative/ Risky Behaviors	• Includes negative and illegal behaviors such as smoking, drinking, involved in fights, gangs, etc • How participant plans to avoid risky behavior in the future	• I avoid drinking in an effort to avoid struggles with addiction within my family.

Original Code Definitions from Dapha Oyserman:

Code Definitions: (Taken from Oyserman(Oyserman, 2004c)

Codes adapted to fit coding scheme for Appalachia career related Future Possible Selves

1. **Achievement**- relates to school and school interactions with teachers, achievement-related activities
2. **Interpersonal Relationships**- involves family, friends, relationships, and social interactions except with teachers
3. **Personality Traits**- relates to personality characteristics, self-descriptions of traits
4. **Physical/Health-Related**- relates to physical health, weight, height
5. **Material/Lifestyles**- relates to material possessions and living situation, including moving
6. **Non-normative /Risky Behaviors**- includes negative and illegal behaviors such as smoking, drinking, involved in fights, gangs, etc.

Appendix D
People not Print: Summary Sheet

People not Print: Codebook/Summary Sheet

FGC Any College **FGC BS** **County** **Status***(ARC Category)*

Engineering Intervention Activities ***(PLTW, Camp, Class, Etc…)*** **CGA** ***(Yes/No)***

Future Career Goal **Future College/Training Choice**

<u>Hope For Future</u>

Description of the participants Desired Future Self. This includes Lifestyle and Employment. Description of Internal and External outcomes of the future self. Included in this section are things that excite the participant about the future and what they want their career to provide.

Examples:

- ***Make things better***
- ***Interesting Job***
- ***Use science for the general good of people.***
- ***Help with advances in Science.***
- ***Stable employment, good income***

Future to Avoid

Description of the participants' future self to avoid. This category includes lifestyle and employment outcomes including internal and external outcomes.

Examples:

Sav-A-Lot Bag Boy

Career involving blood…No Medical Career

Failing Classes

"Slaving" for low pay (recommended by grandfather)

Problems associated with drugs and alcohol

Dreaded job

Local Careers

Description: Exposure to careers. This includes parent/family careers and associated education level, careers in the local community, location of these careers, and careers/jobs directly experienced by the participant. Pertinent information to the career is also acceptable in this category. This could include information about the location of careers and/or existence of careers in their local community.

Examples:

Father-Machinist Mother-Bookkeeper

Factory workers, many factory workers displaced when local factories closed.

Electrician Teacher Farmer

Formal Programs

This includes description of any formal program or activity that introduces engineering. This can include a course, camp, or other formal event credited with providing engineering exposure. In addition this code captures any description of exposure provided by the program.

Examples

Project Lead the Way Course

Career and Technical Agricultural Course

Physics Course

People

This includes description of people described as a career mentor. These code includes discussion related to any professional credited with providing exposure to a future career.

Examples

Met engineers through summer internship.

The engineers I know are just "cool" and "smart

Father, an electrician stresses the importance of a degree in electrical engineering to avoid physically demanding work.

Primary Support

This includes people that the participant credits as support. These participants can include any person mentioned as supporting/influencing the participant toward future goals. These may include family members, teachers, mentors, or any person who influence the participants' future. Description of the support is also acceptable in this category. This support/influence can be negative or influences of a future to avoid.

Example:

Dad-Encourages higher education

H.S. Biology Teacher

Mom-avoid her poor choices in life(drugs/alcohol)

Reason

This category includes reasons associated with future career choice. This can include any factors including actions by people, financial considerations, Interests associated with the career, location/availability of higher education, and/or any other motivating factor related to the career of choice including actions to avoid.

Examples:

Desire to help people

Desire to make things better

Interest in math and science

Engineering class introduced engineering as a career which linked desire to build with interest in math and science.

Interest in healthcare associated with desire to help people and influence with taking care of mother during addiction.

Future Location

Information associated with the participants future location.

Examples:

Hometown-lots of supporting family, Less trouble than city, people come together, wants kids to experience that.

Don't want to leave family or place, will commute to work if necessary

Wants to join the Navy and see the world

Barriers

Any description of a barrier that the participant perceives in pursuit of their hope for future.

Examples:

Not a lot of local jobs for "high level" degrees

Transition from high school to college difficult.

Difficult to adjust to college town from small hometown.

Not well prepared for mathematics in college.

Never been good in math.

Parents on drugs. Had to live with grandparents.

Fears

Fears associated with the participants' future.

Examples:

Uncertainty

Lots of people in college courses

Limited jobs in local community after college

Confidence

Indications of the confidence level the participant displays related to their future career. Can simply be indicated as high/low or may include statements indicating the participants confidence level.

Examples:

High Confidence level

High confidence level in succeeding

Participant will succeed when he "sets his mind to it"

Low ACT scores in Math has participant questioning engineering as a career choice

Engineering Exposure

Description of exposure to engineering as a career choice. This category can include a lack of exposure or misinformation about the field of engineering.

Examples:

Project Lead the Way engineering class in high school introduced the field.

Uncle is a Civil Engineer

Attended President's Academy at TTU

Knows a local engineer who works on cars at the local dealership

Home Culture

Description of the participants' home life particularly related to education.

Examples:

Parents very supportive of education

Mom helps participant with math homework

School Culture

Description of school culture particularly related to higher education and engineering as a career. Also includes general description of the school environment.

Examples:

School offers dual credit courses and PLTW engineering classes

Ag department discusses engineering in courses related to building.

No mention is made of engineering exposure related to the high school.

Small school, teachers know students and care about their success

Community

Description of the participants' local community. This includes description of the physical place, relationships, and any other description of the local town/community.

Examples:

Everybody knows everybody

People are nice

Two engineering colleges within one hour of home

Church very important part of life

Live on family farm

Very safe area, don't ever lock the doors

Long distance to the movie theatre/store

Limited exposure to career options

Answer to the research question for this student.

RQ1 How do high school and college students from rural areas of the Cumberland Plateau perceive their future career?

RQ2 How do these Appalachians students perceive engineering as a career?

RQ3 What supports these students in envisioning and pursuing a future self that includes an engineering career?

RQ4 What inhibits these students from envisioning and pursuing a future self that includes an engineering career?

Categories:

Category 1: Minimal Access-Minimal Intent to Pursue an Engineering Career

This category represents participants who did not describe exposure to engineering through formal programs or access to professionals. These participants could not present a perception of an engineering career in their future. These participants do not plan to pursue engineering as a future career.

Category 2: Access-Minimal Intent to Pursue an Engineering Career

This category represents participants who did describe exposure to engineering through formal programs and/or access to professionals. These participants could present a perception of an engineering career in their future. These participants do not plan to pursue engineering as a future career.

Category 3: Access-Intent to Pursue an Engineering Career

This category represents participants who did describe exposure to engineering through formal programs and/or access to professionals. These participants could present a perception of an engineering career in their future. These participants do plan to pursue engineering as a future career.

* **Access**-An encounter with the field of engineering. Typically through access to formal programs and/or professionals

  Formal Programs-In school or extra-curricular activity

  Professionals-Include individuals with experience necessary to support engineering career choice

  Intent-Verbalization of the desire to pursue an engineering career