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## Snapshot of Rural Appalachian High School Students' College-Going and STEM Perceptions

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To the Graduate Council:

I am submitting herewith a thesis written by Pamela Rosecrance entitled "Snapshot of Rural Appalachian High School Students' College-Going and STEM Perceptions." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Psychology.

Erin Hardin, Major Professor

We have read this thesis and recommend its acceptance:

Melinda Gibbons, Jacob Levy

Accepted for the Council:

Dixie L. Thompson

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

Snapshot of Rural Appalachian High School Students' College-Going and STEM Perceptions

A Thesis Presented for the  
Master of Arts  
Degree  
The University of Tennessee, Knoxville

Pamela Rosecrance

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## ABSTRACT

We examined 892 high school student's perceptions related to college-going and science, technology, engineering, math, and medical (STEMM) careers. Students were 10<sup>th</sup> and 11<sup>th</sup> graders attending three rural Appalachian high schools in the Southeastern U.S. Social Cognitive Career Theory was used to examine group differences in perceptions related to gender, perspective first-generation college student (PFGCS) status, and the presence or absence of aspirations to pursue a STEMM career. Young women and men scored similarly on all but one dependent variable, college-going self-efficacy, where young women scored higher. Students who plan to pursue a STEMM career had higher scores on every measure than those who do not plan to pursue a STEMM career. There was an emergence of a third PFGCS status group, students who were unsure of their parent's education level, indicating that this group of students should be examined in future research as a distinct group.

Keywords: Appalachian students; STEMM; college-going self-efficacy; college outcome expectations; SCCT

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## **CHAPTER I: INTRODUCTION & LITERATURE REVIEW**

After graduating from high school, young women and men face the decision of whether they will begin looking for a job and/or pursue furthering their education, such as by applying to college or to a technical training program. Reports suggest that most students say that they plan to attend college, but the amount that actually do falls significantly short of such indications (Venezia, Kirst, & Antonio, 2003). This gap between college-going intentions and college-going behavior points to the need to understand the factors contributing to actual college-going.

Embedded within student's decisions to go straight into the workforce and/or pursue postsecondary education is the decision of whether they will pursue a STEM (Science, Technology, Engineering, and Math) or non-STEM career. With the increasingly greater demand on the U.S. workforce for skilled workers in STEM (Bureau of Labor Statistics, 2017), it is more important than ever to understand this decision-making process for high school students. Specifically, it is crucial to understand which factors play a role in their decision to pursue educational and vocational trajectories in STEM versus non-STEM fields. STEM jobs currently account for a significant portion of job openings and 99% of STEM jobs require some form of postsecondary education (Bureau of Labor Statistics, 2017). Salaries for STEM workers are well above the national average and the top ten bachelor programs with the highest earning graduates are all in STEM fields (Lehman, 2013). STEM fields are seeing significantly faster growth in job opportunities than non-STEM fields and STEM jobs come with significant financial, achievement, and mobility opportunities (Bureau of Labor Statistics, 2017). From this it can be concluded that students interested in pursuing STEM jobs will likely need postsecondary

education, have better chances of finding a job in their field compared to non-STEM job-seekers, and be more likely to be in higher paying job if they succeed.

Researchers demonstrate an interest in fostering and sustaining STEM pursuits in education for just these reasons (National Academies Press, 2007). However, a concerning deficit exists in the number of adequately skilled STEM workers to fill STEM positions relative to the projected openings (Blustein et al., 2013; National Academic Press, 2007; National Research Council, 2007). Furthermore, deficits in STEM preparation and achievement are more prevalent among marginalized populations, including women, students of color, and first-generation college students (Barton, Tan & Rivet, 2008; National Science Board, 2006, 2010; United States Department of Education, 2007b). These deficits magnify efforts to understand and increase college and STEM pursuits among populations that demonstrate historically lower educational and vocational attainment. One such marginalized and under-researched population is rural Appalachian high school students.

The current study investigates a sample of high school students across three high schools in Central Appalachia and their perception of several variables that Social Cognitive Career Theory (SCCT: Lent, Brown & Hackett, 1994) suggest are key predictors of interest in college-going in general and STEM careers. We seek to increase our understanding of this population in order to advance the literature and applied efforts that aim to reduce disparities in educational and vocational attainment in this region.

### **Background of Appalachian Population**

Despite significant progress in recent decades, students in the Appalachian region of the United States continue to face many socioeconomic and health disparities relative to people living elsewhere in the country (Appalachian Regional Commission [ARC], 2017; deMarrais,

1998; Seal & Harmon, 1995). Additionally, while most people in the region are European American, they have a distinct culture and unique circumstances that often separate them from other groups, particularly middle-class Whites (deMarrais, 1998). The rural Appalachian region is characterized as having a rich cultural heritage, including enduring values of familism, traditionalism, and self-reliance, all of which may influence attitudes toward education and vocation (Billings & Blee, 2000; deMarrais, 1998).

The Appalachian region comprises 420 counties, of which 107 are classified as rural, defined as not having a metro area nor being adjacent to any metro areas (ARC, 2017). Additionally, 84 of the counties in Appalachia are designated as distressed, which means they rank in the lowest 10 percent of the nation on three economic indicators: unemployment rate, per capita market income, and poverty rate. Importantly, when comparing maps of rural and distressed counties, one will notice a great deal of overlap, such that rural counties are much more likely to be economically distressed (ARC, 2017). The Appalachian area also continues to demonstrate lower rates of educational attainment relative to the non-Appalachian areas of the nation. According to recent evidence, high school graduation and college-going rates in this region remain below those of the national average (ARC, 2017). Pollard and Jacobsen (2013) determined that approximately 75% of adults over the age of 25 had no form of postsecondary education. Therefore, students in this region are more likely to come from low-income households and have parents with limited educational attainment or who are unemployed.

### **Prospective First-Generation Students**

Considering the limited portion of the Appalachian adult population who has any form of postsecondary education, there is a high likelihood that students in rural Appalachia would be the first ones in their families to pursue a college education if they so choose (Pollard & Jacobsen,



2013). Students who have not yet graduated high school and whose parents do not have any postsecondary education are known as prospective first-generation college students (PFGCSs; Gibbons & Borders, 2010). Due to their parents' lack of formal postsecondary education, PFGCSs are expected to face notable challenges with college-going. Previous research indicates that PFGCSs tend to rate themselves lower academically and are more likely to endorse plans to go straight into the workforce after high school (Gibbons, Borders, Wiles, Stephan, & Davis, 2006). Furthermore, research shows that first-generation college students (FGCSs), students who are attending college and whose parents did not attend college, demonstrate lower educational expectations and aspirations and are less likely to choose a STEM major (Chen & Carroll, 2005; Hahs-Vaughn, 2004) than students whose parents did attend college. Low-income FGCSs tend to have fewer and lower quality learning experiences in math/science and report lower confidence in academic performance than students whose parents went to college (Bloom, 2007; Bui, 2002).

### **Application of Social Cognitive Career Theory**

Social Cognitive Career Theory (SCCT; Lent et al., 1994) has been a preferred model to conceptualize educational attainment in many groups, including PFGCSs (Gibbons & Borders, 2010) and Appalachian high school students (Ali & Saunders, 2006; Ali & McWhirter, 2006), because of its consideration of context, and thus, the unique contributors to one's experiences. SCCT includes three major variables - self-efficacy, outcome expectations, and goals - and the ways in which they interact to influence career and educational intentions and behaviors. According to research utilizing SCCT with PFGCSs, these students report lower college-going self-efficacy, lower positive outcome expectations regarding college, more barriers to college-going, and less school and parental support for college-going compared to their non-PFGCS peers. (Gibbons & Borders, 2010).

The SCCT model simultaneously considers the influences of person and environment factors and past learning experiences. Wettersten et al. (2005) supported the application of SCCT with rural high school students, and found support for academic self-efficacy, social support, perceptions of barriers, and parents' pro-educational behaviors as predictors of career outcome expectations. Researchers have extended the application of SCCT to students of rural Appalachia and found that increased vocational/educational self-efficacy and perceptions of parental support predicted higher expectations to attend college (Ali & Saunders, 2006). In a similar population, Ali and McWhirter (2006) showed that higher vocational/educational self-efficacy, higher college outcome expectations, lower likelihood of encountering postsecondary barriers, and higher socioeconomic status predicted higher postsecondary aspirations.

### **STEM-Specific Applications**

As previously mentioned, first-generation college students and women are underrepresented among those persisting in STEM-related education (National Science Board, 2006, 2010; United States Department of Education, 2007b). There has been general support for the use of SCCT variables generally in conceptualizing math/science interests and intentions in diverse populations (Fouad & Smith, 1996; Garriott, Flores, & Martens, 2013; Lent, Brown & Gore, 1997; Nauta & Epperson, 2003; Navarro, Flores, & Worthington, 2007; Waller, 2006). Fouad and Smith (1996) supported the important role of math/science self-efficacy on math/science intentions through its influences on outcome expectations and interests. Navarro et al. (2007) demonstrated a similar pattern of relationship between math/science self-efficacy, outcome expectations, interests, and goals in a sample of Mexican-American middle school students. Wallery (2006) found that self-efficacy was the strongest predictor of math interest and choice intentions. Within the marginalized population of rural Appalachian, there is a need to

further understand the relationship between college-going self-efficacy, college outcome expectations, math/science self-efficacy, math science interest, and STEM career aspirations in high school students.

## CHAPTER II: METHOD

This study analyzed the relationship between rural Appalachian high school students' college-going and STEM perceptions and their gender, prospective college generational status, and career aspirations. Utilizing the SCCT model, we asked 10<sup>th</sup> and 11<sup>th</sup> graders to assess their beliefs about pursuing postsecondary education and choosing a STEMM career. This study helps us to more broadly understand the college-going and STEM perceptions of rural Appalachian high school students.

### Research Questions & Hypotheses

**Research Question #1.** How do perceptions of college-going and STEM differ between those who aspire to pursue a STEMM career versus those who do not? We expected students who have STEMM career aspirations to have higher scores on STEM outcome expectations, math/science interest, and math/science self-efficacy than those who have non-STEMM career aspirations. We expected these two groups to score similarly on college-going self-efficacy and college outcome expectations.

**Research Question #2.** How do perceptions of college-going and STEM differ between young men and young women? We expected young men to score higher on STEM outcome expectations, math/science interest, and math/science self-efficacy than young women. We expected young women to score higher on college-going self-efficacy and college outcome expectations.

**Research Question #3.** How do perceptions of college-going and STEM differ among PFGCSs and non-PFGCSs? We expected to see differences on the SCCT variables based upon PFGCS status, such that PFGCSs would score lower on all the variables for college-going.

**Research Question #4.** Are there differences between young women and young men in the number of students who aspire to pursue a STEMM career? We expected higher numbers of young men to aspire to STEM careers than young women.

**Research Question #5.** Are there differences between PFGCSs and non-PFGCSs in the number of students who aspire to pursue a STEMM career? We expected to see differences in STEM aspirations based upon PFGCS status, such that non-PFGCSs would be more likely to aspire to pursue a STEMM career.

### **Participants**

Usable data were collected from 892 10<sup>th</sup> and 11<sup>th</sup> grade students from three East Tennessee rural Appalachian high schools who were part of a larger NIH-funded intervention program (called PiPES; Possibilities in Postsecondary Education and Science) designed to promote interest in post-secondary education as well as career options in science, technology, engineering, mathematics, and medical science (STEMM). PiPES program components include multi-week classroom intervention lessons, a three-day summer camp at a southern public university campus, student leadership training, family information sessions, and collaboration with school counselors, teachers, and other stakeholders. The classroom intervention component is delivered to students through multi-week classroom guidance lessons aimed to raise college awareness and knowledge, reduce perceived barriers, connect student goals to postsecondary options, and introduce STEMM. The following data represent the initial 2015-2016 cohort of students, prior to participation in any of the interventions. The results of this study will serve as a baseline understanding of the current population prior to the implementation of interventions intended to increase college-going and STEM awareness.

All students enrolled in the three target high schools reside in a county designated as rural Appalachian based on the Appalachian Regional Commission's (ARC) definition, and thus represent our minority population, rural Appalachian youth. As described earlier, Appalachian communities are typically rural, low-income, European American, and low-educated. These schools are located in two counties considered to be economically distressed, with the average per capita income ranging from \$17,043-\$18,686 and the unemployment rate ranging from 8.7%-10.5% (ARC County Economic Status, FY 2017).

The three schools range in size from 383 to 1,339 students, with an average of 41.4% of students being classified as economically disadvantaged in the 2015-2016 school year. High school graduation rates from these three schools ranged from 88.3% to 91.0%. ACT scores are lower among these schools relative to Tennessee's state average (19.9), ranging from 16 to 19.3. Moreover, among the two counties from which these schools are located, college completion (bachelor's degree or higher) rates are low among adults 25 or older, with 8.6% in County 1 and 9.5% in County 2, relative to both the state (24.4%) and national averages (29.3%; ARC, 2010-2014).

The sample was 53.1% female and 97.8% non-Hispanic White. Forty-nine percent of participants were in the 10<sup>th</sup> grade, with the remaining 51% of participants being in the 11<sup>th</sup> grade. Of the participants overall, 31.8% of students identified as PFGCSs, 55.2% identified as non-PFGCSs, and 13.0% reported being unsure of their PFGCS status. The majority (64.2%) indicated a STEMM career aspiration and 35.8% indicated a non-STEMM career aspiration.

## **Instrumentation**

**College-going self-efficacy.** The 30-item college-going self-efficacy scale (CGSES; Gibbons & Borders, 2010) assesses beliefs surrounding two aspects of the college-going

experience. The college attendance subscale measures students' beliefs about being able to complete college-preparation tasks, whereas the college persistence subscale assesses beliefs about being able to stay in college once enrolled. Using a 4-point Likert scale (1 = *not at all sure*, 2 = *somewhat sure*, 3 = *sure*, 4 = *very sure*), students reflect on items related to financial issues, academic ability, family-related issues, and decision-making skills. The CGSES has been used with middle and high school students from varying backgrounds (Gibbons & Borders, 2010; Gonzalez, Stein, & Huq, 2013). The total score, which provides an indication of overall strength of college-going self-efficacy beliefs, was used for the purposes of this study ( $\alpha = .95$ ). Higher scores indicate higher self-efficacy perceptions.

**College outcome expectations.** The College Outcomes Expectations Scale (COE; Flores, Navarro, & DeWitz, 2008) is a 19-item measure that assesses students' beliefs about the value of pursuing a post-secondary degree (e.g., *If I get a college education, then I will do well in life*). Students respond to items on a Likert scale ranging from 1 (strongly disagree) to 10 (strongly agree). Item responses were averaged, and higher scores indicate more favorable expectations associated with a college education. The COE was developed for use with high school students and has demonstrated excellent psychometric properties in these populations. In the current sample, internal consistency for this measure was high ( $\alpha = .95$ ).

**STEMM college major outcome expectations.** The 16-item STEMM College Major Outcome Expectations Scale (STEM-OE) was adapted using a measure explained by Lent et al. (2001) and further modified by Byars-Winston et al. (2010). This scale assesses students' beliefs about the value of choosing to major in a STEMM field. Students were asked to respond to items on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*), and a sample item

includes, “Getting a degree in a STEMM-related field would allow me to earn a good salary.” Internal consistency for this measure was high ( $\alpha = .92$ ).

**Math and science self-efficacy and interest.** Students’ perceptions of their own math and science self-efficacy and interest were assessed via the eight-item Math/Science Self-Efficacy and Interest Scale. This scale was created based upon Bandura’s standard methodology recommended for measuring self-efficacy by using a scale from 1 to 100 with 10-unit intervals (2006). The first four items were used to assess math/science self-efficacy. On a scale from 1 to 100, students indicated their degree of confidence in their ability to learn general math, advanced math, general science, and then advanced science topics. The last four items were used to assess math/science interest. On a scale from 1 to 100, students indicated their degree of interest in general math, advanced math, general science, and then advanced science topics.

**Career aspirations.** The Vocational/Educational Aspirations Checklist (Rasheed, 2001) assessed students’ post-secondary aspirations. Using a nine-option list, students were asked to select their preferred option if they were free to choose any option (i.e., were not limited by financial barriers or lack of social support). Examples of options included joining the workforce or military immediately after high school, completing a two- or four-year bachelor’s degree, or obtaining a bachelor’s degree and then completing graduate school. This Checklist has been used with Appalachian high school students (Ali & McWhirter, 2006).

**STEMM Career Aspirations.** Students were asked to list potential careers they might be interested in pursuing and had the option of giving anywhere from one to five answers. In order to categorize these careers, we created three different codes: STEMM, non-STEMM, and unsure. Careers were categorized as “STEMM” if they included science, technology, engineering, math, or medical science in their everyday work. Examples include marine biologist, nurse, surgeon,



engineer, and computer programmer. Any careers that did not include STEMM in their everyday work were coded as “non-STEMM;” examples include cosmetologist, writer, police officer, and professional basketball player. Occupations were coded as “unsure” if the occupation could have been either STEMM or not, such as schoolteacher, but it was unclear without additional knowledge of the specialization (e.g., math teacher versus art teacher). Two undergraduate research assistants each coded approximately half of the 1615 occupations as one of these three categories. Another member of the research team randomly selected and coded 161 of the same occupations listed and found 85.7% agreement and a Cohen’s kappa of .723 with the undergraduate coders.

Using these three codes, students were then sorted into one of two groups: STEMM career aspirations or non-STEMM career aspirations. If a student generated at least one aspiration coded as a STEMM-field occupation, the student was placed in the STEMM career aspirations group. If the student responded solely with non-STEMM-field occupations, the student was placed in the non-STEMM career aspirations group. For occupations that were coded as unsure, the student was placed in the non-STEMM career aspirations group.

## **Procedure**

Data were collected as part of the program evaluation process for the grant-funded project. The University Institutional Review Board approved the use of the program evaluation data for research purposes. Parents of all eligible students received an informed consent statement that was handed out in class and students were instructed to take home. The statement included general information about PiPES and described student involvement in the program as well as student involvement in research. Although all students were expected to participate in PiPES during school hours as part of the school curriculum and to complete program evaluation

measures, parents were able to deny consent to the research portion of the program by returning an opt-out form. No parents opted their child out of the research portion during the 2015-2016 school year. Students also had the opportunity to assent (or decline assent) to have their responses used for research.

Data were collected in the early fall (August/September) of the 2015-2016 school year prior to the start of the PiPES intervention. Students completed self-report measures in classrooms overseen by a team of trained graduate and undergraduate researchers. After completing the battery, students were asked to assent to using their responses for research; 1,006 students (86.4%) assented to have their responses used for research. Students' data were only analyzed for those who indicated a gender and who correctly answered three validity checks embedded within the surveys. The validity checks asked students to select certain answers to the survey questions to ensure they were reading the questions. After removing these from the sample, we were left with data from 892 students to be used in the final analysis.

### **Data Analysis**

All of our data were analyzed using SPSS (Version 24.00). To answer research questions one through three, analyses were performed using a multivariate analysis of variance (MANOVA) to compare the three independent grouping variables with the six college-going and STEM dependent variables. For research questions four and five, chi-square tests of independence were performed to examine the relationships between PFGCS status and STEMM career aspirations as well as between gender and STEMM career aspirations. After a chi-square test of independence was performed on all three PFGCS status groups, three more chi-square tests of independence were performed on two groups at a time in order to make pair-wise comparisons.

## CHAPTER III: RESULTS

On all measures except the MSSE scale, several participants were missing at least one item response. On any scale for which a participant had item-level missing data exceeding 15% of possible items (i.e., 5 or more items missing on CGSES, 3 or more on COE, 3 or more on STEMOE, 1 or more missing on MSSE, or 1 or more missing MSInt), scale scores were not computed. This resulted in 2 participants not receiving a COE scale score and 1 participant not receiving an MSInt score. For all other participants, item-level missing data were handled by calculating the mean of all completed items on that scale (Parent, 2013).<sup>1</sup> Correlations and descriptive statistics for all included surveys are presented in Tables 1-2.

### Tests of Between Groups Effects

A chi-square test of independence was performed to examine the relationship between PFGCS status and STEMM career aspirations. The relationship between these variables was significant,  $\chi^2(2, N = 892) = 10.54, p < .01$ . Non-PFGCSs were significantly more likely to choose a STEMM career than both PFGCSs and unshures, who were not different from each other. Those unshure of their PFGCS status were the least likely (56%) to have STEMM career aspirations and the most likely (44%) to have non-STEMM career aspirations. Non-PFGCSs were the most likely (68.8%) to have STEMM career aspirations and the least likely (31.2%) to have non-STEMM career aspirations. PFGCSs were in-between the other two groups for both

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<sup>1</sup> We identified ten outliers, defined as those with a  $z$  score more than 3.5 standard deviations from the mean and confirmed as outliers through visual inspections of histograms. We ran the analyses without these outliers, however the pattern of the results was the same. Therefore, all of the analyses reported include these outliers.

those who had STEMM career aspirations (59.6%) and those who did not have STEMM career aspirations (40.4%).

Another chi-square test of independence was performed to examine the relationship between gender and STEMM career aspirations. The relation between these variables was significant,  $X^2(1, N = 892) = 34.18, p < .001$ . Young women were more likely than young men to have STEMM career aspirations, with 73.1% of young women and only 54.3% of young men having STEMM career aspirations.

### SCCT Variables

**Between groups differences.** In order to find out if gender, PFGCS status, and STEMM career aspirations were related to our dependent variables, we conducted a 2 (gender: male, female) x 3 (PFGCS status: yes, no, unsure) x 2 (STEMM career aspirations: yes, no) multivariate analysis of variance (MANOVA).

**Main effects.** All three independent variables showed main effects ( $ps < .01$ , partial  $\eta^2 < .12$ ). There was a very small main effect of gender on the CGSES  $F(1,880) = 4.56, p = .033$ , partial  $\eta^2 = .005$ , power = .57. Young women ( $M = 3.12, SD = 0.54$ ) scored significantly higher than young men ( $M = 2.99, SD = 0.55$ ) on the CGSES. Young men's and young women's scores were not significantly different on any of the other measures. Although these results were statistically significant, practical implications are limited due to the small effect size.

There were main effects of STEMM career aspirations on every dependent variable ( $F_s > 30.69, ps < .001$ ). Those who planned to pursue a STEMM career had higher scores on every measure than those who did not plan to pursue a STEMM career. The effect size was small to medium for COE, medium for CGSES, MSSE, and STEMOE, and medium to large on MSInt.

There were main effects of PFGCS status for every dependent variable ( $F_s > 4.21$ ,  $p_s < .016$ ) except STEMOE ( $F = 1.94$ ,  $p > .14$ ). The effect size was very small for MSInst, small for COE, and small to medium for CGSES and MSSE. For all of the variables except STEMOE, the non-PFGCSs were significantly different from both the PFGCS group and the unsure group ( $p_s < .01$ ). The PFGCSs and unshures were not significantly different from each other on any measure, except on the CGSES where unshures scored significantly lower ( $p < .05$ ). Practical implications on the differences between groups on MSInt are limited due to the small effect size, despite reaching statistical significance. For every dependent variable, scale scores were highest for non-PFGCSs, next highest for PFGCSs, and lowest for those unsure of their PFGCS status. See Table 2 for means.

**Interaction Effects.** Although there were no two-way interactions, there was a small, but significant, three-way interaction between gender, PFGCS status, and STEMM career aspirations  $F(10,1752) = 2.53$ ,  $p < .01$ , partial  $\eta^2 = .01$ , power = .96. Tests of between subjects effects showed that the interaction was significant on COE  $F(2, 880) = 3.92$ ,  $p < .05$ , partial  $\eta^2 = .01$ , power = .71 and MSInt  $F(2, 880) = 4.22$ ,  $p < .05$ , partial  $\eta^2 = .01$ , power = .74. In order to probe these interactions we split our data by each of our independent variables and then performed one-way ANOVAs or independent sample  $t$ -test's on each in order to best understand the three-way interaction.

There was a significant STEMM Career Aspirations x PFGCS Status interaction on College Outcome Expectation scores for young men  $F(10, 818) = 2.01$ ,  $p < .05$ , partial  $\eta^2 = .024$ , power = .89, but not for young women. Among young men who were not interested in pursuing a STEMM career, non-PFGCS ( $M = 8.3$ ,  $SD = 1.19$ ) had significantly higher COE scores than those unsure of their PFGCS status ( $M = 7.17$ ,  $SD = 1.79$ ) and PFGCSs ( $M = 7.76$ ,  $SD = 1.45$ ),

who did not differ from each other. In contrast, among young men who were interested in pursuing a STEMM career, PFGCS status was unrelated to COE scores. See *Figure 1* for COE mean scores among young men in each PFGCS status group.

In terms of the interaction for Math / Science interest, we found that among young women who were interested in pursuing a STEMM career, non-PFGCSs had significantly higher MSInt scores ( $M = 72.93$ ,  $SD = 19.59$ ) than both PFGCSs ( $M = 65.87$ ,  $SD = 23.24$ ) and those unsure of their PFGCS-status ( $M = 62.68$ ,  $SD = 18.43$ ), who did not differ from each other. Among young men, MSInt scores did not differ based on PFGCS status, regardless of STEMM career aspirations.

Among PFGCSs interested in pursuing a STEMM career, young women had significantly lower math/science interest scores ( $M = 65.70$ ,  $SD = 23.29$ ) than young men ( $M = 75.29$ ,  $SD = 21.35$ ). Among non-PFGCSs and those unsure of their PFGCS status who are interested in pursuing a STEMM career, there were no gender differences in MSInt scores overall. Among those not interested in pursuing a STEMM career, young men and young women did not differ on MSInt scores within any of the three PFGCS status groups. See *Figure 2* for MSInt mean scores among those who have STEMM career aspirations in each PFGCS status and gender group.

## CHAPTER IV: DISCUSSION

The purpose of this study was to explore the college-going and career beliefs of rural Appalachian youth through the use of Social Cognitive Career Theory (SCCT). Students from three rural Appalachian high schools completed a battery of assessments on post-secondary education and STEMM careers. The results of our MANOVA showed that scores on nearly all variables differed significantly between STEMM career aspiration groups as well as between prospective first-generation college student (PFGCS) status groups. In general, and not surprisingly, students who had STEMM career aspirations had significantly higher math and science self-efficacy, STEM outcome expectations, and math/science interest than those who did not have STEMM career aspirations; more surprising, however, was the finding that students who had STEMM career aspirations also had significantly higher college-going self-efficacy and college outcome expectations. In general, students with at least one parent who had attended college (i.e., non-prospective first-generation college students) had the highest scores, followed by prospective first-generation college students, and then students who were unsure of their prospective first-generation college student status. Conversely, gender groups did not differ significantly on any variables, except on college-going self-efficacy, on which young women scored higher than young men.

### **Comparing Non-STEMM and STEMM Career Aspiration Groups**

These results confirmed our assumption that students who have STEMM career aspirations would have significantly higher scores on STEM outcome expectations, math/science interest, and math/science self-efficacy. This would make sense because STEMM careers commonly require both interest and skills in math and science. We were surprised to find that those with STEMM career aspirations also had significantly higher scores of college-going self-

efficacy and college outcome expectations. This may be because STEMM careers compared to non-STEMM careers are far more likely to require postsecondary education, in addition to interest and skill in math and science, with 99 percent of STEM employment requiring postsecondary education compared to 36 percent of non-STEM employment (U.S. Bureau of Labor Statistics, 2017). Therefore, we can see how those who feel confident in their ability to go to college (CGSES), believe college will be of value to them (COE), believe studying STEMM is of value to them (STEMOE), and are interested and confident in math/science (MSSE & MSSInt) would be expected to have a greater likelihood of choosing a STEMM career over those who display less of these characteristics. Since previous research notes that the SCCT is a helpful tool in determining Appalachian high school student's postsecondary pathways (Ali & McWhirter, 2006), supporting students' development of STEMM career aspirations may also increase their likelihood of pursuing higher education. This may be especially true for PFGCS young men.

### **STEMM Career Aspirations as Protective Factor for Young Men**

Overall, young men were significantly less likely to aspire to a STEMM career than young women. This result echoes national trends of men enrolling in postsecondary education at increasingly lower rates than women (Goldin, Katz, & Kuziemko 2006). In our study, we learned that prospective first-generation college student (PFGCS) status did *not* seem to matter for young men's college outcome expectations, as long as they had STEMM career aspirations. If they had non-STEMM career aspirations, young men who were prospective first-generation college students (PFGCSs) and those who were unsure of their prospective first-generation college student status both had significantly lower college outcome expectation scores than their non-prospective first-generation college student (non-PFGCSs) peers. This demonstrates that interest



in a STEMM career may be a protective factor for young men because this group all placed higher value on going to college.

### **Comparing PFGCS Status Groups**

Main effects of PFGCS status existed on college-going self-efficacy (CGSE), college outcome-expectations (COE), math/science self-efficacy (MSSE), and math/science interest (MSInt), but not on STEM outcome expectations (STEMOE). For all of the variables except STEMOE, the PFGCS and unsure groups, who were not significantly different from each other, scored significantly lower than their non-PFGCS peers. For every dependent variable, except STEMOE, scale scores were highest for non-PFGCSs, next highest for PFGCSs, and lowest for those unsure of their PFGCS status. This is an important finding because we see that the PFGCS and unsure groups see the value in STEM but they have significantly lower belief in themselves being successful in math and science, which according to SCCT leads to less interest. This puts PFGCSs and unshures at a disadvantage when it comes to their chances of being interested in and planning to enter a STEM career. We see these factors play out in our results on which groups were most likely to choose STEMM career aspirations: non-PFGCSs were most likely to have any STEMM career aspirations, followed by PFGCSs, and then the unsure group. It is possible that because students who had parents who went to college would be more likely to choose a career that involved postsecondary education since they have been exposed to it and may therefore consider it to be an attainable goal.

### **Students Unsure of Parent Education Level**

We also learned that there is a distinct and important group of rural Appalachian high school students who are unsure of their parents' postsecondary education level. This means it is likely that parents have not discussed their own education with their child. Out of the 892

students who were included in our analysis, a surprisingly large minority of 116 (13%) fell into this unsure group. There were two very important differences that emerged between the unshures and the other two groups. First, the unsure group was significantly less likely than the non-PFGCSs to have any STEMM career aspirations. Unshures likely have greater barriers and fewer supports in seeking postsecondary education. If no parent or guardian has communicated their education level to their student, we can see how it might be less likely for a student to aspire to a career that involves postsecondary education, such as one in a STEMM field, without a role model who talks about their postsecondary education. This could be due to barriers such as parents' lack of awareness of and information about postsecondary education options as well as low financial resources available in their family. Second, students in the unsure group had significantly lower college-going self-efficacy scores than both non-PFGCSs and PFGCSs. So these students in the unsure group are not only less likely to choose a STEMM career, but they also are not as confident in their ability to get into and succeed in college. Previous research on parent education level has not identified this third group, but given these differences, it seems vital that those without knowledge of their parent's educational level be considered a distinct group, separate from PFGCSs and non-PFGCSs, in future research.

### **Appalachian PFGCSs and Students Unsure of Parental Post-Secondary Education Level**

We have seen in previous research that Appalachian students have unique barriers to pursuing postsecondary education (deMarrais, 1998). One of these unique barriers could be a lack of parental understanding of and information about post-secondary education for those PFGCSs and those unsure of their parents' post-secondary education. If a student's parents did not go to college but the student has enough information to state the degree that they earned, this means they are at least talking about education after high school. The unsure group is unique

because their parents have likely not discussed their education with their student. Students may be less likely to pursue a STEMM career that commonly requires post-secondary education if their parents have never discussed their own post-secondary path.

### **Differences between young women and men on STEMM Career Aspirations**

We found that there were a few significant differences on our STEMM career aspirations and SCCT variables between gender groups. Young women scored significantly higher on college-going self-efficacy than young men. This means that although young women and men have similar levels of math/science interest and self-efficacy and see equal value in both choosing a STEM career and going to college, young men are not as confident as young women in their ability to get into and succeed in college. This is important because this deficit may be limiting young men's decisions to pursue post-secondary education even if they have interest in careers that require it and believe it would be of value to them.

Significantly more young women than young men had any STEMM career aspirations, while there were not significant differences in their math/science interest or math/science self-efficacy. In a previous study on undergraduates in an introductory chemistry course, men had greater STEM interest and STEM self-efficacy than women (Hardin & Longhurst, 2016). From the comparison of these results, it seems that young women may begin to be at a disadvantage between 10<sup>th</sup> grade and their freshman year of college, with their STEM interests and self-efficacy dropping below that of their male peers. However, other results indicate a more nuanced picture: PFGCS young women interested in a STEMM career *did* have lower math/science interest than their male peers (other PFGCSs interested in a STEMM career). Social-cognitive career theory tells us that interest is an important predictor of choice goals and actions. These

results show us that PFGCS young women may be less likely to persist in a STEM field later on due to lack of interest in math and science.

### **Limitations and Future Directions**

**Limitations.** Our sample is highly representative of our population, but limits generalizability to other populations (e.g., rural areas outside of Appalachia with greater minority populations). Future research should compare the results of this study to groups of more diverse populations to know if our findings are generalizable across groups. Another limitation of our study is that STEMM career aspirations were coded so that careers we were unsure about were coded as non-STEMM career aspirations. In the future, it would be helpful to have students specify the specialization of the careers that they are interested in to further refine our results.

Although we found statistical significance on many of our variables, the effect sizes were relatively small. This limits the practical implications of some of our findings, such as the gender difference on scores of college-going self-efficacy which were statistically significant but had a very low effect size.

**Future directions in research.** In our study we found that a significant number of students, 116 out of 892, were unsure of their parent's education level. We found that this unsure group had similar characteristics to the PFGCS group but had even lower scores than this group overall. It will be important in future research to consider this group of unshures instead of possibly leaving them out due to lack of demographic information regarding parental education. PFGCSs are likely to have restricted financial, family, and cultural supports (Pollard & Jacobsen, 2012) and it could be that students unsure of their parents' educational attainment face even

greater barriers. It will be important in future research to look into the characteristics and contextual influences of these unsure students.

Overall, students who had STEMM career aspirations scored significantly higher on all variables than those who did not have STEMM career aspirations. Future research should look into the process by which these aspirations develop and if they become obvious before or after students show higher SCCT and SCCT-based STEM scores than their peers who do not aspire to be in a STEMM career. Future research should also investigate how STEMM career aspirations are a protective factor for young men across PFGCS groups.

Future research should also investigate the group of students who are unsure of their parent's educational level. We've found that this group is not only less likely to choose a STEMM career but they also are not as confident in their ability to get into and succeed in college. Future research should look to determine if these attributes are consistent across populations and regions of the US. If future researchers continue to collect data on the unsure group, we'll be able to develop specific interventions to target this at-risk group. Since young women scored significantly higher on college-going self-efficacy than young men, future research should look into finding out when these differences begin to form and if they persist throughout the years.

PFGCS young women interested in a STEMM career *did* have lower math/science interest than their male peers (other PFGCSs interested in a STEMM career). Social-cognitive career theory tells us that both interest and self-efficacy are important predictors of choice goals and actions. This result is important because it shows us that PFGCS young women may be less likely to persist in a STEM field later on due to lack of interest in math and science. Future

research should take a closer look at how math/science self-efficacy plays a role, since in this case it did not differ.

**Future directions in practice.** This study provides information that could be especially useful to school counselors, teachers, and school administrators who work with rural Appalachian high school students. When working with this population, school counselors should keep in mind the differences that exist between groups on their beliefs and perceptions related to going to college. If counselors are working with groups who have lower college-going and/or STEM beliefs and perceptions it may be helpful to bolster their confidence by focusing on encouragement and support as it relates to their college-going and/or STEM perceptions. Since rural Appalachia is more likely to have students whose parents did not attend college, it would be useful for teachers in this region to weave college information and support into their existing classroom curriculum. This could help to further fill the college and career information gap that exists between students whose parents attended college versus those whose parents did not. Finally, school administrators should support and encourage teachers and school counselors in their endeavors to provide support to students related to college and STEM fields. If this was required in classrooms, or at least rewarded, teachers would be more likely to pass this vital information on to their students. Some of the other ways that administrators could support students' college-going success include endorsing post-secondary education- and STEM- related field trips. Gaining exposure to these environments would provide students with greater opportunities to gain confidence in their ability to succeed in post-secondary educational and STEM environments that they might not normally be exposed to.

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## **APPENDIX**

Table 1

*Variable Correlations*

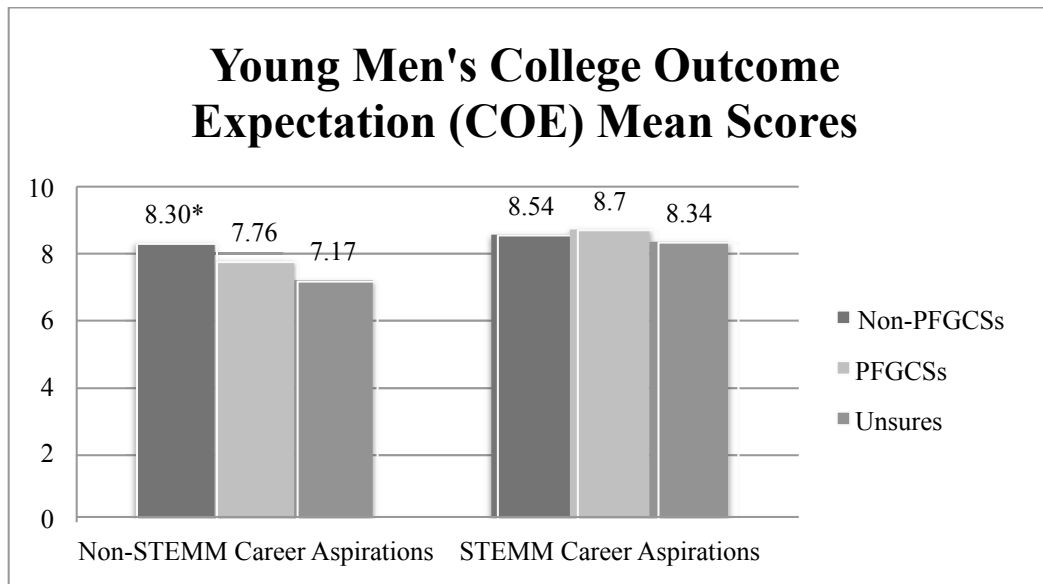
Measure	Mean (SD)	Correlations				
		1.	2.	3.	4.	5.
1. CGSE	3.06(5.44)	-	-	-	-	-
2. COE	8.40(1.32)	.51	-	-	-	-
3. STEMOE	3.76(.65)	.46	.44	-	-	-
4. MSSE	70.90(20.69)	.54	.34	.47	-	-
5. MSInt	64.28(23.74)	.47	.35	.54	.76	-

Table 2

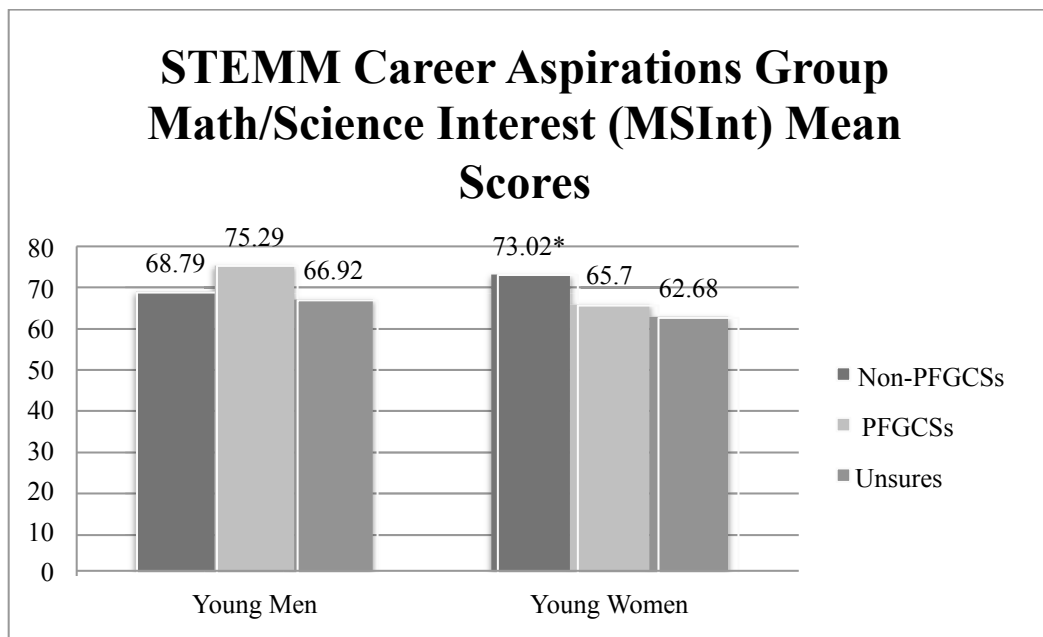
*Means and Standard Deviations for Dependent Variables (N = 892)<sup>2</sup>*

	Gender	STEMM Career Interest	PFGCS Status			Total
			Non PFGCS (N = 492)	PFGCS (N = 284)	Unsure (N = 116)	
C G S E S	Boys	No (N = 192)	2.96(.52)	2.71(.56)	2.55(.61)	2.80(.57)
		Yes (N = 227)	3.21(.44)	3.10(.45)	2.93(.63)	3.15(.47)
	Girls	No (N = 128)	3.07(.53)	2.90(.58)	2.70(.56)	2.95(.57)
		Yes (N = 345)	3.27(.45)	3.06(.57)	3.00(.59)	3.18(.51)
	Total (N = 892)	3.17(.48)	2.95(.56)	2.82(.62)	3.06(.54)	
C O E	Boys	No (N = 192)	8.3(1.19)	7.76(1.45)	7.17(1.79)	7.92(1.45)
		Yes (N = 227)	8.54(1.30)	8.70(1.12)	8.34(1.79)	8.57(1.31)
	Girls	No (N = 128)	8.24(1.26)	7.90(1.43)	8.30(1.41)	8.14(1.31)
		Yes (N = 345)	8.79(.97)	8.43(1.47)	8.37(1.08)	8.64(1.16)
	Total (N = 892)	8.56(1.17)	8.24(1.41)	8.05(1.56)	8.39(1.32)	
S T E M O E	Boys	No (N = 192)	3.47(.56)	3.47(.59)	3.26(.61)	3.44(.58)
		Yes (N = 227)	3.90(.66)	3.93(.56)	3.89(.71)	3.91(.63)
	Girls	No (N = 128)	3.49(.57)	3.32(.64)	3.54(.51)	3.44(.58)
		Yes (N = 345)	4.02(.58)	3.93(.62)	3.73(.59)	3.96(.60)
	Total (N = 892)	3.82(.64)	3.72(.65)	3.61(.64)	3.76(.65)	
M S S E	Boys	No (N = 192)	70.45(17.86)	58.41(23.89)	59.97(25.18)	64.23(22.18)
		Yes (N = 227)	78.22(17.01)	75.74(21.22)	70.95(21.41)	76.71(18.89)
	Girls	No (N = 128)	66.98(21.89)	60.81(19.57)	57.33(22.49)	63.34(21.47)
		Yes (N = 345)	77.39(16.79)	69.30(21.56)	65.85(17.56)	73.65(18.91)
	Total (N = 892)	74.99(18.22)	66.78(22.74)	63.82(21.67)	70.92(20.71)	
M S I n t	Boys	No (N = 192)	59.23(24.11)	50.20(24.94)	48.80(25.43)	54.18(24.95)
		Yes (N = 227)	68.79(22.25)	75.29(21.35)	66.92(21.75)	70.54(22.06)
	Girls	No (N = 128)	55.38(24.10)	52.15(22.73)	52.33(24.12)	53.82(23.54)
		Yes (N = 345)	73.02(19.60)	65.70(23.29)	62.68(18.43)	69.64(20.97)
	Total (N = 892)	67.03(22.75)	62.00(25.12)	58.13(22.99)	64.27(23.76)	

<sup>2</sup> *College-Going Self-Efficacy Scale (CGSES) Average Scores, College Outcome Expectations (COE) Average Scores, STEMM Outcome Expectations (STEMMOE) Average Scores, Math/Science Self-Efficacy (MSSE) Average Scores, and Math/Science Interest (MSInt) Average Scores by gender, career aspirations, and Prospective First-Generation College Student (PFGCS) Status. Males and females N range of*



*Figure 1.* Interaction on College Outcome Expectations (COE). COE mean scores among young men. \*Mean score differs significantly.



*Figure 2.* Interaction on Math/Science Interest (MSInt). MSInt mean scores among students would have STEMM career aspirations. \*Mean score differs significantly.



## VITA

Pamela Rosecrance was born in San Francisco, California, to the parents of John and Jennifer Rosecrance. She has two younger sisters, Jenelle and Katherine. At the age of 13 her family moved from Coralville, Iowa to Fort Collins, Colorado, where she attended Webber Junior High School and Rocky Mountain High School. She completed her bachelor's degree in Business Management at Colorado State University. Soon after graduation, Pamela moved to San Diego, California, to volunteer for an international social justice non-profit organization, where she was hired on as staff soon after. After two years in San Diego, Pamela moved to Berkeley, California to work for the University of California, Berkeley, while also pursuing a post-baccalaureate certificate in Psychology and Counseling and volunteering as a research assistant in the Psychology Department. She is currently enrolled at the University of Tennessee, Knoxville, working with Dr. Erin Hardin in pursuit of a Ph.D. in Counseling Psychology.