Career Intervention Effects on Agricultural Students' Career Development at an 1890 Land-Grant Institution[1]

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Abstract

Social cognitive career theory (SCCT), which is the framework this study and intervention is based on, states that academic interests are developed from beliefs of self-efficacy and outcome expectations and that these two factors should be considered when conducting career counseling and interventions (Brown and Lent, 1996). Currently there is a gap in the literature focusing on African American agricultural students and career development variables. Data was collected and analyzed. Demographics show that the majority of the sample were African American underclassman females who were not first-generation college students. A correlational analysis was conducted between the variables of Science, Technology, Engineering, and Mathematics (STEM) interests, STEM self-efficacy, personal barriers, social supports, technology interests, coping efficacy, and ethnic identity. Our results show low to medium significant correlations between some of the variables. Additionally, a paired samples t-test was conducted to determine differences between pre- and post-test scores following either a control or intervention module; results suggest that supports and technology interests were significantly and negatively impacted from pre- to post-test.

Keywords: SCCT, career development, agricultural students, African American students, minority students

Introduction

This literature review is separated by variables tested in the analyses in this order: Science, Technology, Engineering, and Mathematics (STEM) interests, STEM self-efficacy, personal barriers, coping efficacy, social supports, technology interests, and ethnic identity. Social cognitive career theory (SCCT; Lent et al., 1994), the framework this project was developed on and is based on Albert Bandura's social cognitive theory, stated that academic interests are developed from beliefs of self-efficacy and outcome expectations. Brown and Lent (1996) stated that both self-efficacy and outcome expectations should be cultivated when conducting career counseling and interventions. Students may rule out possible career decisions and paths because of inaccurate self-efficacy beliefs and/or outcome expectations, regardless if they have the interests and skills necessary for these fields. Despite interests, drive, early exposure, and positive feelings African American students are underrepresented in Agricultural majors (Jordan et al., n.d.); agricultural majors comprise of only 3% of bachelor's degrees (Carneval et al., 2016) and only 5-6% of agricultural positions (Food and Agricultural Education Information System, n.d.).

Having an interest in STEM is important in pursuing a STEM major and career for students. Teachers can provide networking opportunities with professionals in the field to foster STEM interests (Jahn and Myers, 2014). Friendships and friendship groups developed during formative years can influence STEM interests (Robnett and Leaper, 2012). Even through these channels, some students think STEM subjects are boring, unwelcoming, and difficult (Hossain and Robinson, 2012). Personal interest in STEM has been found to be the best influence on students' career choices, followed by parents, earning potential, and teachers (Hall et al., 2015; Hossain and Robinson, 2012). Students may not realize their STEM potential at the high school level, and instead may decide at the collegiate level (Hossain and Robinson, 2012). STEM majors and fields are comprised of predominately White males and have fewer numbers of underrepresented minorities who should be prepared for STEM subjects to increase representation in the STEM workforce (Hossain and Robinson, 2012). In fact, STEM interest has been found to be higher in African American than in White students; this interest could lead

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to increased declarations of STEM majors in college (Lichtenberg and George-Jackson, 2013). Females are also underrepresented in STEM subjects (Lichtenberger and George-Jackson, 2013) and females tend to become disinterested in STEM and choose different majors and careers, such as health and medicine careers (Sadler et al., 2012). Su and Rounds (2015) explained this disparity as STEM fields having a things-orientation rather than a people-orientation, which females are more likely to be interested in. Shapiro and Williams (2012) stated that stereotype threat can negatively affect female performance in STEM fields. Stereotype threat is the fear that individuals will confirm negative stereotypes about a part of their identity; sometimes this threat can lead to decreased performance and confirmation of that negative stereotype (Ganley et al., 2013; Rice et al., 2013; Van Loo et al., 2013).

Another crucial aspect to pursuing a STEM degree/career is the belief that one can do well in the subject. Self-efficacy has been found to be a predictor of interests and goals (Lent et al., 2010) and can lead to higher academic performance, since students with higher levels of self-efficacy tend to work towards more difficult goals (Brown et al., 2008). Previous learning experiences predict and are a source of self-efficacy (Schaub and Tokar, 2005). Research self-efficacy can affect intent to pursue graduate school, since belief in ability for conducting graduate level research has been shown to predict active graduate school pursuit (Tate et al., 2014). Personality traits, such as perfectionism, can predict scores of self-efficacy; adaptive perfectionists have higher self-efficacy and grade point averages (GPA) compared to students who are not perfectionists (Rice et al., 2013). Self-efficacy in one sample of African American men was found to be correlated with high school ACT scores, college GPA, and academic persistence (Strayhorn, 2015). Females in STEM majors have been found to have lower levels of STEM self-efficacy when it comes to their thoughts of their abilities and their ability to overcome barriers within the field (Hardin and Longhurst, 2016). When trying to explain high school females' commitment to engineering, Liu et al. (2014) found that beliefs about gender role, self-efficacy about the STEM field, and having female role models all affect play a role in commitment.

Barriers to successful academic careers influences students' STEM career development, such as curriculum, funding issues, lack of qualified teachers, difficulty conducting research, time complaints, as well as difficulty of STEM studies (Hossain and Robinson, 2012). African American STEM students have additional barriers to their career development, such as study skills, ethnic identity, and financial issues (Luzzo, 1993). Furthermore, institutionalized racism can lead to limited sense of self-efficacy, which can impede goal and action development (Raque-Bogdan et al., 2012). Coping efficacy has been defined as the beliefs about a students' ability to overcome barriers on their career path (Tate et al., 2014). Coping styles have a relationship with self-efficacy, which is influenced by social supports and can influence retention in school (Devonport and Lane, 2006). Support from family, friends, and significant others are positively related to coping efficacy (Klink et al., 2008), and coping efficacy can mediate the effect of perceived social status and personal and systemic classism (Thompson, 2012).

Supports are crucial in determining a STEM students' success throughout their academic career. Parents (Raque-Bogdan et al., 2013), teachers, peers, families, and mentors (Falconer and Hays, 2006) are all sources of support for students. Vicarious experiences (seeing other students like the student themselves) can boost self-esteem and self-efficacy; however, if a student sees someone like them going through a judgmental environment, the observers' self-efficacy and esteem could be compromised (Jenson et al., 2011). Peer groups help provide school-life balance and offer encouragements, motivation, and reinforcements, which helps STEM students construct their sense of self-efficacy and persistence (Palmer et al., 2011). Additionally, established networks with STEM professionals produce a strong, nurturing environment, which aids minority students' integration into the STEM field (Stolle-McAllister, 2011). There is a gender difference when it comes to perception of supports. Females perceive more emotional support from their parents than males (Raque-Bogdan et al., 2013) and that females are more likely to perceive family as a support system during school, whereas males see family as a barrier (Inda et al., 2013). Fouad et al. (2010) reported that students identify twice as many supports than barriers when it comes to math and science fields, though there is a decrease of perceived barriers in science and an increase of barriers in math.

Novelty of technology, computers in particular, has transformed over the years, with teachers learning about the computers when computers were newer to students growing up with them and losing the novelty of the mechanics behind it (Swets, 2010). Technology serves to solve problems and expand understanding of our environments; students should use technology as a tool for solving their scientific problems (Grant et al., 2013). Technology interests, especially computer interests, also have a gender bias; females are underrepresented in this field, possibly due to stereotyping, gender bias, and culture (females are not reinforced for technology field; Banerjee and Santa Maria, 2012).

Identity development occurs in stages. Brown et al. (2013) stated that one African American model, Black Racial Identity Development Model, lists the statuses as Preencounter (White culture is idealized while African American identity is devalued), Encounter (challenging of idealization of majority culture), Immersion/Emersion (identification with African American culture, and anger towards White culture may occur), and Internalization (a positive African American identity is developed and meaningful relationships with White people occur). Major events can shape identity formation; President Barack Obama's election helped inspire increases in exploration of racial identity for African American college students (Fuller-Rowell et al., 2011). However, acculturation stress can be a risk factor for suicidal ideation in African American students, especially those students who were less attached to their identified ethnic group (Walker et al., 2008). Ethnic identity can also be a protective factor; if college students have an affirmation to their ethnicity, then they endorse fewer anxiety and depression symptoms (Brittian et al., 2013), and higher levels of self-worth, self-meaning, and purpose, which can influence social-psychological well-being (Reitzes and Jaret, 2007). Ethnic identity affects career aspiration and development in minorities: Tovar-Murray et al. (2012) found that ethnic identity, including racism and race-related stress, has been shown to be a buffer between racism and career aspirations, and that individuals with stronger ethnic identity have stronger vocational identity.

Purpose of the Study

The purpose of the present study was to explore career development levels among agricultural students at a southeastern 1890 land-grant institution. The following research questions were investigated:

1. What are the demographic characteristics of agricultural students at a southeastern 1890 land-grant institution?
2. What are the relationships between STEM interests, STEM self-efficacy, personal barriers, social supports, technology interests, coping efficacy, ethnic identity, in post-intervention?
3. What was the effect of the intervention on the measures for career development?

Materials and Methods

This study used a quazi-experimental, longitudinal, pre-test/post-test control group design (Cook and Campbell, 1979; Heppner et al., 2016) with students from a southeastern mid-size 1890 land-grant institution's Agricultural Sciences department. The sample was comprised of 30 students who declared a major in the Agricultural Sciences department of the university and who were enrolled in STEM-focused ag classes during the 2012 through 2015 academic years. Validated measures by Lent et al. (2003) measuring STEM career development variables were used, along with the Multigroup Ethnic Identity Measure (Phinney, 1992) to measure ethnic identity. The instruments were accompanied by informed consent and a demographic questionnaire. All the Lent et al. (2003) measures were scored by averaging each subscales, and the higher the number, the more of the tested variable the participant had.

Measures

Interest in a STEM major was measured by a 12-item questionnaire by Lent et al. (2003), which was graded on a five-point Likert scale ranging from 0 (very low interest) to 4 (very high interest). Participants responded to the question "How much interest do you have in…" followed by a list of STEM majors (e.g. "Chemistry," "Computer Science").

To measure STEM self-efficacy, a Lent et al. (2003) 12-item questionnaire was used, which was graded on a ten-point Likert scale, ranging from 0 (no confidence at all) to 9 (complete confidence). The measure presented a list of STEM majors (e.g. "Agricultural Sciences," "Civil Engineering") and asked participants to grade confidence of their ability to complete the major with at least a B average. Cronbach alpha coefficients range between 0.89 - 0.94.

To measure supports and barriers, Lent et al. (2003)'s 38-item questionnaire was used. Scoring was on a five-point Likert scale, ranging from 1 (not at all likely) to 5 (extremely likely). Fifteen items focused on support (e.g., "Feel accepted by your classmates," "Get helpful assistance from your advisor"), and 23 items focused on barriers (e.g. "Receive negative comments or discouragement about your major from family members," "Receive unfair treatment because of your racial or ethnic group"). Supports and barriers were scored separately in this study. Cronbach alpha coefficients range between 0.88 and 0.92 for supports, and 0.90 – 0.94 for barriers.

Interest in technology was measured using a Lent et al. (2003) seven-item questionnaire that was graded on a five-point Likert scale, ranging from 1 (very low interest) to 5 (very high interest). Questions focused on practical behaviors that participants could be doing to build interest in technology (e.g. "Solving practical math problems," "Solving computer software problems"). One study found the coefficient alpha for this scale as α=0.83.

Coping efficacy was measured using a Lent et al. (2003) seven-item questionnaire that was graded on a ten-point Likert scale, ranging from 0 (no confidence) to 9 (complete confidence). Example questions from this section are "Cope with a lack of support from professors or your advisor," and "Find ways to overcome communication problems with professors or teaching assistants in STEM courses." Alpha coefficients range between 0.89 - 0.94.

Ethnic identity was measured using the Multigroup Ethnic Identity Measure (Phinney, 1992), with 20 items graded on a four-point Likert scale ranging from 1 (strongly disagree) to 4 (strongly agree). An example question was "I have spent time trying to find out more about my own ethnic group, such as its history, traditions, and customs." The final three questions asked about personal and parental ethnic identity with seven options to choose from (such "Asian, Asian American, or Oriental," "Black or African American"). The last three questions are not included in the scoring of the measure. Some items were reversed scored, then summed with the others for a total score. The higher the score, the more the participant identified with their ethnic identity. Cronbach's alpha has been found for the total scale ranges between 0.81 - 0.90.

The demographic survey consisted of questions pertaining to educational level, age, ethnicity, gender, SAT/ACT score, college and major, parental education levels (both paternal and maternal), socioeconomic status, country of origin, years U.S. resident, immigrant status (and reason for immigration, if applicable), and primary language.

Procedure

The grant intervention was conducted over a span of three academic years following IRB approval. Graduate research assistants (GRAs) on the grant conducted brief in-class presentations that explained the purpose of the study and invited students to participate in the survey. GRAs visited selected and approved classes to encourage students to participate. Students were informed that participation is voluntary, and withdrawal could be done at any time without consequences. Pre-test data were collected within the first two weeks of the semester. Data collected were matched by a GRA who did not have contact with participants to ensure confidentiality.

Results

Data cleaning, editing, and statistical analyses were performed with the Statistical Package for the Social Sciences (SPSS, version 24; IBM Corp, 2016). Table 1 summarizes the demographics of the sample. The total number of participants was 30. Most of the sample was either 18-21 years of age. After further analysis, 18 (n=8) or 19 (n=9) year olds comprised over 56% of the sample. The majority of the sample was African American (n=27; 90%), female (n=16; 53.3%), and all were undergraduate students (43.3% freshman, 30% sophomore, 16.7% junior, 10.0% senior). The majority of students self-identified with a middle class socioeconomic status (n=28; 93.4%). Most of the participants (n=19; 63.3%) were not first-generation college students; most fathers (49.9%) and mothers (76.7%) did complete some college or more.

To test the second research question, a correlational analysis was conducted between the variables of STEM interests, STEM self-efficacy, barriers, supports, technology interests, coping efficacy, and ethnic identity. Table 2 shows the correlations. Results showed 9 of 28 correlations were significant, with significant correlations ranging from $r=0.26$ to 0.66, $p<0.05$. The strongest correlation, $r=0.66$, $p<0.01$ was between STEM Interests and STEM self-efficacy, followed by $r=0.61$, $p<0.01$ for STEM interests and technology interests. The lowest significant correlation was between supports and technology Interests, $r=0.26$, $p<0.05$.

To answer the third research question, a paired sample t-test analysis was conducted to determine whether the interventions designed for the grant was successful in altering students' perspective on the variables tested. These statistical analyses show a small intervention effect when the group was split into two groups. Students were either in a control (n=19) or an intervention (n=11) group, and both groups were given pre- and post-tests. The intervention consisted of 14-hour classroom-based instruction focusing on career development. Data were compiled over three academic years. The results showed that, from the variables tested, two (supports and technology interests) were significantly different between pre- and post-intervention (Table 3). The researchers further analyzed the data and there was a significant difference for supports pre-intervention ($M=3.83$, $SD=0.69$) and post-intervention ($M=3.5$, $SD=0.83$); $t(10)=3.71$, $p<0.05$. Additionally, there was a significant difference for technology interests pre-intervention ($M=2.89$, $SD=0.89$) and post-intervention ($M=2.68$, $SD=0.83$); $t(10)=2.38$, $p<0.05$. As expected, there were no significant differences in the control group from pre- to post-test.

Table 1. Sample Demographics

Variable		Frequency	Percent
Age	18 - 21	25	83.3%
	22 - 29	3	9.9%
	30 +	2	6.6%
Ethnicity	African American	27	90.0%
	White	2	6.7%
	Multicultural	1	3.3%
Sex	Male	13	43.3%
	Female	16	53.3%
	Missing	1	3.3%
Education Level	Freshmen	13	43.3%
	Sophomore	9	30%
	Junior	5	16.7%
	Senior	3	10.0%
Socioeconomic Status	Lower Class	1	3.3%
	Middle Class	28	93.4%
	Upper Class	1	3.3%
First Generation	No	19	63.3%
	Yes	11	36.7%
Paternal Education	Some High School	5	16.7%
	High School Graduate	6	20%
	Vocational Training	1	3.3%
	Some College	7	23.3%
	Associate's Degree	1	3.3%
	Bachelor's Degree	6	20%
	Post-Graduate	1	3.3%
	Missing	3	10%
Maternal Education	Some High School	3	10%
	High School Graduate	4	13.3%
	Some College	7	23.3%
	Associate's Degree	2	6.7%
	Bachelor's Degree	9	30.0%
	Post-Graduate	5	16.7%

Table 2. Correlations between Variables

	1.	2.	3.	4.	5.	6.	7.
1. STEM Interests	-	0.66**	0.27*	0.14	0.61**	- 0.01	- 0.00
2. STEM Self-Efficacy		-	0.05	0.15	0.50**	0.28*	- 0.20
3. Barriers			-	0.01	0.42**	- 0.12	0.33*
4. Supports				-	0.26*	0.41**	- 0.03
5. Technology Interest					-	- 0.02	0.08
6. Coping efficacy						-	-0.04
7. Ethnic Identity							-
Pre-Test Mean	1.68	5.08	2.12	3.82	2.89	6.24	1.78
Pre-Test SD	0.79	1.96	0.91	0.69	0.89	1.72	0.67
Post-Test Mean	1.75	4.76	2.27	3.50	2.67	5.57	1.86
Post-Test SD	0.88	2.16	1.00	0.82	0.83	2.18	0.71

Note: 1 = STEM Interest; 2 = STEM Self-Efficacy; 3 = Barriers; 4 = Supports; 5 = Technology Interests; 6 = Coping Efficacy; 7 = Ethnic identity. *p < 0.05. **p < 0.01.

Table 3. Paired Samples t-test from Pre/Post Tests

				95% CI			
Pair	$\bar{x}$	SD	SE	Lower	Upper	t	df
1	0.04	0.35	0.11	-0.20	0.28	0.40	10
2	0.67	1.32	0.40	-0.22	1.55	1.67	10
3	0.10	0.62	0.19	-0.32	0.52	0.55	10
4	0.54	0.49	0.15	0.22	0.87	3.71*	10
5	0.27	0.38	0.11	0.02	0.53	2.38*	10
6	0.61	1.84	0.58	-0.64	1.99	1.15	9
7	-0.11	0.24	0.10	-0.36	0.14	-1.14	5

Note: 1 = STEM Interest; 2 = STEM Self-Efficacy; 3 = Barriers; 4 = Supports; 5 = Technology Interests; 6 = Coping Efficacy; 7 = Ethnic identity. *p < 0.05.

Conclusions and Implications

This study examined career development variables in a sample of students who majored in agricultural science at a southeastern 1890 land-grant institution. Concerning demographic variables, most of the sample was between the ages of 18–21 (83.4%), African American (90%), mostly female (53.3%) and underclassmen (73.3%). Most of the participants were not first-generation college students (63.3%) and had fathers (53.3%) and mothers (76.7%) who completed some college and were from middle class socioeconomic background (93.4%). This sample stands out from the current literature because most of the sample were females; greater numbers of males have been represented in the literature for agricultural majors (Labo et al., 2013; Rosch and Coers, 2013). Correlations between variables tested were observed in the current study. To recap, interest in STEM subjects was found to have a high and significant relationship with STEM self-efficacy, barriers, and technology interest. STEM self-efficacy is significantly related to technology interest and coping efficacy. Barriers were significantly related to technology interest and ethnic identity, and supports were significantly related to technology interest and coping efficacy.

It is unsurprising that interest in STEM subjects has a strong and significant relationship with self-efficacy. The more interest a student has in the subject, the more likely they are to do well at the subject, thus leading to feelings of competence and confidence in their ability to excel in the subject. Additionally, STEM self-efficacy and coping efficacy's relationship with each other is understandable; students' belief that they can do well at activities will help them overcome barriers they come across in academia and in future careers. The relationship between supports and technology interest could be explained by the fact that our society is moving towards using technology more and more in both the home and classroom. Additionally, having supports around students can help them overcome barriers, thus explaining the significant relationship between the two variables. The relationship between ethnic identity and barriers has been established in previous literature. African American students tend to receive negative feedback on assignments (Richardson et al., 2015), which could discourage future attempts. Additionally, barriers at home, school, and the community, such as racism, poverty, drug use, and juvenile crime are all risk factors for "at risk" individuals; traditional counseling styles may not be appropriate to help at risk African American students (Fusick and Bordeau, 2004).

Since the sample size was small, the effect size for the intervention was low, so determinations were unable to be made to determine whether the intervention was successful or not in this sample. Preliminary analyses were conducted and found that, of the significant results, supports and technology interests' scores were lower from pre- to post-test measurements. The reason for this is unknown. It is interesting to note that, while not significant, interest in STEM subjects, perceived barriers, and ethnic identity levels increased slightly over the intervention. Future studies should be conducted to explain this phenomenon and to increase power to determine true effects. To make generalizability better, sample sizes should be increased, and groups should be balanced. Since this sample was limited to one agricultural sciences department at a single 1890 land-grant institution, future studies should consider applying both the SCCT measures and the interventions to agricultural departments at other institutions to determine if the phenomena measured in this sample is limited to this sample or is also present at other universities.

Summary

This study found that some career development variables were significantly related to each other when measured in agricultural science students at an 1890-land grant institution. Furthermore, this study found that there was significant change for supports and technology interests from pre- to post-tests, but not on other variables. Further research should be conducted to continue studying this phenomenon in agricultural science students to expand the knowledge base.

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