

Presence of Stereotype Vulnerability in Freshman STEM students at a Historically Black College

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Work in Progress - Presence of Stereotype Vulnerability in Freshman STEM students at a Historically Black College

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Abstract - The first year of college encompasses one of the most challenging transitions a student may face during their college career and/or lifetime. For minority students in Science, Technology, Engineering, and Math (STEM), the transitioning experience may yield many stressors that lead to diminished college experiences. In the first year, STEM students not only explore their sense of belonging within their fields of study but how they fit within their environment. The psychological effects of fitting into an environment unlike their usual, may expose and establish diminished sense of worth and self-efficacy [1]. One of which, Stereotype Threat Vulnerability (STV), exposure to being perceived and/or treated as a stereotype, which self-fulfills as the stereotype, may diminish student's academic abilities (Robertson & Chaney, 2015). This quantitative study examined the presence of STV at a Historically Black University of approximately 179 students (n=13 freshman STEM students). Demographics of the students in the study consisted of approximately 80% female and 20% male. Reported racial/ethnic background of participants were approximately 80% African American, 13% Asian American, 4% White, 4% Other, and 1% Hispanic/Latino. The findings indicated will be discussed.

Index Terms – HBCU, stereotype threat

INTRODUCTION

Despite the projected growth of underrepresented students in science, technology, engineering and mathematics (STEM) fields and demand for opportunities to decrease inequity in the field, scholars suggest that African Americans remain notably underrepresented in engineering [2]. In particular, engineering programs have a higher attrition rate compared to other STEM programs, with attrition rates exceeding 60% [3][4]. For African American students, specifically, limited engagement and low retention have been associated with conscious and unconscious biases, micro-aggressions, low faculty expectations, poor teaching, and limited support and resources to ensure success [5][6]. It has been surmised that African American students' experiences with stereotype threat,

microaggression, conscious and unconscious biases are sources of chronic stress and trauma that negatively impact their academic achievement [7]. Stereotype threat describes a condition in which students' belonging to a group has been stereotyped causing the student to suffer an additional cognitive or emotional burden that is not seen in students outside the stereotyped group [1]. The goals of this study were to determine the existence and possible impact of stereotype threat on African American engineering students' academic performance and psychological well-being. This paper provides the results of a quantitative analysis of a secondary dataset in which currently enrolled pre-engineering STEM majors at an Historically Black College/University (HBCU) participated in an online survey that included modified items from the Stereotype Vulnerability Scale (SVS) and Sense of Belonging Scale (SOBS).

Stereotype Threat Theory

Stereotype threat is the term that refers to being at risk of confirming a negative stereotype about one's group [8][9]. Stereotype threat describes a condition in which students' belonging to a group has been stereotyped causing the student to suffer an additional cognitive or emotional burden that is not seen in students outside the stereotyped group [1]. For example, when African American college students are stereotyped as intellectually inferior when enrolled at predominantly White institutions of higher education, anything that reminds them of their race can significantly decrease achievement [10]. In their groundbreaking work, Aronson and Steele showed that African American college freshmen and sophomores performed poorer on standardized science and mathematics tests than White students when their race was emphasized. When race was not emphasized, however, African American students performed as well as or better than White students. The results showed that performance in academic contexts can be harmed by the awareness that one's performance and behavior might be viewed through the lens of racial stereotypes.

It has also been suggested that there are psychological consequences of stereotype threat, such as maladaptive levels of arousal, negative emotional regulation, and

cognitive depletion [11]. Stereotype threat undermines academic achievement in two ways. First, it induces anxiety that may impair academic performance. Second, in the long-term, it causes students to devalue their academic interests and eventually leads to dis-identification with academic goals [1]. Additionally, stereotype threat decreases working memory capacity [12] a critical aspect for success in engineering. Further, numerous scholars have highlighted the low numbers of African American students receiving engineering degrees nationally. Explanations for disparities in engineering include, blaming students for their underperformance despite evidence of hostile and uninviting learning environments [13]. As such, African American engineering students may be at greater risk of experiencing stereotype threat because of widely held negative stereotypes and misconceptions related to their academic performance and engineering and mathematics aptitude [14]. For African American students, in particular, Walton and Cohen [15] suggested that, in academic and professional settings, members of socially marginalized groups are more uncertain of the quality of their social bonds and sensitive to issues of social belonging.

Given African American students' limited engagement in engineering education, it is imperative that STEM educators explore issues, such as stereotype threat, sense of belonging, and implicit bias as factors in broadening their participation in engineering careers. Using a secondary data set, the researchers asked the question, "What is the relationship between stereotype vulnerability and a sense of belonging among African American physics/engineering majors at an HBCU?"

RESEARCH METHODS

This quantitative, non-experimental study was designed to explore perceptions of stereotype threat among African American pre-engineering and engineering majors at an historically Black college/university (HBCU) using existing data from the CRSS.

STEM (rather than engineering) majors were selected because of the 3:2 dual degree option available at the host university. Thus, all of their STEM majors are potential engineering majors. This survey was developed to elicit STEM students' perceptions of their student experience at an HBCU.

Participants

For the current study, participants included 289 current pre-engineering STEM students at an HBCU located in the Southern region of the U.S. Participants included freshman, sophomore, junior, and senior classification. The entire population of STEM majors received an emailed link to the survey that was administered online. Students self-selected to participate and all participants in this study were volunteers. In this paper we focus on the freshman students (n=13) to explore how freshman STEM students

Measures and Covariates

Measures. The Cultural Responsiveness Student

Survey CRSS) did not consist of questions adopted directly to SVS but a confirmatory factor analysis was completed to relate questions to the SVS (the process is described below). The SVS is a unidimensional scale designed to measure the degree to which college students feel threatened by having a negative stereotype about their academic success [18]. The internal consistency of alpha is 0.67 (n=414). Students were asked to respond on a five-point Likert scale.

Confirmatory Analysis

To confirm questions identified are measuring our factor/construct of SVS a confirmatory factor analysis was conducted via SPSS. The following questions were identified as SVS questions:

- Q20. My advisor is aware of race and gender biases African American and minority students may experience at other institutions
- Q22. I feel comfortable discussing race or gender issues with my advisor.
- Q23. My advisor expresses views that demonstrate race or gender bias.
- Q24. I think the racial/cultural biases of my advisor influences his/her interactions with students from diverse backgrounds.
- Q25. My advisor makes exclusionary comments that could have alienated some students from certain cultural backgrounds.
- Q31. My advisor supports the idea that programs aiding African American students to succeed in STEM courses is important to the mission of Xavier University.
- Q35. My advisor shows interest in me as a person.

The reliability of the items was calculated using Cronbach's Alpha and measured to .836, which indicates the SVS construct inside the CRSS was a reliable measure. When any item was removed from a scale considered for the overall SVS construct, the reliability remained consistent, or decreased indicating that all items (or questions) added value when computing the Cronbach's Alpha value for this construct.

DATA ANALYSIS

In this paper, current freshman STEM student (n=13) data was analyzed. The mean and standard deviation from the SVS construct can be found below in **Table 1**. All questions are measured on a 7 point Likert scale with 1 = strongly disagree and 7 = strongly agree.

Table 1: Mean and Standard Deviation of SVS Scores

	Mean	Standard Deviation
Q20	5.33	1.32
Q22	4.71	2.36
Q23	3	2.05
Q24	2.5	1.65
Q25	2.1	1.45
Q31	5.44	1.51
Q35	5.7	2

From the results we can see the mean for question 20, 31 and 35 are between somewhat agree and agree. The mean for question 22 is between neutral and somewhat agree. And the mean for questions 23, 24 and 25 are between disagree and somewhat disagree.

Scores on the SVS are additive to give a measure of how vulnerable a student would be to stereotype threat. On the CRSS, seven questions were identified for SVS with a maximum score of 49. See **Table 2** for a summary of the scores for the 13 freshman. Three students did not have an SVS score because they did not answer the identified questions. In general, the average SVS score is 28. The majority of the students have a score around the average and one student has a high score of 37. Two students have a low score of 14 and 19, respectively.

Students	SVS Scores
1	29
2	14
3	N/A
4	31
5	29
6	37
7	30
8	30
9	30
10	19
11	N/A
12	14
13	N/A
<i>Mean</i>	20.2
<i>Standard Deviation</i>	13.3

IMPLICATIONS

Based on the SVS scores, students are entering college with a moderate level of stereotype vulnerability. This indicates that freshman students are potentially impacted by negative experiences. This finding helps support the importance of a

positive first year experience.

Reviewing the questions from the survey, the students have indicated that they have advisors who can relate to their experiences. When matching the relationship of advising to the SVS there seems to be a decrease in stereotype threat vulnerability due to the student/advisor relationship. More data needs to be collected for the freshman students for proper data analysis to understand trends. Data collected from the CRSS needs to be analyzed and correlated to sense of belonging.

FUTURE WORK

The next phase of this project is to continue to analyze all collected data points for sophomore, junior and senior students and compare SVS between groups. We also aim to explore a second construct of sense of belonging. Since the CRSS did not contain questions adapted from the sense of belonging scale (SOBS), we will have to conduct another confirmatory factor analysis for questions that may measure sense of belonging.

The CRSS will be administered a second time at Xavier University Louisiana. Before the second round of data collection the research team will make recommendations for questions to ensure both constructs of stereotype vulnerability and sense of belonging are included on the scale.

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