Undergraduate Students' Confidence in Scientific Activity and Support Systems Based on Diversity in an Environmental Science Course

Kimberly J. Parris[a*], Zakiya H. Leggett*[b], & Porche L. Spence*[c]

[a]*Department of Science, North Carolina State University, Raleigh, NC*
[b]*Department of Forestry and Natural Resources, North Carolina State University, Raleigh, NC*
[c]*Department of Natural Resources and Environmental Design, North Carolina A&T State University, Greensboro, NC*

https://doi.org/10.33697/ajur.2024.113

*Students: kjparris@ncsu.edu**
Mentor: plspence@ncat.edu, zakiya_leggett@ncsu.edu

ABSTRACT
Undergraduate student support systems and individual confidence in science courses have been linked to better academic performance among college students. As the topics of diversity and inclusion continue to draw the attention of the collegiate, the problem of equity surrounding supportive learning environments for all races in higher education comes into focus. This paper adds to the literature by highlighting the importance of adequate support for students in collegiate settings.

Disparities in student support and confidence with scientific activities among students of color (SOC) and white students in an undergraduate environmental science course had been evaluated. Students (n = 235) were asked to complete a Qualtrics survey containing questions focused on evaluating support from parents, siblings, close relatives, friends, peers, classmates, and professors and confidence regarding self-efficacy in learning and doing scientific activities. The perceived support and confidence in scientific activities in white students and SOC were measured using an independent T-test. The findings demonstrated that white students may have had access to stronger support systems and had higher perceived confidence levels in completing scientific activities based on survey responses. On average, white students had greater perceived support and more confidence. As a result, higher dropout rates, lower performance overall, and alienation of these students in higher education environments could occur. If this trend continues, racial discrepancies suggest that students of color need stronger support networks related to scientific activities in higher education settings.

KEYWORDS
Student Support; Student Scientific Confidence; STEM Confidence; Students of Color; Academic Support; Undergraduate Student; Family Support; Student Peers

INTRODUCTION

As the population of the United States of America continues to increase in racial diversity, opportunities to examine inequities within institutions pertaining to diverse groups will grow as well. It is well known that generational wealth and legacies of groups holding power in the country have led to disproportionate wealth and educational gaps.[1] According to the 2019 Survey of Consumer Finances, even though white citizens made up about 68.1% of the country's population, they held 86.8% of the country's overall wealth.[2] These racial disparities often begin at the educational level where a larger family income can be associated with children receiving better quality primary and secondary school education.[1] This support from family early on to curate a safe and healthy primary and secondary school education is extremely influential on a student's desire, confidence, and ability to achieve success in higher education.[3] The motivations for students to explore their individual creativity in educational fields and allow themselves to prosper in university settings depends on crucial factors such as support and mentoring.[4] In this study students enrolled in an undergraduate environmental science course were surveyed to gather data on their individual perceived confidence in science-related activities and perceived support systems available to them. The survey results were evaluated with respect to student's racial backgrounds.

Previously, support of students of color (SOC) in higher education and confidence had been studied separately within literature. A study by Fuse & Bergen[5] found that support for underrepresented groups in a professional science field differed based on racial background. The study highlighted the need for better emotional, financial, and alumni role model support and discussed how this impacted support in academic outcomes and graduate admissions. However, there is a lack of papers addressing the

relationship between both support and confidence variables on students' of color ability to succeed, in contrast to their white counterparts. This study seeks to examine both items and observe any potential differences between the two based on race.

In this study we used Phillips et al.[6] for the definitions of scientific activity confidence and support, which examine and explore the framework for articulating and measuring learning outcomes in the scientific field. This study defines self-efficacy in the scientific field as the "extent to which a learner has confidence in his or her ability to participate in a science or environmental activity".[6] The questions modeled around the student's self-efficacy and identity were used in this study to give insight on a student's perceived confidence surrounding scientific activities. Support in this study is defined based on London et al.,[7] which describes the influences that perceived identity compatibility and social support have on women in nontraditional fields during their transition into college. The study defines social support to include "emotional concern or comfort, affirmation, instrumental or tangible assistance, and the provision of information" from close friends, family members, and others around the students.[7]

Support is a broad category that offers students a better chance at success. Familial Support includes many factors like familial structure, familial socioeconomic status, familial level of education, familial involvement in academic preparation, familial emotional connection, and more.[8] These factors all contribute to ways a student can be supported by their families. Social and institutional support is just as important as these factors and contributes to a student's self-esteem, validation, sense of community and direct connections while away from home. [8] Institutional support for students can be seen as an extension of a familial community that will be students "rock and a support to lean on".[4] Some ways in which students can be supported better by family in these settings would be to have families draft an academic success plan for their student, discuss their students futures in the academic world with professors and advisors, take factors of adversity such as the stereotypical hardships that come depending on race into account, help their student identify sources on campus that can help students with additional academic and social issues, and to encourage students to get involved on campus.[8] Institutions can better support students by increasing the diversity of faculty, encouraging the facilitation of diversity conversations on campus, and .Support is a large aspect of a student's path to success and analyzing discrepancies in higher education can bring academia one step closer to closing the gap.

METHODS AND PROCEDURES

A total of 235 students were surveyed in an undergraduate environmental science course at a large land grant university in the southeastern United States. This study was originally conducted with a sample size of 238 students enrolled in an introductory environmental science course. Among these students, three of the responses were dropped due to the students preferring not to answer demographic questions including race, gender, and other categories. This study received exemption status by the North Carolina State University Internal Review Board (NCSU IRB # 14368).

Qualtrics™ was used to develop and implement a survey that included socio-demographic (age, classification, gender identity, race and major) and support questions which were adapted from London et al.[7] Students were asked if their mother, father, siblings, other close relatives, friends, peers, and professors supported them in their major/educational pursuit using a Likert scale (1 being strongly disagree and 7 being strongly agree). This scale rated the perceived support of individuals who were close with the students and would have influenced their journey throughout their academic careers.

By allowing the students to self-assess their own level of strength when it comes to scientific topics, an understanding of their own perceived levels of confidence with scientific activities can be found.[9] Survey questions regarding student's self-efficacy on learning and doing science topics from the Cornell Lab of Ornithology[9] were adapted to measure scientific activity confidence. A Likert scale (1 being strongly disagree and 7 being strongly agree) was utilized in a Qualtrics™ survey. The questions provided insight about a student's perceived self-efficacy level. The Likert scales were collapsed into three categories: 1-3 as disagree, 4 is neutral, and 5-7 is agree. An independent t-test was conducted to determine if there were significant differences between the perceived scientific activity confidence and support scores of white students when compared to students of color (SOC). Differences were considered significant at p-values <0.05.

RESULTS

Demographics

This study included 235 students in total. Due to blank responses, the gender, age, and student classification measures in the study consisted of 234 students. The race measure consisted of 231 students in this study. Students of color (SOC) were defined as students who did not solely identify as white. This included African American, Asian, Native Hawaiian/Pacific Islander, Hispanic/Latin X, American Indian/Alaskan Native, and those of two or more races. It is a diverse classification meant to represent students who are not represented by whiteness. The University in the study is a predominantly white institution (PWI) where the majority of the students are white. In 2022, there were 2,450 faculty (white=70.8%, race other than just white=29.2%) at the institution in the current study. The lack of diversity in teaching faculty may offer some insight into the difference of support found amongst SOC and white students.

Student Demographics			
Measure	**Item**	**Count (n)**	**Percentage (%)**
Gender	Man/Male	125	53.4
	Woman/Female	106	45.3
	Other	3	1.3
Age	18-24	225	96.2
	25-34	7	3.0
	35-44	2	0.9
Student Classification	Freshman	89	38.0
	Sophomore	87	37.2
	Junior	37	15.8
	Senior	21	9.0
Race*	American Indian/Alaskan Native	2	0.9
	American Indian/Alaskan Native, White/Caucasian	1	0.4
	Asian	21	9.1
	Asian, White/Caucasian	5	2.2
	Asian, Native Hawaiian/Pacific Islander	1	0.4
	Asian, White/Caucasian	1	0.4
	Black/African American	12	5.2
	Black/African American, White/Caucasian	4	1.7
	Hispanic/Latinx	12	5.2
	Hispanic/Latinx, White/Caucasian	2	0.9
	Native Hawaiian/Pacific Islander, White/Caucasian	1	0.4
	White/Caucasian	169	73.2

Figure 1. Mean scientific activity confidence values for students based on the corresponding statements. *Each student did not disclose their race, therefore the count for race is n = 231.

Perceived Student Scientific Activity Confidence

The number of white students that completed the survey (168) was more than double the number of SOC (62). Students were asked to rate statements to measure their confidence when it comes to science related activity (**Figures 2 and 3**). Results indicated that there were significant differences amongst the two groups mean confidence values. Students of color produced significantly higher mean values for statements associated with a negative confidence viewpoint on scientific concepts. Two of these statements were: "It takes me a long time to understand new science topics" (M=3.40 for SOC, M = 2.73 for CS; p = 0.001*) and "It takes me a long time to understand how to do scientific activities" (M=3.24 for SOC, M=2.67 for CS; p =0.004*). Responses to the statements "I think I'm pretty good at understanding science topics" (M=5.00 for SOC, M = 5.53 for CS; p = 0.003*) and "I feel confident in my ability to explain science topics to others" (M=4.23 for SOC, M = 4.82 for CS; p =0.003*) indicated white students had perceived a significantly higher positive scientific activity confidence when compared to SOC(**Figure 3**).

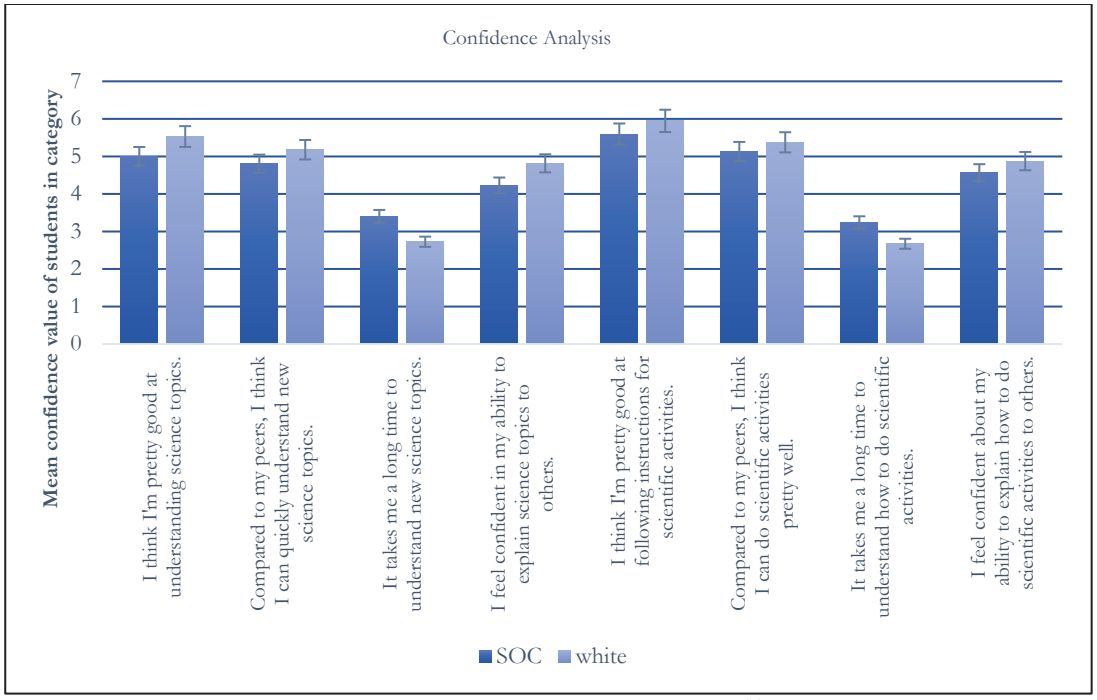

Figure 2. Mean scientific activity confidence values for students based on the corresponding statements. The error bars represent a 95% confidence interval.

Confidence statements	Student Race	N	Mean	Std. Deviation	Std. Error Mean	P-value
I think I'm pretty good at understanding science topics.	SOC	62	5.00	1.32	0.17	0.003*
	white	168	5.53	1.12	0.09	
Compared to my peers, I think I can quickly understand new science topics.	SOC	62	4.81	1.30	0.17	0.042*
	white	168	5.18	1.20	0.09	
It takes me a long time to understand new science topics.	SOC	62	3.40	1.42	0.18	0.001*
	white	168	2.73	1.30	0.10	
I feel confident in my ability to explain science topics to others.	SOC	62	4.23	1.31	0.17	0.003*
	white	168	4.82	1.34	0.10	

I think I'm pretty good at following instructions for scientific activities.	SOC	62	5.60	1.27	0.16	0.05
	white	168	5.95	1.00	0.08	
Compared to my peers, I think I can do scientific activities pretty well.	SOC	62	5.13	1.25	0.16	0.16
	white	168	5.38	1.14	0.09	
It takes me a long time to understand how to do scientific activities.	SOC	62	3.24	1.28	0.16	0.004*
	white	168	2.67	1.31	0.10	
I feel confident about my ability to explain how to do scientific activities to others.	SOC	62	4.56	1.35	0.17	0.13
	white	168	4.88	1.36	0.10	

Figure 3. Descriptive statistics for students as it relates to their science activity confidence (* denotes significance at a p = <0.05). A Levene test was performed, but was not found to be significant at a 95% confidence interval.

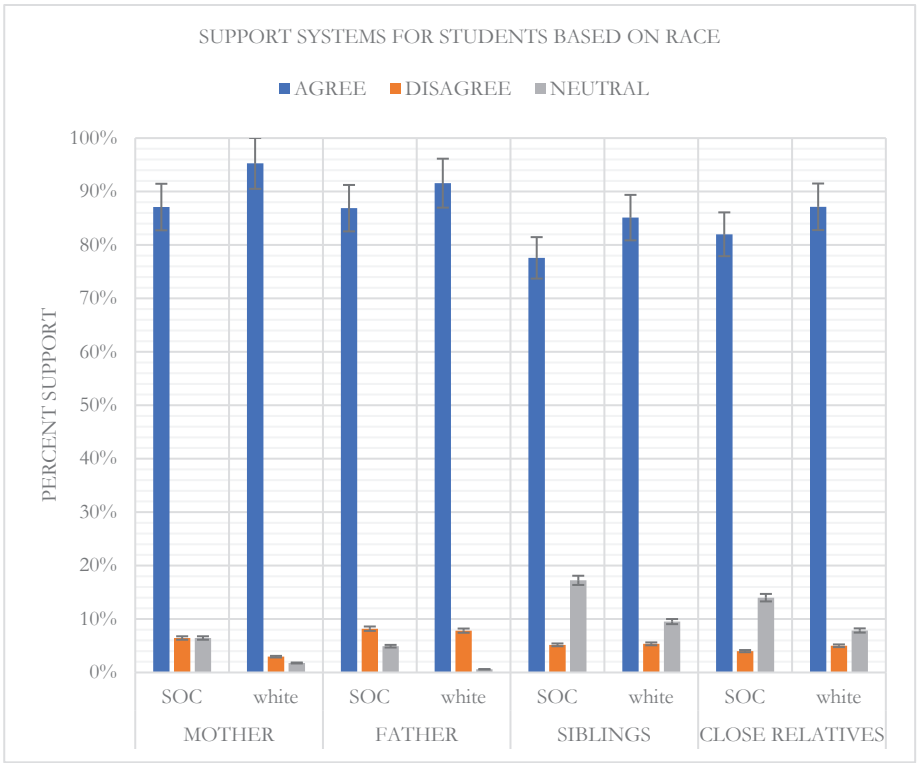

Figure 4. Percentage of student agreement to a statement that family in their life supported them in their choice of major. The error bars represent a 95% confidence interval.

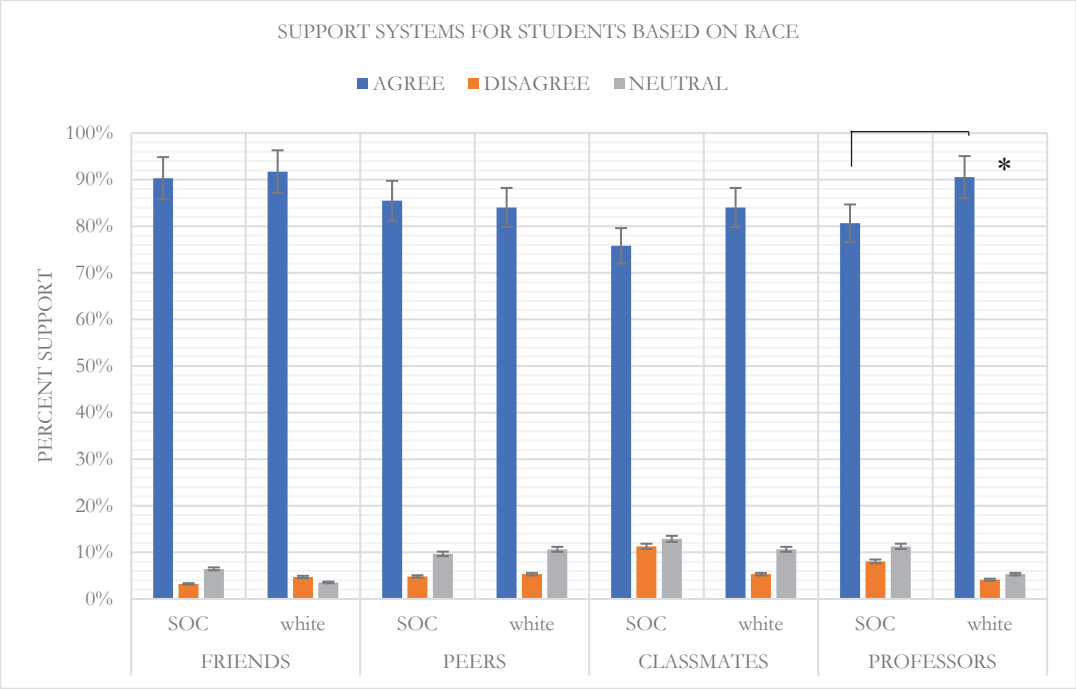

Figure 5. Percentage of agreement based on the support of the following persons regarding their choice of major. The error bars represent a 95% confidence interval.

Support Systems	Student Race	N	Mean	Std. Deviation	Std. Error Mean	P-value
Mother	SOC	62	6.20	1.48	0.19	0.07
	white	169	6.59	1.16	0.09	
Father	SOC	61	6.16	1.38	0.18	0.49
	white	166	6.31	1.46	0.11	
Siblings	SOC	58	5.95	1.65	0.22	0.36
	white	168	6.16	1.47	0.11	
Close Relatives	SOC	50	5.78	1.45	0.20	0.06
	white	140	6.20	1.30	0.11	
Friends	SOC	62	6.06	1.16	0.15	0.29
	white	169	6.25	1.22	0.09	
Peers	SOC	62	5.90	1.24	0.16	0.87
	white	169	5.93	1.34	0.10	
Classmates	SOC	62	5.56	1.70	0.22	0.11
	white	169	5.95	1.33	0.10	
Professors	SOC	62	5.63	1.60	0.20	0.03*
	white	169	6.11	1.22	0.09	

Figure 6. Descriptive statistics for students as it related to their support systems (* denotes significance at a p = <0.05). A Levene test was performed but was not found to be significant at a 95% confidence interval.

Perceived Support

Students were asked if the following persons in their life supported them in their major/educational pursuit (**Figures 4 and 5**). In an analysis of the student's support systems, results indicated that there was a significant difference amongst the support perceived from professors by SOC and white students. White students displayed a higher mean value (M=6.11) in contrast to

SOC (M=5.63). This perceived support value from professors was significantly greater (p =0.03*) in white students than in SOC. Both SOC and white students placed their peers and classmates among the groups that they felt the least support from (**Figure 6**). The mean values when ranking support perceived from their classmates about their choice of major were similar for white students and SOC.

The independent t-test indicated that for these family support variables, there is no significant difference in white students and SOC perceived support from their mother, father, siblings, and close relatives regarding their choice of major (**Figure 6**). Similar to the family perceived support, results suggest that student's perceived support from friends, peers and classmates, there was not a significant difference between white students and SOC. Students support values were overall the highest for mother and father and were the lowest for peers and professors. However, when evaluating students perceived support levels from their professors, the t-test indicated a significant difference (p=0.034*) between how much white students (M=6.11) and SOC (M=5.63) perceived support from them.

DISCUSSION/CONCLUSION

Discrepancies in academic performance of undergraduate students of color (SOC) and their white counterparts in the scientific field could be associated with the support systems around them and their own confidence surrounding science activity. In this study, students in an introductory environmental sciences course communicated their own perceived levels of support and confidence. In both the support and scientific activity confidence results, white student's results yielded more positive outcomes than SOC. It was found that there were significant differences between the two groups pertaining to their perceived level of support from professors and their individual confidence pertaining to STEM related topics.

Upon entering the collegiate environment, many different factors contribute to the success of students in academics. Two key factors examined in this study included scientific activity confidence and support. Science-related confidence is the students "sense of their competence and skill, [and] their perceived capability to deal effectively with various situations".[10] An increase in a student's self-confidence can be correlated with a higher level of academic success.[11] Support "can be conceptualized in terms of the structural components (e.g., social integration: being a part of different networks and participating socially) and the functional components (e.g., different types of transactions between individuals, such as emotional support or favors)".[12] Support is an important factor in the academic setting because it promotes positive reinforcement that motivates students to try their best in school and maintain/exceed their current performance.[13]

Based on a study by Quintana et al.,[1] a connection was found between race and the levels of support in undergraduate students. Some groups have a higher chance of performing better in academic settings than others,[1] which could be due to the abundance of evidence linking better support systems to better academic performance.[14] McKown et al.[15] delves into a series of three studies conducted at primary schools. These studies examined different racial groups of students and the relationship between what their teachers expected of them and how this related to their academic performance. In this paper, researchers concluded that when the teachers expected more from students, they taught more enthusiastically and provided "higher quality instruction". Subsequently these students would become influenced based on the expectations from teachers and as a result would respond by either working harder to meet the higher standard or becoming demotivated in the face of prejudice and low expectations.[15] In reference to the results above, the SOC in this study ranked the perceived support from professors when it comes to their choice of major significantly lower than that of the white students. This could provide insight into an academic achievement gap that could result for SOC where they must work harder against what is perceived to be less support from their professors.

Science activity confidence and support systems are connected. The more positive a student's support system tends to be, the better their scientific confidence will be when approaching difficult or new topics.[16] Confidence is a factor that is strongly associated with high performance in all aspects of life.[11] Those who tend to hold onto higher perceived self-confidence seem to attribute better qualities in terms of likeability, self-esteem, performance, and competence.[10] Three studies conducted around "self" by the University of New York at Buffalo, determined that college students with considerable self-confidence are attributed with more positive future academic outlooks.[10] Our results indicated that SOC were repeatedly responding with significantly lower values for scientific activity confidence statements compared to their white classmates. The lower the student's confidence surrounding these topics, the more students may struggle to achieve the same level of academic success as other students within the scientific field.[17]

Such disparities may possibly lead to more SOC having harder times navigating the same environments as their white counterparts. The support system of a student can be a major indicator of their success in school and academic environments.[8] This discrepancy and lack of support could lead to gaps in terms of science activity confidence and quality education for SOC. Higher dropout rates, lower performance overall, and alienation of SOC in higher education could result. Along with some of the other factors that SOC must overcome in collegiate settings, these additional aspects can continue to make it difficult for them to

successfully enter, succeed, graduate, and find jobs.[18] "Only with a keen understanding of the sources of ethnic disparities in academic achievement can social policies be designed to promote greater equity and by extension, optimal youth development and a healthy society".[19]

Some limitations in this study include the classification of students in the course surveyed, the small number of SOC (n=62) within the overall population surveyed, and a lack of open-ended survey questions. In an introductory environmental science course, most students were underclassmen and fell into the freshman and sophomore classification. If the study included more students of higher classifications, it may have provided better insight regarding support in collegiate settings from students who were further along in their academic career. The small amount of SOC in the sample size of the data may have resulted in an underpowered study. Additionally, more in depth survey questions that were open ended may have provided information regarding why students did not feel supported or confident regarding the topics asked. There were also other factors of support commonly found in collegiate settings that were not analyzed in this study, which may have had an impact on student support scores such as family finances, tutors, academic advisors, teaching assistants, and other faculty.

Something worth noting is that even if many of the results did not yield significant differences, perhaps due to a low sample size, white students consistently had a trend of better/more positive ratings than SOC. This demonstrates a consistent difference that may be worth exploring for future research. Some other implications from this study that future research may call to answer is the examination of study groups, mentor programs, and monetary support from family specifically on the effect of support. Although these factors were not observed in this study, they may have a profound effect on students support systems in higher education. This may call for a reanalysis of the term "support" and the many layers of it impacting students' lives. This study was also conducted at a large PWI, and analysis for support and confidence at historically Black colleges or universities, other minority serving institutions, and smaller institutions may offer different results that are worth investigating.

ACKNOWLEDGMENTS
The authors thank the students from the Introduction to Environmental Science course who participated in the survey.

REFERENCES

1. Quintana, Stephen M., and Lana Mahgoub. (2016) "Ethnic and Racial Disparities in Education: Psychology's Role in Understanding and Reducing Disparities." Theory Into Practice 55, no. 2: 94–103. *https://doi.org/10.1080/00405841.2016.1148985*.
2. Bhutta, Neil, Andrew C. Chang, Lisa J. Dettling, and Joanne W. (2020) Hsu with assistance from Julia Hewitt. "Disparities in Wealth by Race and Ethnicity in the 2019 Survey of Consumer Finances,". *https://www.federalreserve.gov/econres/notes/feds-notes/disparities-in-wealth-by-race-and-ethnicity-in-the-2019-survey-of-consumer-finances-20200928.html*.
3. Ransaw, Theodore S., and Richard Majors, eds. (2020) Teaching to Close the Achievement Gap for Students of Color: Understanding the Impact of Factors Outside the Classroom. New York: Routledge. *https://doi.org/10.4324/9781003093855*.
4. Robinson, Sean, and Veronica Franklin. (2011) "Working Against the Odds: The Undergraduate Support Needs of African American Women." In Diversity in Higher Education, edited by Crystal Renée Chambers, 21–41. Emerald Group Publishing Limited. *https://doi.org/10.1108/S1479-3644(2011)0000008005*.
5. Fuse, Akiko and Bergen, Michael. (2018) "The Role of Support Systems for Success of Underrepresented Students in Communication Sciences and Disorders," Teaching and Learning in Communication Sciences & Disorders: Vol. 2: Iss. 3, Article 3. *https://doi.org/10.30707/TLCSD2.3Fuse*
6. Phillips, Tina, Norman Porticella, Mark Constas, and Rick Bonney. (2018) "A Framework for Articulating and Measuring Individual Learning Outcomes from Participation in Citizen Science." Citizen Science: Theory and Practice 3: 3. *https://doi.org/10.5334/cstp.126*.
7. London, Bonita, Lisa Rosenthal, Sheri Levy, and Marci Lobel. (2011) "The Influences of Perceived Identity Compatibility and Social Support on Women in Nontraditional Fields During the College Transition." Basic and Applied Social Psychology 33: 304–321. *https://doi.org/10.1080/01973533.2011.614166*.
8. Sledge, Lanita. (2012) "Get Your Education: Family Support for African-American College Students" 4 : 22.
9. Cornell Lab of Ornithology. (2015) "Developing, validating, and implementing situated evaluation (DEVISE) instruments scales." Ithaca, NY.
10. Shrauger, J. Sidney, and Mary Schohn. (1995) "Self-Confidence in College Students: Conceptualization, Measurement, and Behavioral Implications." Assessment 2, no. 3 : 255–278. *https://doi.org/10.1177/1073191195002003006*.
11. Erwin, T. Dary, and Karlease Kelly. "Changes in Students' Self-Confidence in College." Journal of College Student Personnel 26 (1985): 395–400.
12. Reblin, Maija, and Bert N. Uchino. (2008) "Social and Emotional Support and Its Implication for Health." Current Opinion in Psychiatry 21, no. 2 : 201–205. *https://doi.org/10.1097/YCO.0b013e3282f3ad89*.

13. Thayer, Robert E. (1973) "Do Low Grades Cause College Students to Give Up?" The Journal of Experimental Education 41, no. 3 : 71–73.
14. DeFauw, Chloe, Katelyn Levering, Rosemary Msipa, and Samuel Abraham. (2018)"Families' Support and Influence on College Students' Educational Performance." Journal of Education and Development 2 : 11. *https://doi.org/10.20849/jed.v2i1.312*.
15. McKown, Clark, and Rhona S. Weinstein. (2008)"Teacher Expectations, Classroom Context, and the Achievement Gap." Journal of School Psychology 46, no. 3 : 235–261. *https://doi.org/10.1016/j.jsp.2007.05.001*.
16. Good, Catherine, Joshua Aronson, and Michael Inzlicht. (2003)"Improving Adolescents' Standardized Test Performance: An Intervention to Reduce the Effects of Stereotype Threat." Journal of Applied Developmental Psychology 24, no. 6 : 645–662. *https://doi.org/10.1016/j.appdev.2003.09.002*.
17. Acosta-Gonzaga, Elizabeth. (2023) "The Effects of Self-Esteem and Academic Engagement on University Students' Performance." Behavioral Sciences 13, no. 4 : 348. *https://doi.org/10.3390/bs13040348*.
18. Mina, Liliana. (2011)"Can I Succeed? Challenges African-American Women Face in Technology-Driven College Classrooms." In Diversity in Higher Education, edited by Crystal Renée Chambers, 43–57. Emerald Group Publishing Limited. *https://doi.org/10.1108/S1479-3644(2011)0000008006*.
19. McKown, Clark, and Michael J. Strambler. (2009)"Developmental Antecedents and Social and Academic Consequences of Stereotype-Consciousness in Middle Childhood." Child Development 80, no. 6 : 1643–1659. *https://doi.org/10.1111/j.1467-8624.2009.01359.x*.

ABOUT STUDENT AUTHOR

Kimberly Parris is a Senior at North Carolina State University where she works as a research assistant in the Environmental Sciences department under the mentorship of Dr. Zakiya Leggett and Dr. Porche Spence. She will graduate with her bachelor's degree in Biological Sciences in May of 2024.

PRESS SUMMARY

Undergraduate student support systems and individual confidence in science courses have been linked to better academic performance among college students. As the topics of diversity and inclusion continue to draw the attention of the collegiate, the question of equity surrounding supportive learning environments in higher education comes into focus. Students (n = 235) were asked to complete a survey with the intent to measure the differences in support and confidence among white students and students of color (SOC). The findings demonstrated that white students may have had access to stronger support systems and had higher science activity confidence levels than SOC based on survey responses. As a result, higher dropout rates, lower performance overall, and alienation of these students in higher education environments could occur.