

# A Nationwide Study Exploring the Religious Backgrounds and Evolution Perceptions of Black and Hispanic Biology Students

Elizabeth Barnes,<sup>1</sup> Sara Brownell,<sup>2</sup> and K. Supriya<sup>2</sup>

<sup>1</sup>Middle Tennessee State University, Murfreesboro, TN

<sup>2</sup>Arizona State University, Tempe, AZ

## Subject/Problem

*Racial/ethnic URM students are at a disadvantage in evolution education*

A breadth of research documents many disadvantages that racial/ethnic underrepresented minority (URM) students face in STEM education (Holdren et al., 2010). Emerging research suggests that specifically, the evolution education experiences of racial/ethnic URM students may be different from non-URM students (Graves, 2019). Several recent studies have found that URM biology students, on average, accept evolution less (Metzger et al., 2018; Sbeglia & Nehm, 2018), that they understand evolution less (Mead et al., 2015) and that they may feel a lower sense of belonging in evolutionary biology (O'Brien et al., 2020) than their non-URM peers. Further URM students, on average, experience less gains in acceptance of evolution after evolution instruction compared to White or Asian students. Indeed, the negative effect of race/ethnicity on evolution acceptance is greater than the positive effect of instruction on evolution (Sbeglia & Nehm, 2018). Given that evolution is a foundational component of biology education, these experiences may contribute to the underrepresentation of these groups in biology. So why do students struggle with accepting evolution or feeling a sense of belonging within evolutionary biology? One potential explanation is that students struggle with a perceived conflict with their religious beliefs when learning evolution (Barnes & Brownell, 2018).

*Evolution education can be a challenge because of students' religious beliefs*

The more one identifies as religious and participates in religious activities (hereafter referred to as religiosity) the more likely they are to have negative evolution education experiences (Barnes & Brownell, 2017). Studies also show that religious biology students, predominately Christians, may not feel as though they do not fit in with the biology community while learning about evolution (Barnes, Truong, et al., 2017; Barnes & Brownell, 2018). These experiences could make it less likely that religious students can benefit from evolution education and may lead to the underrepresentation of Christians, which make up ~75% of the American population but only 25% of academic biologists (Pew, 2009).

*Race/ethnicity and religious identity covary*

Hispanic and Black students are underrepresented and underserved in biology fields. Additionally, both Hispanic and Black individuals are more likely to identify as Christian, attend religious services and pray (Pew, 2009). If a student identifies as Hispanic or Black and Christian they will hold at least two underrepresented identities in science. Thinking about the intersection of racial/ethnic<sup>1</sup> identity and Christian identity both in evolution education and STEM retention studies could help instructors better understand how to support URM students. *The current study*

---

<sup>1</sup>Race does not provide an accurate representation of human biological variation. It was never accurate in the past, and it remains inaccurate when referencing contemporary human populations. Humans are not divided

Although we know URM students hold stronger religious beliefs, on average, than students from majority racial/ethnic groups, researchers have not explored how these students' religious backgrounds may contribute to lower levels of evolution acceptance among biology students. In this study, we aimed to fill this gap in the literature.

### Research Questions

- 1.) On average, do Black, Hispanic, and White undergraduate biology students' levels of religiosity and evolution acceptance differ from one another?
- 2.) Can the differences between Black, Hispanic, and White students' evolution acceptance be explained by their differing levels of religiosity?

### Design/Procedure

We identified college biology instructors online and asked them if they would be willing to send a link to an online survey to their students for a small amount of extra credit. All activities were approved by ASU's Institutional Review Board protocols #8191 and #3910. We collected data on student racial/ethnic identity, their religiosity (Cohen et al., 2008) (i.e., "*I consider myself a religious person*") ( $\alpha = .91$ ), and their acceptance of evolution (Nadelson & Southerland, 2012) (microevolution acceptance:  $\alpha = .87$ ; macroevolution acceptance:  $\alpha = .87$ ; human evolution acceptance:  $\alpha = .92$ ) from 8,192 students in 60 biology courses across 15 states.

### Analyses and Findings

To examine how student religiosity and evolution acceptance vary by race/ethnicity, we first converted religiosity into z-scores to get standardized regression coefficients. Next, we modeled religiosity, microevolution acceptance, macroevolution acceptance and human evolution acceptance using linear mixed models (LMM) with course as the random effect and race/ethnicity as a predictor. Finally, to see if differences in levels of evolution acceptance by race/ethnicity can be explained by religiosity, we ran mediation analyses. The goal of mediation models is to identify the extent to which the observed relationship between a predictor variable and an outcome variable is explained by a third variable, the mediator variable. Figure 1 offers a graphical depiction of our proposed model.

---

biologically into distinct continental types or racial genetic clusters. Instead, the Western concept of race must be understood as a classification system that emerged from, and in support of, European colonialism, oppression, and discrimination. It thus does not have its roots in biological reality, but in policies of discrimination. Because of that, over the last five centuries, race has become a social reality that structures societies and how we experience the world. In this regard, race is real, as is racism, and both have real biological consequences." (AAPA, 2019)  
In line with this definition, we refer to race/ethnicity throughout this manuscript as a social identity (which often has negative consequences for an individual's experiences due to racism) and not a biological classification.

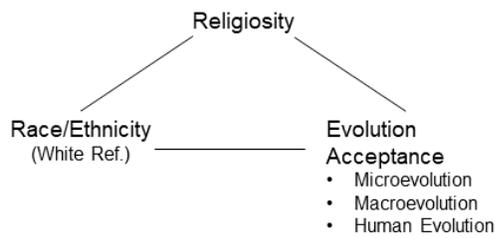


Figure 1: A model depicting the theorized relationships between race/ethnicity, evolution acceptance, and religiosity.

**Finding 1: On average, Black students are more religious than students with all other racial/ethnic identities.**

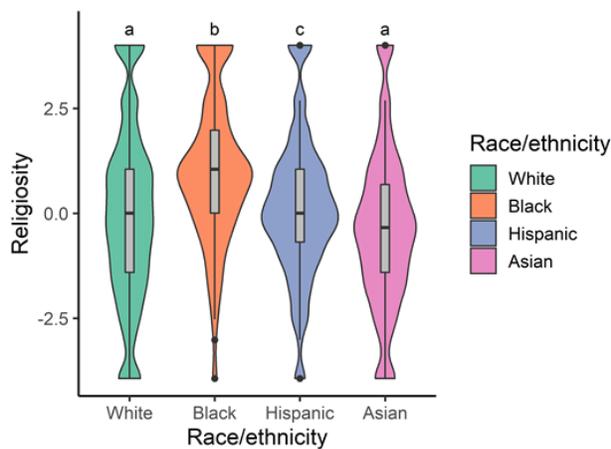
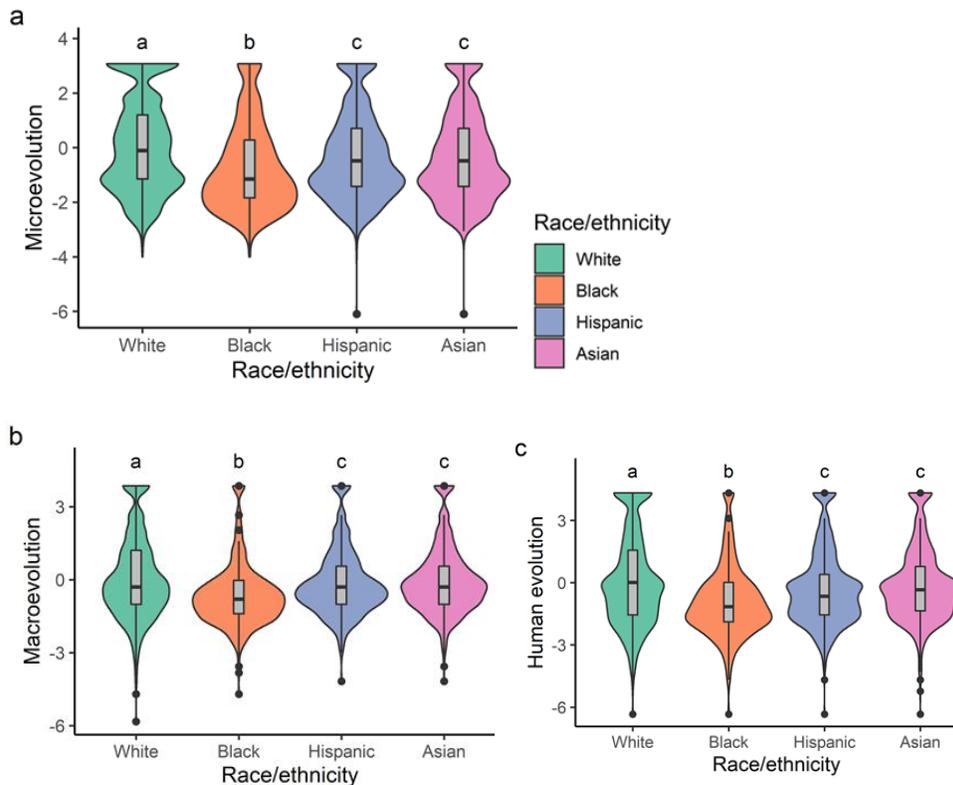


Figure 2: student religiosity scores disaggregated by student racial/ethnic identity. Violin plots show the distribution of the data, grey bars in the middle of each violin indicates the interquartile range and black lines in the middle of these bars indicate the median, black lines stretched out from the bar indicate first/third quartile  $\pm$  1.5 interquartile range. Different letters represent statistically significant differences between groups ( $p < .05$ ).

**Finding 2: On average, Black students accept evolution less than students with all other racial/ethnic identities.**



**Figure 3:** Figure 3: Student acceptance of (a) microevolution, (b) macroevolution, and (c) human evolution acceptance by racial/ethnic identity.

**Finding 4: The high mean religiosity of Black and Hispanic students can explain their lower levels of evolution acceptance.**

Our mediation analyses revealed that a large portion of the differences between Black/Hispanic and White student evolution acceptance levels can be explained by their higher than average religiosity levels. The average causal mediation effect of religiosity on race/ethnicity and evolution acceptance was  $-0.26$  for microevolution acceptance,  $-0.32$  for macroevolution and  $-0.47$  for human evolution acceptance (all  $p < 0.001$ ) indicating that religiosity explained less of the association between race/ethnicity and microevolution acceptance than macroevolution acceptance and human evolution acceptance. However, regardless of the evolution acceptance measure, a large proportion of the difference in evolution acceptance between White and Black students can be attributed to religiosity (32% for microevolution acceptance, 48% for macroevolution acceptance and 49% for human evolution acceptance). Religiosity was also a strong mediator for macro- and human evolution acceptance among Hispanic students (67% & 50% respectively) and a weaker mediation of microevolution acceptance (22%).

### Contribution and General Interest

Prior research shows that evolution instructors are hesitant to discuss interactions between science and religion while teaching evolution (Barnes & Brownell, 2016) but this study reveals

how this could be disadvantageous to Black students, who tend to be more religious than other students. Our prior work has advocated for the use of Religious Cultural Competence in Evolution Education (ReCCEE) as a means to improve the evolution education outcomes for religious college biology students (Barnes & Brownell, 2017); these data suggest that this framework may be particularly beneficial to religious Black students. The instructional practices that fall under the umbrella of ReCCEE could help these students reduce their perceived conflict between religion and evolution (Barnes, Elser, et al., 2017). For instance, one ReCCEE practice includes highlighting relevant religious scientist role models who accept evolution (Barnes & Brownell, 2017; Holt et al., 2018). One of the prior studies examining evolution education outcomes of Black students found that these students placed emphasis on the importance of role models in a discipline for guiding their interests (Mead et al., 2015). One such role model instructors could introduce to students is Dr. Joseph Graves, a prominent African American evolutionary biologist who considers himself part of a religious community. He was the first African American to ever earn a PhD in evolutionary biology and was an author on both prior studies that explored the evolution education outcomes of African American students (Bailey et al., 2011; Mead et al., 2015).

- AAPA. (2019). *AAPA Statement on Race & Racism*. <https://physanth.org/about/position-statements/aapa-statement-race-and-racism-2019/>
- Bailey, G., Han, J., Wright, D., & Graves, J. L. (2011). Religiously expressed fatalism and the perceived need for science and scientific process to empower agency. *The International Journal Science in Society*, 2(3), 55–88.
- Barnes, M. E., & Brownell, S. E. (2016). Practices and Perspectives of College Instructors on Addressing Religious Beliefs When Teaching Evolution. *CBE-Life Sciences Education*, 15(2), 1–19. <https://doi.org/10.1187/cbe.15-11-0243>
- Barnes, M. E., & Brownell, S. E. (2017). A Call to Use Cultural Competence When Teaching Evolution to Religious College Students: Introducing Religious Cultural Competence in Evolution Education (ReCCEE). *CBE-Life Sciences Education*, 16(4), es4. <https://doi.org/10.1187/cbe.17-04-0062>
- Barnes, M. E., & Brownell, S. E. (2018). Experiences and practices of evolution instructors at Christian universities that can inform culturally competent evolution education. *Science Education*, 102(1), 36–59. <https://doi.org/10.1002/sce.21317>
- Barnes, M. E., Elser, J., & Brownell, S. E. (2017). Impact of a Short Evolution Module on Students' Perceived Conflict between Religion and Evolution. *The American Biology Teacher*, 79(2), 104–111. <https://doi.org/10.1525/abt.2017.79.2.104>
- Barnes, M. E., Truong, J. M., & Brownell, S. E. (2017). Experiences of Judeo-Christian Students in Undergraduate Biology. *CBE-Life Sciences Education*, 16(1), ar15. <https://doi.org/10.1187/cbe.16-04-0153>
- Cohen, A. B., Shariff, A. F., & Hill, P. C. (2008). The accessibility of religious beliefs. *Journal of Research in Personality*, 42(6), 1408–1417. <https://doi.org/10.1016/j.jrp.2008.06.001>
- Graves, J. L. (2019). African Americans in evolutionary science: Where we have been, and what's next. *Evolution: Education and Outreach*, 12(1), 18. <https://doi.org/10.1186/s12052-019-0110-5>
- Holdren, J. P., Lander, E. S., Varmus, H., & others. (2010). Prepare and inspire: K-12 education in science, technology, engineering, and math (STEM) for America's future. *Executive Report*). Washington, DC: President's Council of Advisors on Science and Technology.

- Holt, E. A., Ogden, T. H., & Durham, S. L. (2018). The positive effect of role models in evolution instruction. *Evolution: Education and Outreach*, *11*(1), 11. <https://doi.org/10.1186/s12052-018-0086-6>
- Mead, L. S., Clarke, J. B., Forcino, F., & Jr, J. L. G. (2015). Factors influencing minority student decisions to consider a career in evolutionary biology. *Evolution: Education and Outreach*, *8*(1), 1–11. <https://doi.org/10.1186/s12052-015-0034-7>
- Metzger, K. J., Montplaisir, D., Haines, D., & Nickodem, K. (2018). Investigating undergraduate health sciences students' acceptance of evolution using MATE and GAENE. *Evolution: Education and Outreach*, *11*(1), 10. <https://doi.org/10.1186/s12052-018-0084-8>
- Nadelson, L. S., & Southerland, S. (2012). A More Fine-Grained Measure of Students' Acceptance of Evolution: Development of the Inventory of Student Evolution Acceptance—I-SEA. *International Journal of Science Education*, *34*(11), 1637–1666. <https://doi.org/10.1080/09500693.2012.702235>
- O'Brien, L. T., Bart, H. L., & Garcia, D. M. (2020). Why are there so few ethnic minorities in ecology and evolutionary biology? Challenges to inclusion and the role of sense of belonging. *Social Psychology of Education*. <https://doi.org/10.1007/s11218-019-09538-x>
- Pew. (2009). Scientists and Belief. *Pew Research Center's Religion & Public Life Project*. <http://www.pewforum.org/2009/11/05/scientists-and-belief/>
- Sbeglia, G. C., & Nehm, R. H. (2018). Measuring evolution acceptance using the GAENE: Influences of gender, race, degree-plan, and instruction. *Evolution: Education and Outreach*, *11*(1), 18. <https://doi.org/10.1186/s12052-018-0091-9>
- Sbeglia, G. C., & Nehm, R. H. (2019). Do you see what I-SEA? A Rasch analysis of the psychometric properties of the Inventory of Student Evolution Acceptance. *Science Education*, *103*(2), 287–316. <https://doi.org/10.1002/sc.21494>