Exposure to Counterstereotypical Scientist Role Models Impact How Students Relate to Scientists

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The representation of scientists in biology curricular materials does not reflect the demographic composition of society or of biology students (Wood et al., 2020). However, the presence of relatable role models benefits students who possess identities that are excluded in science by increasing their persistence and success in science disciplines (Schinske et al., 2016; Seymour et al., 2019). Due to the importance of role models within science classrooms, we investigated how students relate to scientists in biology, and specifically scientists who possess counterstereotypical identities. Specifically, we asked (1) does the amount of information given about a counterstereotypical scientist affect how students relate to scientists in undergraduate biology courses? and (2) what about counterstereotypical scientists do students relate to most?

To answer these questions, we implemented three treatments in introductory undergraduate biology courses across the country. These treatments involved data literacy activities created by Data Nuggets (datanuggets.org) paired with scientist profiles created by Project Biodiversify (projectbiodiversify.org). We manipulated scientist profiles to contain varying levels of information about counterstereotypical scientists. In treatment one (the control treatment), the data literacy activities were not accompanied by any information about the scientists; in treatment two (the visual treatment), the activities included pictures of the scientists; in treatment three (the humanizing treatment), the activities included pictures and extended 'About Me' sections with humanizing information (i.e., hobbies, interests, obstacles faced) (Fig. 1). Throughout the semester, students were given three different data nuggets of the same treatment at different time points.

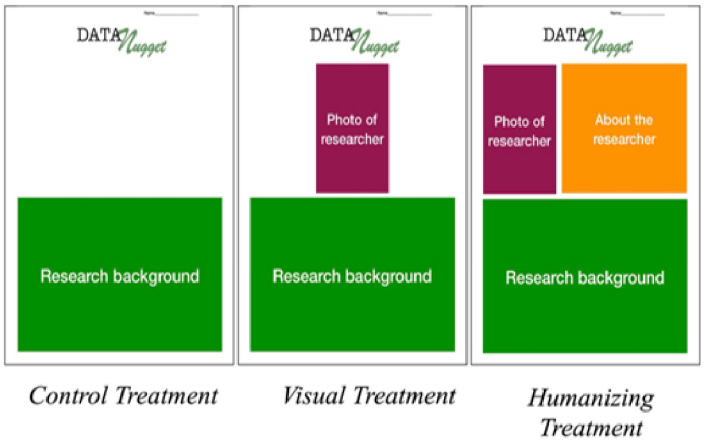

Fig. 1 Example of data nugget layout with varying amounts of scientist information.

We collected data through Qualtrics surveys administered immediately after students completed each activity. Students responded to the prompt, "Describe how you related to the featured scientist, if at all." We thematically coded 1574 student responses from 34 biology instructors across the United States. We created twenty-four codes within four major categories. These four categories included (1) student relates to diverse

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identities of the scientist, (2) student relates to humanizing elements of the scientist, (3) student relates to the science rather than the scientist, and (4) student did not relate (Fig. 2).

After thematically coding all student responses, we used logistic regressions to quantify the impact of treatment on how students related to the featured scientist. In both the control treatment, where no scientist information was given, and the visual treatment, where only a scientist photo was given, students were more likely to relate to the science rather than the scientist ($\chi 2 = 5.47$, $p = 0.065$). In both the visual and traditional treatments, students most identified with the scientists' scientific interests (53%), the process of scientific methods (28%), and sharing a general interest in science (14%). Students within the humanizing treatment were most likely to emphasize the scientists' counter-stereotypical identities ($\chi 2 = 11.54$, $p = 0.003$; Fig. 3). Here, students most often identified with the scientists' gender (57%), LGBTQIA+ status (18%), and how the scientists overcame barriers (39%).

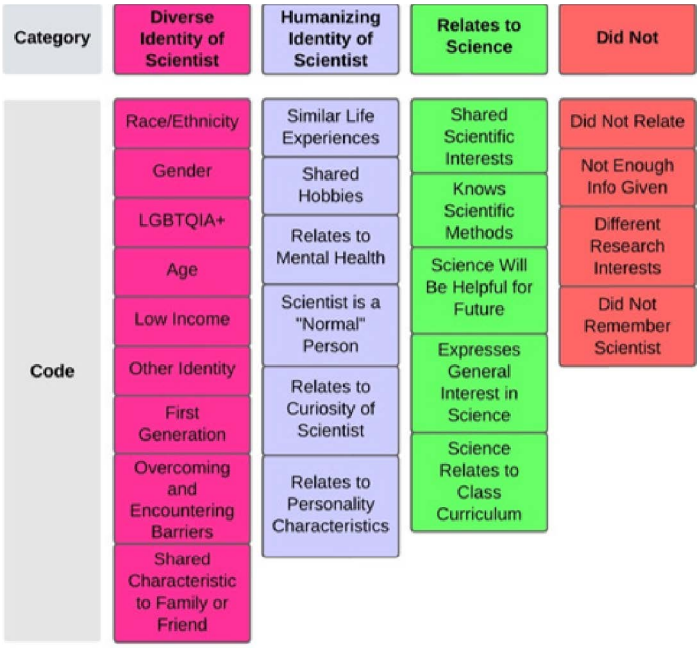

Fig. 2 Codes used to analyze open-ended student responses to the prompt "Describe how you related to the featured scientist, if at all".

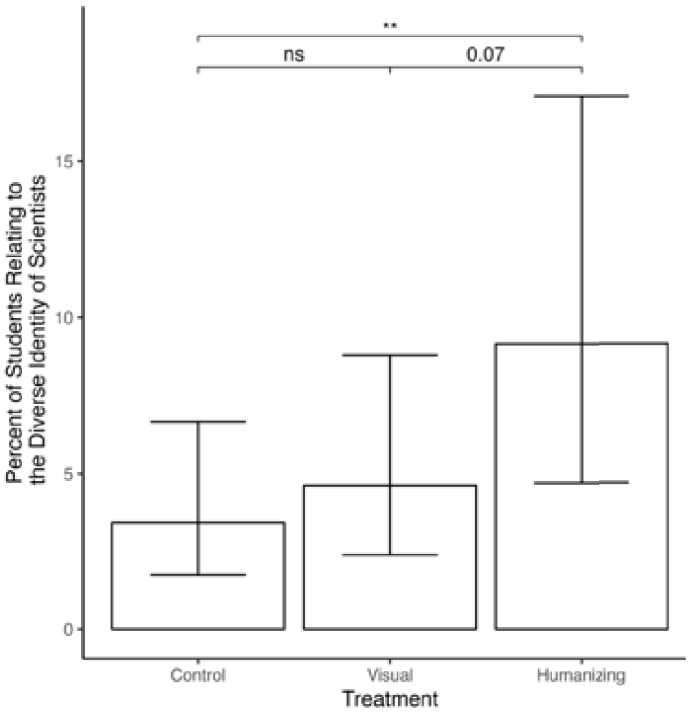

Fig. 3 Percent of students who relate to scientists' diverse identities by treatment type. **$p < 0.01$.

This research highlights the importance of humanizing scientific role models within undergraduate biology courses. By humanizing scientists, we create opportunities for students to see themselves in science while presenting contemporary science as accessible to all.

Statement of Research Advisor

RYM groomed, coded, analyzed, and visually depicted all qualitative data presented in this research. She mentored several other undergraduates and assisted in a graduate-level course with CJB that emphasized qualitative methods in biology education research. Her contributions were critical to clarifying our novel understanding of how relatability to scientists benefits students, and several additional peer-reviewed publications will result from her efforts.

- Cissy Ballen, Department of Biological Sciences, College of Sciences and Mathematics

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Authors Biography

Rachel M. Youngblood is a senior-year student pursuing a B.S. degree in Exercise Science at Auburn University. She has played key research roles in researching the role scientific role models play in undergraduate Biology courses. She plans to pursue Occupational Therapy school after graduation.

Robin A. Costello is a postdoctoral researcher in Cissy Ballen's lab at Auburn University. She received her PhD in evolutionary biology from the Brodie lab at the University of Virginia. Her postdoctoral work empirically identifies classroom interventions that promote equitable postsecondary STEM education.

Emily Driessen is a PhD candidate at Auburn University She earned a B.S. in Microbiology from North Dakota State University and a M.S. in STEM Education from the University of Kentucky. She is currently in her final year of a Biology PhD, studying in Cissy Ballen's lab where she focuses on how to best support the achievement and success of all students in post-secondary biology, recognizing structural barriers and historical biases.

Amelia is a graduating senior at Colorado College with a bachelor's degree in Organismal Biology and Ecology. She is passionate about equity and equality, especially in regard to education and food access. After college, she plans to serve through the Peace Corps in Guinea, where she will focus on both of those issues.

Elizabeth Schultheis (she/her) is the Education and Outreach Coordinator for the Long-Term Ecological Research program at the W.K. Kellogg Biological Station, and the co-founder of Data Nuggets. Elizabeth received her PhD from Michigan State University in Plant Biology and Ecology, Evolutionary Biology and Behavior, and completed a postdoc in science education research. Her work includes outreach, research, curriculum development, and professional development for teachers and scientists.

Melissa K. Kjelvik is a science education research specialist at Michigan State University. She is a co-founder of Data Nuggets and a content editor for Project Biodiversify and has been working with educators, curriculum developers, and education researchers for over 10 years to create, innovate, and disseminate effective resources to increase data literacy and representation of scientists in K-16 classrooms.

Ash Zemenick is the Manager of Sagehen Creek Field Station where they support researchers, educators, students, and the community members as they immerse themselves in a very gorgeous and special slice of the Sierra Nevada. They are also proud to be the Director and Co-Founder of Project Biodiversity.

Marjorie Weber is an assistant professor in the Ecology and Evolutionary Biology department at the University of Michigan. Her lab focuses on the evolutionary ecology of species interactions. She is the co-founder of Project Biodiversify, a program for increasing equity in undergraduate biology classrooms.

Cissy Ballen is an assistant professor in the department of biological sciences at Auburn University. Her lab conducts discipline-based education research broadly focused on biology education and STEM equity.