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ARTICLE
Highlighting Diversity in Neuroscience through Course Content

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Slides showcasing research of one or two neuroscientists from diverse backgrounds were added to weekly, learning assistant-led sections in a large (~80 person) primarily lecture course required for neuroscience majors. Students appreciated the slides, and survey data suggests that the slides increased the sense of belonging for both underrepresented and not underrepresented students.

Key words: diversity; inclusion; belonging; educational resources

While life science departments often have strong interest from women and students from underrepresented racial backgrounds starting college, these students leave the life sciences at high rates (National Science Board, 2000; Rivers 2017). A greater sense of belonging in STEM disciplines has been linked to retention in STEM fields, and representation within your own sub-discipline increases the sense of belonging for some identities (Rainey et al., 2018). Exposure to experts from one's own identity can reduce stereotype threat which may be a contributing factor to an increased sense of belonging (Dasgupta, 2011).

Several studies have demonstrated how small interventions and role models can lead to an increased sense of belonging (Walton and Cohen, 2011; Walton et al., 2015; Master and Meltzoff, 2020). Furthermore, when students who do not identify as underrepresented learn about and appreciate diversity, underrepresented students report being treated better by their peers which increases their sense of belonging (Murrar et al., 2020). Here we describe a small intervention where slides showcasing neuroscientists from diverse backgrounds were added to learning assistant-led sections in a large lecture course. These slides were appreciated by the students, increased their knowledge of diversity in the field, and increased students' sense of belonging.

MATERIALS AND METHODS
Participants
Seventy-eight students at Brown University were enrolled in Neural Systems in the Fall 2019 semester. Neural Systems is a primarily lecture-based course required for neuroscience majors. The course is a 1000-level course, with the introductory neuroscience course as its only prerequisite. In the Fall 2019 semester, two-thirds of the class were sophomores, one quarter of the class were juniors, and the remaining students were seniors. Forty-five of the students completed an optional post-then-pre survey related to the inclusion of diversity slides in the learning assistant-led course sections.

Diversity in the Neural Systems Course Content
Neural Systems course content is largely a historical look at sensory and motor systems, and most of the experiments discussed in detail in the course were the work of white men, likely men of means. The course syllabus includes an extensive and authentic diversity and inclusion statement (Linden and Wright, 2017). The diversity and inclusion statement acknowledges the potential implicit and explicit bias in the course content. This acknowledgement did not seem sufficient. Therefore, the purpose of this project was to intentionally increase the diversity of neuroscientists that students would be exposed to throughout the course. The course instructor (Linden) discussed this purpose on the first day of class.

Diversity Slides
The Neural Systems course includes 13 weekly learning assistant-led sections (run by pairs of learning assistants including both undergraduate and graduate students). Two slides were created each week (for an example, see Figure 1) to showcase the research of one or two different neuroscientists from diverse backgrounds. Here we define diversity to include both racial diversity and diverse gender identities. The slides included photographs obtained from the web, some background information about the researcher, a brief description of their research, and links students could visit if they were interested in further information. The neuroscientists were chosen such that their research was relevant to the topics covered in that week's section.

Survey
To gauge the students' feelings about the diversity slides and to assess their effectiveness, students were given an optional, anonymous survey at the end of the semester. No identifying information was collected about the students and the results of the survey were not analyzed until after the semester had concluded and grades had been submitted. Table 1 shows the survey questions. Students were asked yes or no questions to self-identify "from an underrepresented racial background," "as a low-income student," and/or "as an LGBTQI student". Women were not considered underrepresented for the purposes of this survey. The survey then used a post-then-pre design format (Rockwell, 1989). Students were given a series of 5-point Likert scale questions related to the slides. They were also asked to confirm that they attended section regularly (average 4.95 on the 5-point scale).

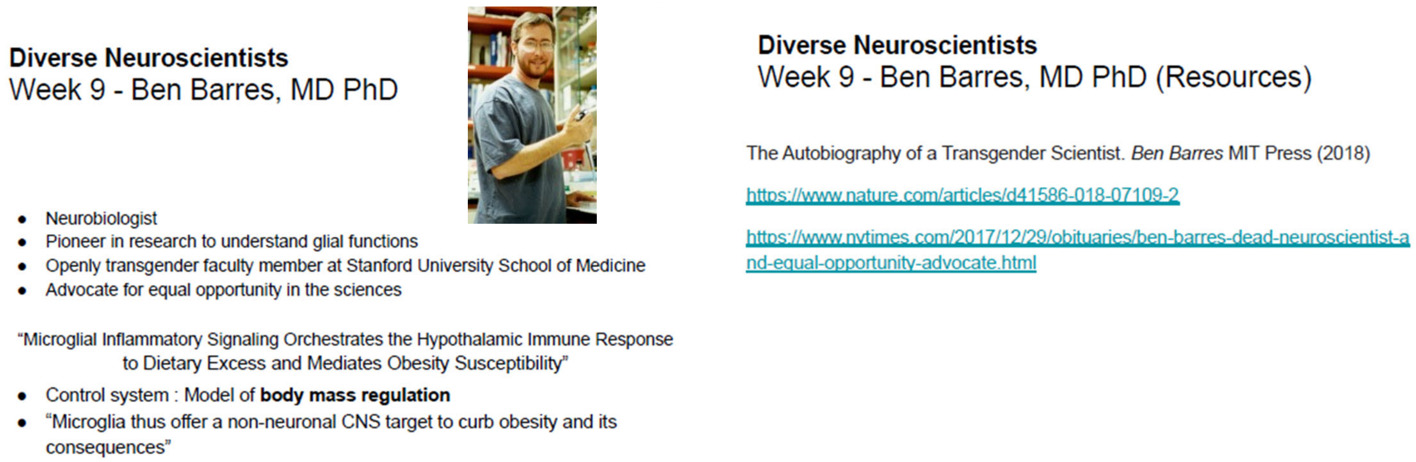

Figure 1. An example of slides used at the beginning of the Week 9 learning assistant-led sections. Ben Barres, an openly transgender neuroscientist, was featured with his work on the relationship between microglia and obesity linked to the course topic of control systems and body mass regulation. Students could also download the slides to explore the links. Image: Dr. Ben A. Barres, photo by the Myelin Repair Foundation https://www.flickr.com/photos/myelinrepairfoundation/3785874138/in/dateposted/ CC BY 2.0.

Statistical Analysis

For the post-then-pre survey items, data were analyzed using a Wilcoxon Signed-Rank (WSR) test, which is a paired, non-parametric method (http://www.socscistatistics.com). Due to the low sample numbers in the underrepresented subgroups, all students who identified as either "from an underrepresented racial background" and/or "as an LGBTQI student" were grouped together for statistical analysis, although the data presented in Figures 2-4 are separated by subgroups.

RESULTS

Student Diversity

Twenty-two of the forty-five students who completed the survey identified with one or more "underrepresented" categories. Sixteen students identified as belonging to an underrepresented racial background. Eight students identified as LGBTQI students, with two of those students also identifying as belonging to an underrepresented racial background. Seven students identified as low-income, with all of these students also identifying as belonging to an underrepresented racial background. Because all low-income students identified this way, that subgroup of students was not treated separately.

Identity Questions - Yes or No
I identify as a student from an underrepresented racial background.
I identify as a low-income student.
I identify as an LGBTQI student.
Slide Questions – 5-point Likert scale
I appreciated the inclusion of diversity slides in section.
The inclusion of the diversity slides wasted time in section.
At the beginning of the semester, I was aware of the diversity of neuroscience researchers.
Currently, I am aware of the diversity of neuroscience researchers.
At the beginning of the semester, I could see myself having a future in life science research.
Currently, I can see myself having a future in life science research.
I attend section regularly.

Table 1. Questions in the student survey.

Using Learning Assistant-led Section Time for Slides

Figure 2 shows that students generally appreciated the use of learning assistant-led section time for the purpose of showing the diversity slides and did not consider them a waste of time. Students who identified as being both from an underrepresented racial group and as LGBTQI had the highest average score on the appreciation scale. This may represent an increased appreciation due to intersectionality, although due to the size of the group, it is impossible to draw conclusions.

Awareness of the Diversity of Neuroscience Researchers

Figure 3 shows the student responses to the two survey items that capture awareness of diversity in neuroscience researchers. Using the post-then-pre design, the survey item with results in Figure 3A was "At the beginning of the semester, I was aware of the diversity of neuroscience researchers," with the survey item with results in Figure 3B reading "Currently, I am aware of the diversity of neuroscience researchers. Here we see a strong overall rightward shift in the data, indicating an increase in awareness. Both the underrepresented students ($p<0.001$, WSR) and non-underrepresented students ($p<0.001$, WSR) show significant changes towards greater awareness of the diversity of neuroscience researchers.

A Future in Life Science Research

To capture students' sense of belonging in life science research, students were asked their level of agreement to two survey items: "At the beginning of the semester, I could see myself having a future in life science research" (Figure 4A); and, "Currently, I could see myself having a future in life science research" (Figure 4B). Here we see a small but significant overall rightward shift in the data, indicating an

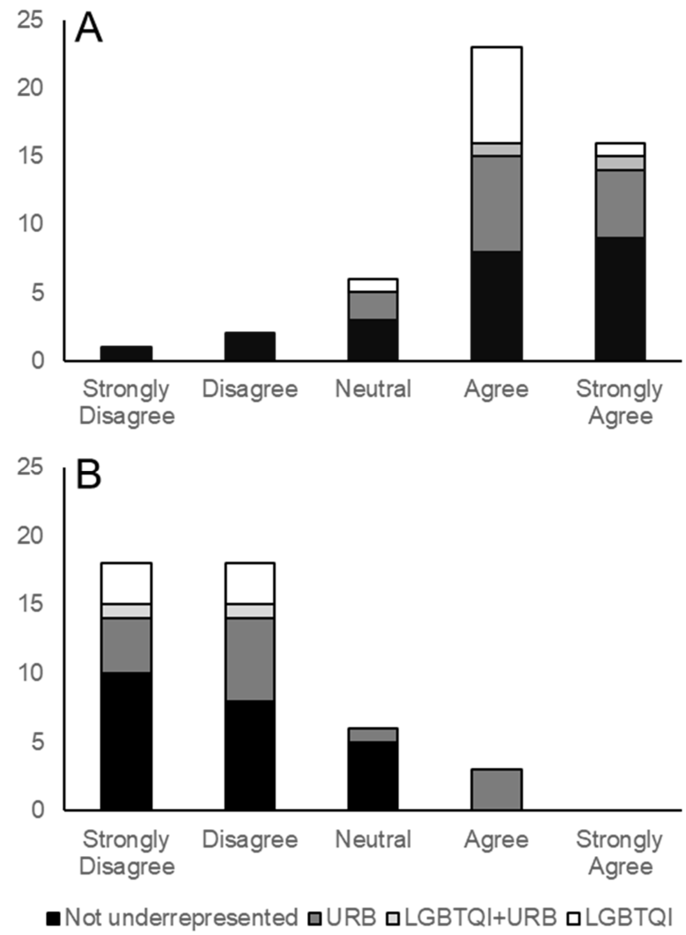

Figure 2. *A* shows the number of students providing each of the possible responses to the survey item: "I appreciated the inclusion of the diversity slides in section." All groups of students show appreciation for the slides. Converted to a 1-5 scale, we found an overall mean of 4.04; underrepresented racial background (URB) mean of 4.24; LGBTQI mean of 4; URB and LGBTQI-identifying mean of 4.5; and not underrepresented mean of 3.96. *B* shows the number of students providing each of the possible responses to the survey item: "The inclusion of the diversity slides wasted time in section." Both groups of students tend towards disagreeing with this statement. Converted to a 1-5 scale, we found an overall mean of 1.87; URB mean of 2.21; LGBTQI mean of 1.5; URB and LGBTQI-identifying mean of 1.5; and not underrepresented mean of 1.78.

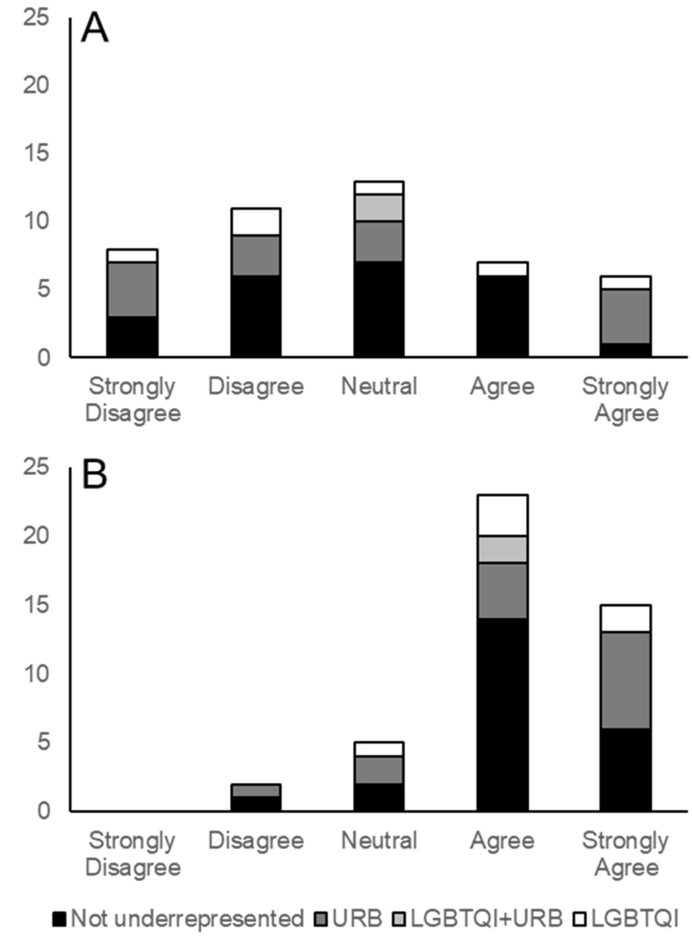

Figure 3. *A* shows the number of students providing each of the possible responses to the survey item: "At the beginning of the semester, I was aware of the diversity of neuroscience researchers." Converted to a 1-5 scale, we found an overall mean of 2.82; underrepresented racial background (URB) mean of 2.79; LGBTQI mean of 2.83; URB and LGBTQI-identifying mean of 3; and not underrepresented mean of 2.83. *B* shows the number of students providing each of the possible responses to the survey item: "Currently, I am aware of the diversity of neuroscience researchers." Converted to a 1-5 scale, we found an overall mean of 4.13; URB mean of 4.21; LGBTQI mean of 4.17; URB and LGBTQI-identifying mean of 4; and not underrepresented mean of 4.09.

increase in awareness. Both the underrepresented students ($p<0.01$, WSR) and non-underrepresented students ($p<0.05$, WSR) show a significant change towards agreement with the post-survey item, suggesting that by the end of the semester, they had a greater sense of belonging in life science research.

Additional Feedback

Students were also given the option to provide additional written feedback regarding the diversity slides. Ten students provided feedback. Five of the students requested that additional section time be spent learning more about the content of the slides. One student requested that the class include a speaker from a diverse background. One student suggested we add pronouns to the slides (which were included in some, but not all of the slides, and one student felt that the slides were "out of place" in section. The tenth comment was "This was the first time any STEM class I have taken has made a true effort to be more inclusive to the work of women and minorities. I found this to be incredibly valuable." This comment both suggests to us that the slides are important to some students but that more work needs to be done across the curriculum.

DISCUSSION

Overall, the student responses suggest that including slides to showcase diverse neuroscientists is appreciated by students, including those from underrepresented groups. It also helped increase the students' sense of belonging in life science research. For these reasons, we

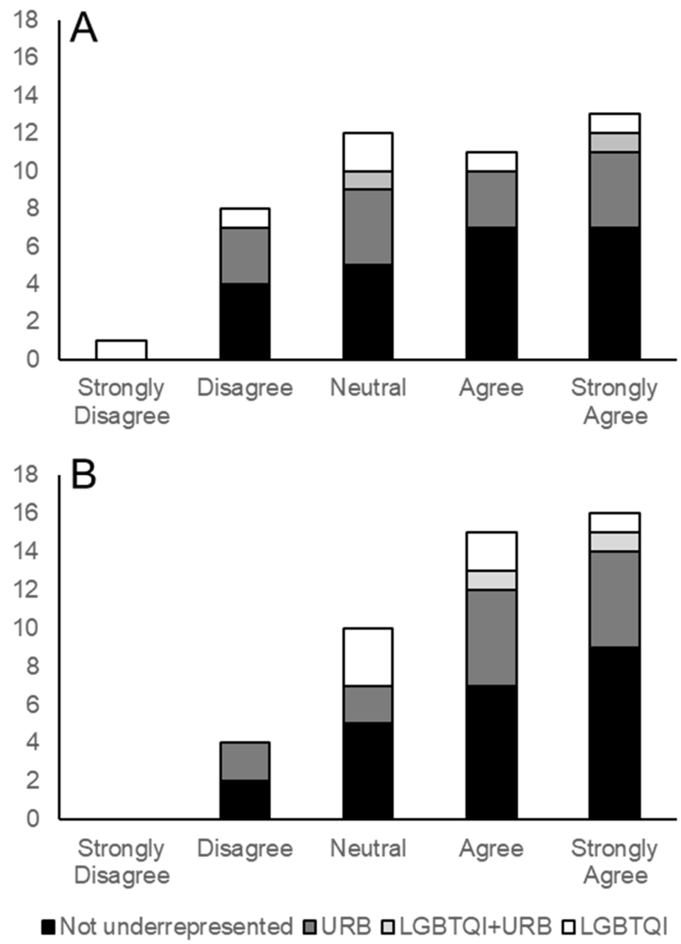

Figure 4. *A* shows the number of students providing each of the possible responses to the survey item: "At the beginning of the semester, I could see myself having a future in life science research." Converted to a 1-5 scale, we found an overall mean of 3.60; underrepresented racial background (URB) mean of 3.57; LGBTQI mean of 3.00; URB and LGBTQI-identifying mean of 4.00; and not underrepresented mean of 3.79. *B* shows the number of students providing each of the possible responses to the survey item: "Currently, I could see myself having a future in life science research." Converted to a 1-5 scale, we found an overall mean of 3.96; URB mean of 3.93; LGBTQI mean of 3.67; URB and LGBTQI-identifying mean of 4.5; and not underrepresented mean of 4.00.

will continue to include these slides in the course going forward.

Future Work

The slides will continue to be used in weekly sections in future years of the course. Additionally, this work has been expanded to include the development of new problem sets that feature additional researchers and showcase the work of these researchers within the problems. These problem sets are intended to be used as formative assessments to be solved in group problem solving sessions. In the development of the problem sets, scientists who identified as disabled were also included, as this identity was not included in the original work.

As we revise the content of the slides and develop new content to increase belonging, it is important to consider how to select the neuroscientists to feature on materials such as these. So far, this work has been completed by white women. We made our selections by looking for scientists who self-identified in these underrepresented groups, for example through their advocacy (e.g., Barres, 2006) or Twitter profiles, or were part of databases including the Neuroscientist Portrait Project (https://issuu.com/twophotonart/docs/neuroscientist_portrait_zine_previe), 500 Queer Scientists (https://500queerscientists.com/) and Pride in STEM's Out Thinkers (https://prideinstem.org/out-thinkers/). Future work may use other resources including BlackInNeuro Profiles (https://www.blackinneuro.com/profiles), the SPARK: Scholars of Color Database (https://docs.google.com/spreadsheets/d/1188aq_e2FXv7qvbkrmlT3-OUT47JKU2UjY2FFt1_Y24/edit?usp=sharing), Scientist Spotlights (https://scientistspotlights.org/), and Project Divine from the Faculty for Undergraduate Neuroscience (https://www.funfaculty.org/project_divine).

This work was designed to improve students' sense of belonging. However, one limitation of the work is that it showcased neuroscientists from a variety of marginalized identities, rather than focusing on persons excluded because of their ethnicity or race, known as PEERs. PEERs are known to leave STEM fields at higher rates than their non-PEER counterparts, even though they are overrepresented among college students intending to major in STEM at the beginning of their college careers (Asai, 2020. To have the greatest impact on the students that need the intervention the most, future iterations will strive to focus on showcasing more PEER scientists.

The survey also provided some limitations to the study. We did not include survey questions that would have allowed students to identify with other underrepresented categories including first-generation students and students with disabilities. Therefore, our data do not capture the effects of the intervention on these groups, nor do we explore the intersectionality of these identities with the PEER identity.

While our survey is not a validated instrument, only asked a limited number of questions, and we had a relatively small response rate, all of the data point to the overall success of this simple intervention. Despite the limitations of how we studied the outcome, we look forward to continuing to include diverse neuroscientists in our course content.

REFERENCES

Asai DJ (2020) Race matters. Cell 181(4):754-7.

Barres BA (2006) Does gender matter? Nature 442(7099):133-136.

Dasgupta N (2011) Ingroup experts and peers as social vaccines who inoculate the self-concept: The stereotype inoculation model. Psychological Inquiry 22(4):231-46.

Linden ML, Wright M (2017) Diversity and inclusion - Put it in the syllabus! Tomorrow's Professor. Available at https://tomprof.stanford.edu/posting/1625.

Master A, Meltzoff AN (2020) Cultural stereotypes and sense of belonging contribute to gender gaps in STEM. International Journal of Gender, Science and Technology 12(1):152-98.

Murrar S, Campbell MR, Brauer M (2020) Exposure to peers' pro-diversity attitudes increases inclusion and reduces the achievement gap. Nature Human Behaviour 29:1-9.

National Science Board (2000) Science & engineering indicators.

Alexandria, VA: National Science Foundation.
Rainey K, Dancy M, Mickelson R, Stearns E, Moller S (2018) Race and gender differences in how sense of belonging influences decisions to major in STEM. International Journal of STEM Education 5(1):10.
Rivers E (2017) Women, minorities, and persons with disabilities in science and engineering. Alexandria, VA: National Science Foundation.
Rockwell SK, Kohn H (1989) Post-then-pre evaluation. Journal of Extension 27(2):19-21.
Walton GM, Cohen GL (2011) A brief social-belonging intervention improves academic and health outcomes of minority students. Science 331(6023):1447-51.
Walton GM, Logel C, Peach JM, Spencer SJ, Zanna MP (2015) Two brief interventions to mitigate a "chilly climate" transform women's experience, relationships, and achievement in engineering. Journal of Educational Psychology 107(2):468.

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