Supplemental Material

CBE—Life Sciences Education

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Appendix A: Overview of LEADS – Learners Engaged in Advocating for Diversity in Science – Service-Learning Course

While this manuscript provides evidence supporting the core findings that 1) student-authored scientist spotlights are themselves effective interventions and 2) the process of authoring the spotlights impacts the student authors themselves in positive ways, we appreciate that readers may be curious about the service-learning course context in which this research was conducted. It is important to note that this study was conducted during the first offering of the LEADS course in our department. At our own institution, the specifics of the course continue to evolve in response to new instructors for the course, new insights from assessment and evaluation evidence, departmental priorities, and other local influences. No doubt there are many approaches to engaging students in authoring Scientist Spotlights, and future studies could investigate the merits of different models. While we did not set out to investigate the importance of different structural details of the service-learning course in the current study, future research could investigate these issues, as well as broader impacts of the course on instructor partners, the department, and the institution more broadly. Below, we include a brief description of the structure of the course in which the student-authored Scientist Spotlights under study were developed.

How was the LEADS course structured?

The LEADS course was semester-long, upper-division, biology service-learning science course, designed for biology major students interested in collaborating with instructors to promote inclusive teaching in the biology department. Importantly, the course counted as an elective course towards all biology degrees. The 4-unit course included both in-class activities and discussions (2-hour seminar each week), a fieldwork component (meeting with biology instructor partner and student partner each week), and a reflection component (written weekly as submitted homework and discussed during class time). In class, students discussed issues of diversity, equity, and inclusion in science and explored science education literature (e.g., Scientist Spotlights, community cultural wealth models, stereotype threat, and more) and evidence-based science teaching strategies. In addition, the course scaffolded students' research and development to produce 4 Scientist Spotlights over the semester. The majority of homework assignments and class sessions were devoted to Scientist Spotlight development activities, support for partnership with instructors, students' peer-review of one another's draft Scientist Spotlights, and general support and guidance from the LEADS course instructors.

What were the goals of the LEADS course?

- to engage and empower students of color as leaders in departmental transformation efforts
- to develop and integrate curricular materials on the importance of diversity in science into courses
- to expand faculty capacity to implement inclusive, scientific teaching practices

Who were the LEADS biology instructor partners, and what was their role?

The LEADS course fieldwork component consisted of 2 students partnering with a biology course instructor (or team) with whom they would develop relevant Scientist Spotlights to be used to teach biological content in the course. Participating biology instructors were all alumni of previous professional development efforts in evidence-based teaching in the department, which had been attend by >85% of biology instructors (Owens, et al 2018). Instructors were recruited and specific partnerships – based on students' interests and prior course experience – were established by the LEADS course instructors in advance, before the beginning of the semester.

All partner biology instructors attended a LEADS orientation during the third week of the semester where they met their student partners. At this 2-hour orientation, activities focused on setting clear team expectations, getting to know one another, planning for weekly meetings, and brainstorming potential scientists and topics to drive Scientist Spotlight development for the course. Students and faculty then met at least once a week outside of class time to collaborate in the development of 4 Scientist Spotlights per student, which yielded a variety of choices of Spotlights for the instructor to implement. In this first offering of the course, we did not have the capacity to systematically investigate the content of these meetings, though class time was spent debriefing these meetings and supporting students in navigating their partnerships with instructors.

Partner instructor input into the development process was focused generally on the topics for which they wanted Scientist Spotlights they could use for teaching their course content and then review and feedback on draft Scientist Spotlight assignments. LEADS course instructors, not partner biology instructors, provided all other support for students in their research and development process. The student-authored Scientist Spotlights developed were then implemented at the instructors' convenience as written homework assignments in their biology course. The LEADS course concluded in the last week of the semester with a celebratory poster session highlighting the Scientist Spotlights developed in the course, where students, faculty, and university administrators and other stakeholders were invited to celebrate.

How did the development timeline relate to instructor implementation of Scientist Spotlights?
In this very first offering of the LEADS course, there was a delay in implementing Scientist Spotlights until the first set of student-authored Scientist Spotlights had been developed, peer-reviewed, partner instructor reviewed, refined, and finalized. In contrast, instructors now have access to previously developed student-authored Scientist Spotlights, such that implementation can begin immediately, even if new student partners are developing new student-authored Scientist Spotlights or other culturally-responsive assignments and activities for later in the semester.

How can I access the growing collection of student-authored Scientist Spotlights?
Thanks to a National Institutes of Health (NIH) Science Education Partnership Award (SEPA), *The Scientist Spotlights Initiative* now hosts a free and open-access website – www.scientistspotlights.org – where anyone in the world can access the growing collection of student-authored Scientist Spotlights.

Appendix B: Scientists featured in student-authored Scientist Spotlights in each partner course

Two LEADS students each authored 4 Scientist Spotlights for their partner course. The names of the 8 scientists for whom Scientist Spotlights were developed are listed below for each course. Instructors implemented either 3 (Courses B and J) or 4 (Courses C, D, E, F, G, I) of these student-authored Scientist Spotlights – of their choice – as homework assignments over the term. Scientist Spotlights were authored for some scientists by multiple LEADS student authors, which is why they appear in the table below multiple times. Additionally, individuals featured in student-authored Scientist Spotlights who were graduate students or post-doctoral scholars at the time are bolded below.

To access all the Scientist Spotlight assignments in their entirety, please visit: *https://scientistspotlights.org*

Course B	**Course C**	**Course D**	**Course E**	**Course F**	**Course G**	**Course I**	**Course J**
Tanai Cordona	Harold Amos	Bonnie Bassler	Scott Edwards	James Chen	Derek Braun	Maydianne Andrade	Laura Burrus
Mary Jackson	Marciela DeGrace	Carlos J Bustamante	Philip Emagwali	Albert Claude	Carlos D. Bustamante	Isabel Perez Farfante	Aurora Chavez
Ernest Everett Just	Jennifer Doudna	Jay Keasling	Carole Goble	**Alia Edington**	Martha Chase	**Xiaohui Feng**	Pride Chigwedere
Luis Leloir	Angela E. Douglas	**Ari Kozik**	**Ryan Hernandez**	Emmeline Jean Hanson	Barbara McClintock	Dian Fossey	Cynthia Davis
Ruth Smith Lloyd	Terence Hwa	**Adrienne Le**	Ryan Hernandez	George Langford	**Mariela Moreno Ayala**	**Adrienne Le**	Anne Fausto-Sterling
Edith Perez	**Adrienne Le**	Esther Lederberg	Margaret Okomo-Adhiambo	Gia Voeltz	**Cathy Samayoa**	Ynes Mexia	**Violeta Gonzalez**
Sam Pingdewinde	**Adrienne Le**	Cecilia Martinez-Gomez	Victoria Rodrigues	**Jasmine Sims**	Mariel Vasquez	Carlos A. Peres	Bianca Laurano
Sofia Prado-Irwin	Jian Zhou	Margaret Okomo-Adhiambo	**Ryan Winstead**	Shoichiro Tsukita	Nancy Wexler	Johanna Westerdijk	**Bronwyn McHargue**

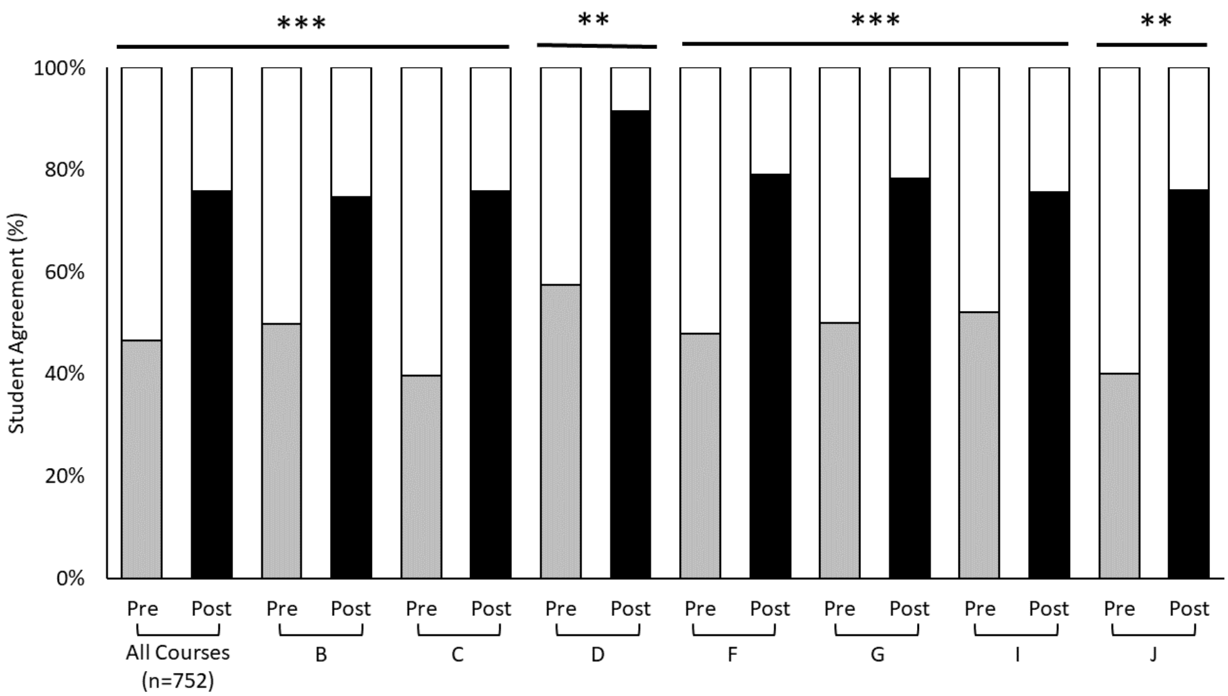
For a specific example, please see the Spotlight for Sam Pingdewinde at: https://scientistspotlights.org/scientist/sam-pingdewinde/

Appendix C: Coding rubric for the stereotypes prompt, *"Describe the types of people who do science"* (adapted from Schinske et al., 2016).

Category	Description	Student Evidence
Positive Stereotype Descriptors	• People that do experiments (hypothesize…) • Curious • Especially Intelligent • Discover Things • Interested in Science/Work • Enjoy Learning • Passionate • Patient/persistent • Good at Subject (i.e., Math/science/physics) • People that investigate the natural world • Make the world better	• *People who do science are people who are curious and have ambition to seek knowledge* • *All scientist asks questions and are ambitious about contributing to science and research.* • *Another characteristic that they have is a love for humanity and living things* • *People that do science are hardworking and do not give up no matter what obstacles come at them* • *The types of people who do science only need to have a curiosity about the world around them, and have a desire to act upon this curiosity*
Negative Stereotype Descriptors	• ONLY…Affluent background (i.e., rich parents, educated family) • ONLY…Dominant Culture (i.e., white) • Asocial/introverted • Mad/crazy • Always reading books (bookworm) • Always working in lab/inside • Scientist is Boring • Overly involved in work • Greedy • Competitive • Always wearing lab coat and goggles • Egotistical	• *[Scientists] spend hours on research. I think that this is because aside from not having the same drive as most scientists do, I think that too often it seems like they are withdrawn from people due to their work* • *People who are always working in solitude* • *I think some scientists argue everyday because they want to prove that their experience or idea is right to each other.* • *One major theme throughout scientists is that is seems to be a male dominated field.* • *In science, there are the passionate ones, and the greedy ones.* • *Overall, this tells me that people that do science are competitive and forget to give credit where it is due.*
Non-Stereotypical Descriptors	• All types of people…do science • No one type of person…does science • Anyone/everyone does science • All/any __[personal characteristic]____________ (e.g., all races, all ages, any gender, etc.)	• *Any race, background, culture, or gender is capable of doing science.* • *Everyone does science even if they aren't a scientist.* • *Women do science. Women of color, who are first generation do science.*

	• Many different ___[personal characteristic]_________ (e.g., many different types of people, many different countries, etc.) • Go against stereotypes/no stereotype • Other non-stereotypical descriptions (i.e., outdoorsy, compassionate, science is done with soul, creative…)	• *All types of people can do science- men, women, transgender, black, white, Mexican, etc... Anyone has the capability to do science.* • *I feel that there are many different people who do science.* • *People who do science … do not let things like stereotypes, skin color, gender, and more stop them* • *Being a scientist does not mean you are the typical stereotype people usually think about*
Stereotypical Scientists	• Albert Einstein • Isaac Newton • Charles Darwin • Sigmund Freud • Thomas Edison • Benjamin Franklin • Leonardo di Vinci • Galileo Gliei • James Watson • Francis Crick	• *These scientists are Thomas Edison, Albert Einstein, Isaac Newton* • *Albert Einstein for example* • *Thomas Edison, Benjamin Franklin, Albert Einstein, Sir Isaac Newton, and many others.* • *there are astronomers who study the stars, planets, and galaxies such as Galileo* • *One scientist that contained both traits was Charles Darwin*
Non-Stereotypical Scientists	• Bill Nye • Family Member/Friend • Marie Curie • Nikola Tesla • Neil deGrasse Tyson • Other non-stereotypical scientist (i.e., Jane Goodall, mythbusters…)	• *Alfred Kinsey was a sickly child from a poor family.* • *A recurring example of people who do science is my professors at SFSU, such as Dr. Pasion, Dr. Knight, and Dr. Burrus [specific professors or teachers]* • *People who do science, the people such as students, grad students, postdocs, and lab employees*

Appendix D: Course-based Disaggregation of Shifts in Relatability

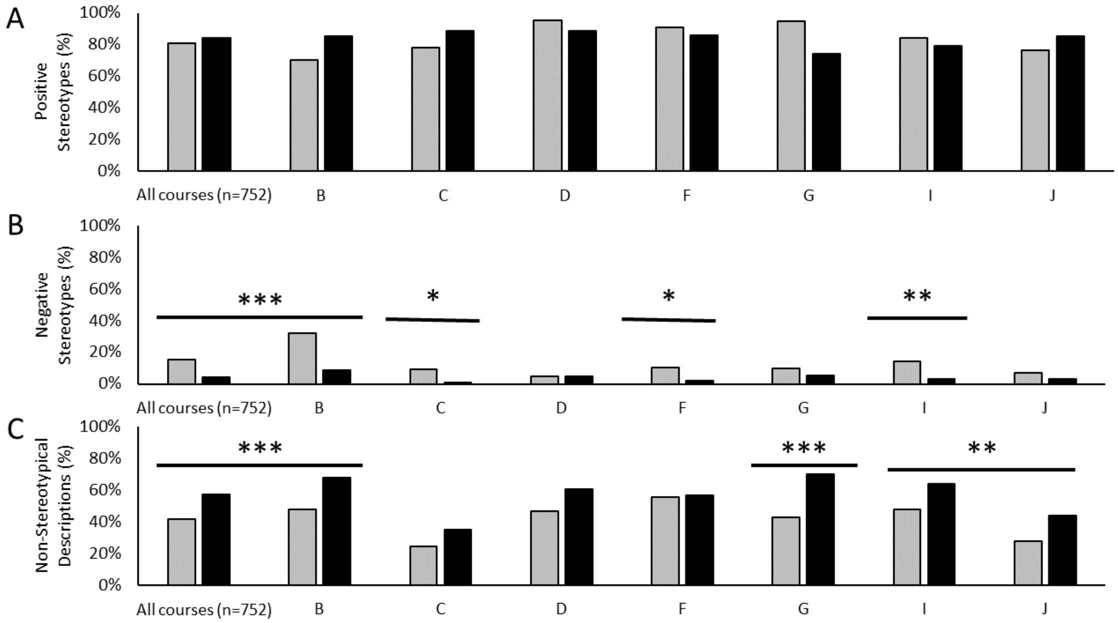


Course-specific analyses of students' relatability to scientists before and after student-authored Scientist Spotlights. Students' pre- and post- agreement to the prompt: *"I know of one or more important scientists to whom I can relate" by* partner course. For pre- data, "Agree" is shown in gray and "Disagree" in white; for post- data, "Agree" is shown in black and "Disagree" in white. While the n-value for all courses (n=752) is shown, individual course sample sizes remain anonymous to protect confidentiality. Pre-post differences are significant at **p<0.01 and ***p<0.001.

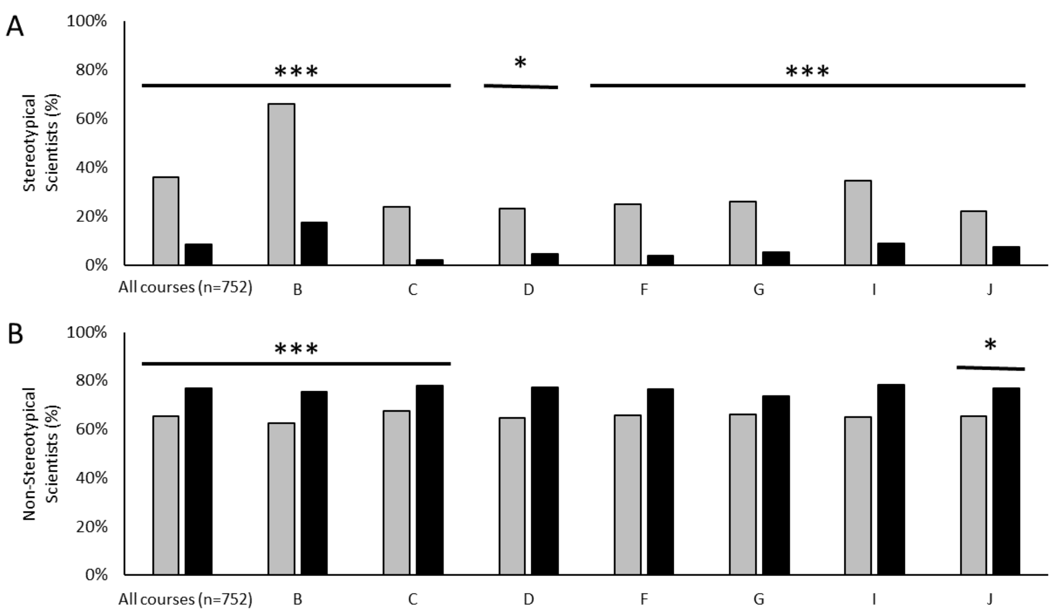
Disaggregation by partner course of enrolled students' shifts in relatability to scientists

	Pre-Assessment Agreement % (n)	**Post-Assessment Agreement % (n)**	**p Value**	**Chi Square Value**
Enrolled students in all Partner Courses	47% (350/752)	76% (570/752)	<0.0001	157
Course B	50%	74%	<0.0001	36.0
Course C	40%	76%	<0.0001	47.5
Course D	56%	91%	0.0099	23.2
Course F	48%	79%	0.0001	35.3
Course G	50%	78%	0.0095	23.4
Course I	53%	75%	<0.0001	40.2
Course J	40%	76%	0.0013	29.0

Appendix E: Course-based Disaggregation of Enrolled Student Responses to Stereotypes



Course-specific analyses of students' descriptions of scientists before and after student-authored Scientist Spotlights. Coding of students' pre- and post- responses to the prompt: *"Describe the types of people who do science"* by course showing proportions of students that expressed (A) positive stereotype descriptors, (B) negative stereotype descriptors, and (C) non-stereotypical descriptors of scientists. Pre- data is shown in gray, and post- data is shown in black. Pre-post differences are significant at *p<0.05, **p<0.01, ***p<0.001.



Course-specific analyses of named scientists offered by students before and after student-authored Scientist Spotlights. Coding of students' pre- and post- responses to the prompt: *"Describe the types of people who do science"* by course showing proportions of students that offered (A) stereotypical scientist names or (B) non-stereotypical scientist names. Pre- data is shown in gray, and post- data is shown in black. Pre-post differences are significant at *p<0.05 and ***p<0.001.

Course-based Disaggregation of Enrolled Student Responses to Stereotypes Prompt (n=752)

Positive Stereotypes	**Pre-Assessment % (n)**	**Post-Assessment % (n)**	**P Value**	**Chi Square Value**
Enrolled students in all partner courses	81% (609/752)	84% (631/752)	0.107	2.60
Course B	70%	86%	0.0002	13.8
Course C	78%	88%	0.025	5.00
Course D	95%	88%	0.257	1.29
Course F	91%	86%	0.275	1.19
Course G	95%	74%	0.0006	11.8
Course I	84%	79%	0.201	1.64
Course J	76%	84%	0.046	4.00
Negative Stereotypes	**Pre-Assessment % (n)**	**Post-Assessment % (n)**	**P Value**	**Chi Square Value**
Enrolled students in all partner courses	15% (113/752)	4.4% (33/752)	<0.0001	54.2
Course B	32%	8.6%	<0.0001	34.6
Course C	9.5%	1.1%	0.011	6.40
Course D	4.7%	4.7%	1	0.00
Course F	10%	2%	0.011	6.40
Course G	9.6%	5.5%	0.366	0.82
Course I	14%	3.3%	0.005	8.05
Course J	6.7%	3.0%	0.096	2.78
Non-Stereotype Descriptions	**Pre-Assessment % (n)**	**Post-Assessment % (n)**	**P Value**	**Chi Square Value**
Enrolled students in all partner courses	42% (313/752)	57% (429/752)	<0.0001	41.0
Course B	48%	67%	<0.0001	16.0

Course C	24%	35%	0.096	2.78
Course D	47%	61%	0.109	2.57
Course F	56%	57%	0.884	0.02
Course G	43%	70%	0.0009	11.1
Course I	48%	64%	0.008	7.08
Course J	28%	43%	0.0028	8.96
Women	41% (215/525)	59% (310/525)	<0.0001	39.7
Men	43% (98/227)	52% (118/227)	0.0412	4.17
URM	43% (133/312)	60% (188/312)	<0.0001	22.1
Non-URM	41% (180/440)	55% (240/440)	<0.0001	19.4
Pell-Eligible	41% (136/332)	59% (197/332)	<0.0001	25.9
Not Pell-Eligible	42% (177/420)	55% (231/420)	<0.0001	17.4
Stereotypical Scientists	**Pre-Assessment % (n)**	**Post-Assessment % (n)**	**P Value**	**Chi Square Value**
Enrolled students in all partner courses	36% (273/752)	8.6% (65/752)	<0.0001	174.0
Course B	66%	17.7%	<0.0001	83.0
Course C	24%	2.1%	<0.0001	17.6
Course D	23%	4.7%	0.011	6.40
Course F	25%	4.0%	<0.0001	17.6
Course G	26%	5.5%	0.0006	11.8
Course I	35%	9.1%	<0.0001	26.0
Course J	22%	7.5%	0.0003	13.3
Non-stereotypical Scientists	**Pre-Assessment % (n)**	**Post-Assessment % (n)**	**P Value**	**Chi Square Value**
Enrolled students in all partner courses	65% (492/752)	77% (579/752)	<0.0001	27.8
Course B	72%	84%	0.0009	11.08
Course C	54%	78%	0.0006	11.8
Course D	63%	79%	0.071	3.27
Course F	68%	74%	0.343	0.90
Course G	67%	71%	0.564	0.33
Course I	70%	72%	0.758	0.10

Course J	59%	75%	0.002	9.80
Women	65% (342/525)	78% (410/525)	<0.0001	26.3
Men	66% (150/227)	74% (167/227)	0.065	3.40
URM	63% (195/312)	75% (234/312)	0.0001	14.6
Non-URM	68% (297/440)	78% (343/440)	0.0002	13.6
Pell-Eligible	65% (215/332)	77% (255/332)	0.0002	13.7
Not Pell-Eligible	66% (277/420)	77% (322/420)	0.0002	14.4

Appendix F: Demographic Disaggregation of Enrolled Student Pre-Assessment Responses to Stereotypes Prompt (n=752)

Women and Men	**Men Pre-Assessment % (n=227)**	**Women Pre-Assessment % (n=525)**	**P Value**	**Chi Square Value**
Positive stereotypes	79% (179)	82% (430)	0.888	0.02
Negative stereotypes	14% (32)	16% (82)	0.369	0.81
Non-stereotype Description	43% (98)	41% (215)	0.258	1.28
Stereotypical Scientist	32% (72)	38% (201)	0.118	2.44
Non-stereotypical Scientist	66% (150)	65% (342)	0.663	0.19
URM Students and Non-URM Students	**URM Pre-Assessment % (n=312)**	**Non-URM Pre-Assessment % (n=440)**	**P Value**	**Chi Square Value**
Positive stereotypes	79% (247)	82% (362)	0.399	0.71
Negative stereotypes	16% (51)	14% (63)	0.952	0.004
Non-stereotype Description	43% (133)	41% (180)	0.373	0.80
Stereotypical Scientist	39% (121)	35% (152)	0.210	1.58
Non-stereotypical Scientist	63% (195)	68% (297)	0.950	0.004
Pell-eligible Students and Non-Pell-eligible Students	**Pell Eligible Pre-Assessment % (n=332)**	**Non-Pell Eligible Pre-Assessment % (n=420)**	**P Value**	**Chi Square Value**
Positive stereotypes	81% (270)	81% (339)	0.256	0.613
Negative stereotypes	17% (57)	14% (57)	0.005	8.02
Non-stereotype Description	41% (136)	42% (177)	0.685	0.165
Stereotypical Scientist	38% (125)	35% (148)	0.020	5.4
Non-stereotypical Scientist	65% (215)	66% (277)	0.408	0.684