ARTICLE
Memphis NeuroSTART Program: Promoting Student Success and Increasing the Diversity of Applicants to Neuroscience Graduate Programs

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With grant support from the Research Experience for Undergraduates (REU) program funded by the National Science Foundation (NSF) and the Awards to Stimulate and Support Undergraduate Research Experiences (ASSURE) program funded by the Department of Defense (DoD) Air Force Office of Scientific Research (AFOSR), we established a program intended to increase the number of underrepresented racial and ethnic minority (URM) and first-generation undergraduate students successfully applying to neuroscience and other STEM-related graduate programs. The Neuroscience Techniques and Research Training (NeuroSTART) Program aimed to increase the number of undergraduate students from the Memphis area involved in behavioral neuroscience research. In this two-semester program, students completed an empirical research project in a neuroscience lab, received individual mentoring from neuroscience faculty, became part of a STEM network, presented at research conferences, and attended specialized professional development seminars.

In two cohorts of 15 students, 4 are PhD students in neuroscience-related programs or in medical school (27%), 4 are employed in neuroscience-related research facilities (27%), 3 are employed as clinical assistants (20%), and 1 is employed in the IT field (7%). The remaining three recently graduated and are planning a gap year prior to applying for admission to graduate/medical school. The Memphis NeuroSTART program has provided valuable training to participants, making them competitive applicants for jobs in the health sciences and for admittance into graduate neuroscience programs. By providing this training to first-generation and URM students, the broader impact of this program was an increase in the diversity of the health sciences workforce, particularly those specializing in neuroscience-related research and treatment.

Key words: underrepresented, minorities, STEM education, neuroscience, first-generation college students, NSF REU, AFOSR ASSURE, research experience, undergraduates

To maximize scientific progress, it is important to welcome contributions from a diverse group of individuals. The journey to achieve a career in Science, Technology, Engineering, and Mathematics (STEM) is often metamorphized as an academic pipeline, with leaks that prevent scientists from reaching their career aspirations (Hinton et al., 2020; Hernandez et al., 2013). The small yet important section of pipe running from the completion of undergraduate education to entry into a STEM graduate program has been identified as a particularly leaky point, especially for students that identify as an underrepresented racial and ethnic minority (URM). In 2021, Black, Hispanic, American Indian, and Alaska Native persons collectively accounted for 37% of the US population aged 18-34 years, and of the graduates that year, these minorities collectively earned 26% of science-related bachelor degrees, 24% of science-related masters degrees, but only 16% of science-related doctoral degrees (National Center for Science and Engineering Statistics, 2023). Regarding neuroscience PhD programs specifically, the latest survey by the Society for Neuroscience indicates that URM students make up only 17% of the applicants and 18% of the accepted offers (SfN, 2017).

We see a similar “leaky pipeline” trend in our Psychology department (which houses the behavioral neuroscience faculty and concentration) at the University of Memphis (UofM), with 58% of our undergraduates identifying as URM, but only 25% of our master’s students and 14% of our experimental psychology PhD students identifying as URM. We have sought funding and implemented a new training program to seal this leak by increasing the number of opportunities for undergraduates to build skills needed for graduate programs and by making these opportunities attainable for students of all backgrounds.

In 2021, we were awarded a Research Experience for Undergraduates (REU) grant funded by National Science Foundation (NSF) and the Department of Defense (DoD) Air Force Office of Scientific Research (AFOSR). The Neuroscience Techniques and Research Training (NeuroSTART) Program aims to increase the number of undergraduate students from the Memphis area involved in behavioral neuroscience research. The program was designed with the overarching goal of increasing the number of competitive URM applicants successfully applying to graduate neuroscience programs, thus ultimately increasing diversity in the neuroscience workforce.

The UofM is the only Carnegie R1, comprehensive doctoral-granting university in West TN and the perfect environment for the NeuroSTART program. Although the NeuroSTART application process is open to any NSF-eligible undergraduate student, the excellent diversity of the region’s four-year colleges - Christian Brothers University (CBU), LeMoyne-Owen College (LOC), Rhodes College (RC), as well as the UofM - makes Memphis an ideal

location for recruiting rising junior and senior URM students.

We previously identified two key obstacles that preclude undergraduate students from actively participating in research. The first is a financial barrier. At CBU, LOC, RC, and the UofM, 93%, 90%, 90%, and 70% of undergraduate students (respectively) receive financial aid, and a substantial percentage are PELL eligible (i.e., high financial need). Many students work 20 or more hours/week during the academic year to support themselves. Thus, many undergraduates lack the time to commit to research. Absent meaningful research experience and a resultant limited skill set combine to make these undergraduate students less competitive during the graduate application process.

The second barrier is limited knowledge about research opportunities and careers. At CBU, LOC, RC, and the UofM, 36%, 49%, 12% and 32% of students (respectively) are first-generation. The professional network of first-generation students is typically less extensive than that of students who are not first-generation (Terenzini et al., 1996; Pascarella et al., 2004). As such, first-generation students tend to be more socially isolated making it less likely they will seek out mentoring. All of this serves to limit their awareness of and opportunities to participate in career-advancing experiences, which also makes them less competitive graduate school applicants.

To overcome the financial barrier, NeuroSTART students receive a monthly stipend while in the program. This alleviates the need for them to have additional employment and ensures they can commit the time necessary to fully participate in the program (10-15 hrs/week). NeuroSTART students are fully integrated into neuroscience research on campus as they interact with other neuroscience faculty, graduate students, technicians, and undergraduate research assistants. While working as part of a team, this promotes self-efficacy, a sense of belonging, and a supportive scientific network. All three of these affective factors have been shown to influence the retention and success of URM UG students transitioning into scientific graduate programs (Trujillo et al., 2014; Byars-Winston et al., 2016).

We have completed our first 2.5 years of the NeuroSTART program and review the goals and outcomes here. By promoting scientific literacy, engaging participants in hands-on research experience and technical skills training, and providing additional opportunities for professional development and networking to first-generation and URM students, the broader impact of the NeuroSTART program is an increase in the diversity of the health sciences workforce, particularly those specializing in neuroscience-related research and treatment.

PROGRAM DESCRIPTION

Participant Recruitment and Demographics

We advertised the program to rising juniors and seniors from CBU, LOC, Rhodes College, the UofM. In our first 3 years (2021-2023), we received 145 completed applications with representation from all the aforementioned colleges/universities. Of the 145 completed applications, 8 were determined not to be eligible because the applicant was not a citizen or permanent resident of the US. The remaining applicant pool (n = 137) was extremely diverse, with 34.3% of participants identifying as White, 32.8% as Black, 11.7% as Hispanic, 10.2% of mixed race/ethnicity, 8.2% as Asian, 2.2% as American Indian, and 1.5% as Native Hawaiian or Other Pacific Islander. An additional 10.9% identified as Other (i.e., race/ethnicity not listed). The applicant pool was heavily female (75.2%) and consisted of a large number of first-generation college students (40.9%).

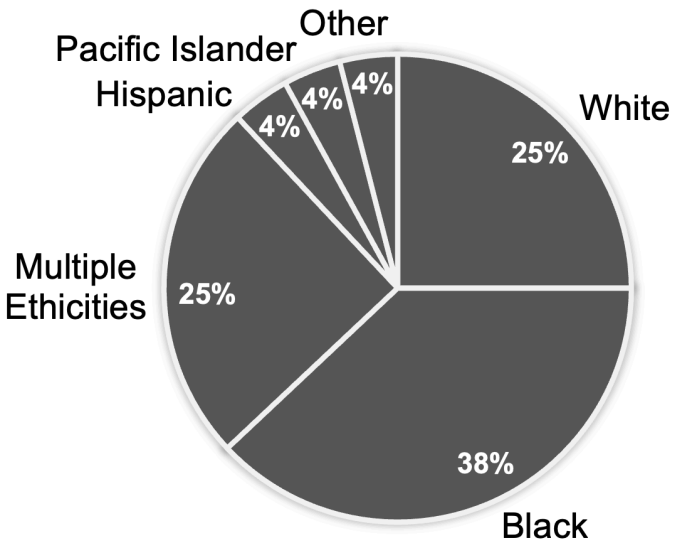

Figure 1. Ethnic/racial distribution of the first three NeuroSTART cohorts.

We accepted 24 (8/year) of the 137 completed and eligible applications (2.9%). None of the applicants that we accepted had research experience outside of course assignments. Of the 24 participants that were accepted, 18 (75%) identified as a URM (i.e, 9 Black, 6 of mixed ethnicity/race, 1 Hispanic, 1 Native Hawaiian or Other Pacific Islander, and 1 Other) (Figure 1). Sixteen (67%) participants identified as female, and 8 (33%) identified as male. Fifteen (63%) participants were first-generation college students. Twelve (50%) were rising juniors, and 12 (50%) were rising seniors. Thirteen participants (54%) were *not* from the UofM (i.e., 6 from CBU, 5 from Rhodes, and 2 from LOC). One participant submitted his resignation half-way through the program. This student had decided to change his major and pursue a different career path (not in neuroscience), and therefore felt his time was better spent elsewhere.

Student Activities and Milestones

Research

Undergraduate students who have participated in research have shown more interest in pursuing a science-related career and in obtaining a PhD (Byars-Winston et al., 2016). Furthermore, PhD programs expect research experience from promising applicants. According to a survey of Neuroscience Departments and Programs by the Society for Neuroscience (McKinley Advisors, 2017), 98% of PhD graduate program applicants had undergraduate research experience. The NeuroSTART Program provides students

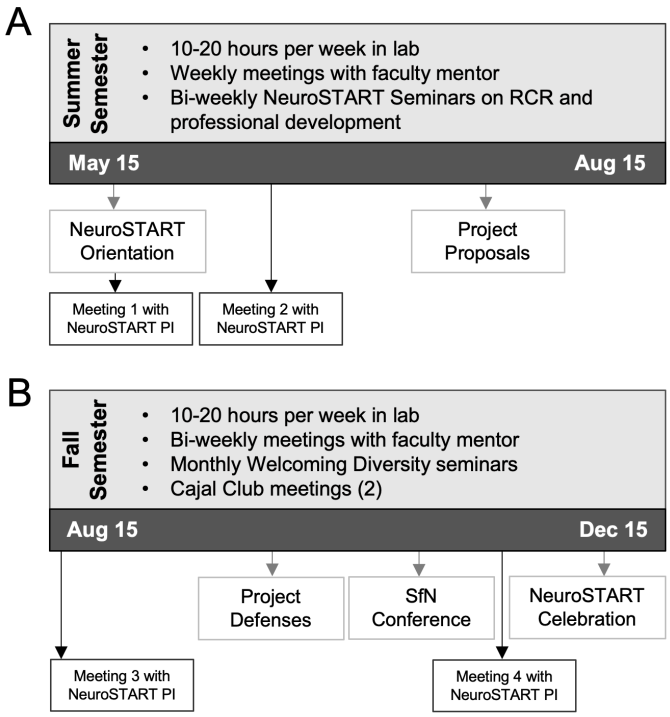

Figure 2. Timeline of the NeuroSTART student activities during the summer *(A)* and fall *(B)* semesters.

with a quality, hands-on, extensive research experience. Over the course of two semesters, participants are trained in a lab and complete an empirical project, enabling them to become an integrated member of a lab with an active role in experimental design, data collection and analyses, and communication of findings. In this way, the research experiences of the NeuroSTART Program participants stand out from less intensive, observational, and course-related research experiences.

The NeuroSTART program consists of 4 faculty mentors who regularly teach undergraduate courses and run independent neuroscience research labs. These mentors have strong track records of mentoring undergraduatesthrough thesis projects and guiding students through the process of entering graduate programs.

NeuroSTART students are matched with their preferred neuroscience faculty mentor based on their research interests and career goals. Students are expected to work ~10-15 hours per week in their assigned lab and are financially compensated with a stipend of $1200 per month. Figure 2 outlines the timeline of student activities.

Orientation

The NeuroSTART Orientation serves as a welcome event, giving participants the opportunity to meet one another as well as the neuroscience faculty. The NeuroSTART PI and Co-PI (Drs. Sable and Lester, respectively) host the event and invite the Provost and/or the Dean of the College of Arts and Sciences to address and welcome the students. The orientation includes sessions lead by the following speakers: the campus veterinarian to outline Institutional Animal Care and Use (IACUC) procedures, a specialist from the Office of Environmental Health and Safety to discuss lab safety procedures, a staff member from the Office of Institutional Equity to review expectations and campus procedures, and UofM Librarian Assistant to explain how to access research databases and journals. The orientation concludes with a tour of the neuroscience research labs and UofM animal colonies.

One-On-One Meetings

To ensure that students are gaining the desired experiences and skills in the program, participants meet one-on-one with the NeuroSTART Co-PI at least four times during the 7-month program. First, an initial individual meeting following the NeuroSTART Orientation allows the Co-PIs to address any concerns or questions the participants may have about program expectations. A follow-up meeting takes place approximately one month later to confirm successful lab placements from the student perspective. The third meeting takes place at the conclusion of the summer semester (midway through the NeuroSTART Program) to ensure that the student is progressing at the expected rate in their research training. The final meeting takes place at the conclusion of the fall semester (end of the NeuroSTART Program) to provide and receive program feedback and establish a plan for future communications and mentoring support. During meetings with the Co-PIs, program participants also create and monitor progress of an Individual Development Plan. The Individual Development Plans include descriptions of career goals (10-15 year projection), long-term goals (5-10 years), short-term goals (1-2 years), and semester goals (summer and fall). The skills and qualifications needed to successfully reach each goal are noted, as well as experiences that aid in attaining the necessary skills. Skills and competencies are listed under the following categories: research and technical skills, professional and interpersonal skills, and management and leadership skills. The NeuroSTART Co-PI also helps each participant identify allies/mentors to support their plans and recommend assessments such as mastery of coursework, mentor feedback, and/or successful lab work used to determine progress.

Although participants interact with their faculty mentors frequently, sometimes daily, in the lab, faculty mentors individually meet with participants weekly to maintain consistent communication and personalized training throughout both summer and fall semesters.

Student Project Proposals and Defenses

NeuroSTART Students conduct an independent research project, ensuring active engagement in neuroscience and the establishment of a science identity. With the help of faculty mentors, participants formulate a hypothesis and determine an appropriate experimental design. Before the end of the third month, NeuroSTART participants propose their projects by completing a written report and oral presentation. After collecting and analyzing data, students defend their projects at the end of October by completing another written report and oral presentation. Their papers are reviewed by their faculty mentor and the program PIs, and all NeuroSTART participants and other student researchers from the labs attend the project presentations.

In this way, students receive ample feedback and gain the confidence to present their findings at conferences.

Researchers have identified three base components for establishing science identity in students, specifically URMs: scientific competence, performance, and recognition (Carlone and Johnson, 2007). The completion of an empirical project covers these components for the NeuroSTART participants: competence in the background literature (project proposal and research design), performance of relevant scientific practices (application of research techniques and engagement in scientific communication), and recognition from mentors and peers (project presentations). The student presentations are commonly referred to as the participants' favorite NeuroSTART events.

Research Conference Participation

All NeuroSTART students present their findings at a research conference, usually multiple conferences. Students have presented at local conferences (through CBU, LOC, RC, or the UofM) and regional conferences (such as the Midsouth Psychology Conference). Students also receive travel funds to attend and present at either the international Society for Neuroscience Conference or the National Conference for Undergraduate Research (NCUR). These trips have been extremely successful for the students in that they received expert feedback on their projects, expanded their scientific networks, and further solidified their role as a neuroscientist. Although regular abstracts for the Society for Neuroscience Conference are due in June (too early for NeuroSTART students to have data), NeuroSTART students can independently present their project findings at the conference via the undergraduate poster session sponsored by the Faculty for Undergraduate Neuroscience (FUN). The FUN poster session is a heavily attended event, with an encouraging atmosphere for undergraduates.

Neurostart Seminars

Engaging in science-related activities outside the classroom improves the likelihood of students adopting a science identity (Chemers et al., 2011). As NeuroSTART participants progress through the activities and milestones of the program, they are gradually immersed into a diverse and supportive network of faculty and students. The NeuroSTART Seminars, which are organized by the PIs, facilitate this process more than any of the other activities outside the lab. Students gather to discuss topics of responsible conduct of research (RCR) and engage in other activities that promote professional development. The RCR seminars address mistakes versus negligence, rigor, IRB/IACUC compliance, authorship, intellectual property, and conflicts of interest. The professional development seminars are designed to provide broad examples of science-based careers, help with CV construction, and assist the students in applying for post-baccalaureate and graduate school applications and prepare for interviews.

The NeuroSTART seminars occur biweekly during the months of May, June, July, and August and bi-monthly September – December. We frontload these meetings to foster student relationships sooner and capitalize on the flexibility of students' summer schedules.

In the fall semester, NeuroSTART participants are required to attend the Cajal Club (held twice a semester for the entire UofM Neuroscience community) and encouraged to attend a "Welcoming Diversity Forum" held monthly. The Cajal Club is intended to be a fun and educational way to promote unity among the neuroscience faculty and students. Meetings include things like lab tours, data blitzes, practice poster sessions, outside invited speakers, "hot off the press" journal article reviews, etc. The Welcoming Diversity Forum is for faculty, graduate students, and undergraduate students across schools and departments. This seminar series aims to create a setting where students and faculty can engage in dialogue and continued education surrounding topics of diversity as they relate to current events, community climate, and interdisciplinary relations.

Science identity, or conceptualizing oneself as a scientist, also influences retention in the sciences (Carbajal, 2015; Carlone and Johnson, 2007; Trujillo et al., 2014). Engaging in science-related activities (like research) outside the typical classroom improves the likelihood that students will assume a science identity (Chemers et al., 2011) perhaps because such events promote a "neuroscience-community" that ties back in to a sense of belonging. Undergraduates are often advised to interact with faculty and "network". However, studies have found that URM undergraduates feel invisible to faculty and that these feelings often preclude URM students from actively interacting with faculty (Ahmad et al., 2019; Suarez-Balcazar et al., 2003). As the NeuroSTART participants progress through the program, the program activities allow them to become immersed into a diverse and supportive network of faculty and students.

Assessments

We evaluated student matriculation during the 7-month program (i.e., completing activities and research project milestones) and the effectiveness of the mentorship being provided. By evaluating the content of the participants' Individualized Development Plans, we track student progress and ensure they are participating in program activities and making adequate research progress. If it appears a student is not making good progress, we identify the area of need and refer the student to the appropriate resource on campus (e.g., counseling, writing center, etc.) that can provide additional support. Data from a modified version of the Student Research Skills Comparison (SRSC) is collected to evaluate how the research ability of each participant has developed (Cox and Androit, 2009). Because the SRSC is completed by both the mentor and the student, we can look at overall score as well as agreement among the two ratings as an indirect measure of mentorship integrity. In cases where individual mentor-student scores are not highly correlated, the PI met separately with the faculty mentor and student to directly discuss the discrepancy. Specific plans for improvement were added to that student's IDP and shared with that student's mentor. Lastly, we also ask program participants about the quality of

	Faculty rating		Student rating		|(Faculty-Student)|‡		% That Chose Agree	
I am confident in the student's/my* ability to:	**Mean**	**SEM**	**Mean**	**SEM**	**Mean**	**SEM**	**Faculty**	**Student**
Learn neuroscience laboratory techniques.	4.00	0.00	4.00	0.00	0.00	0.00	100.00	100.00
Apply critical thinking and problem-solving skills in an authentic research experience.	3.87	0.09	3.87	0.09	0.13	0.09	86.67	86.67
Analyze data using statistics.	3.07	0.15	3.60	0.13	0.67	0.16	20.00	60.00
Incorporate the scientific method.	3.87	0.09	3.93	0.07	0.20	0.11	86.67	93.33
Learn new software packages.	4.00	0.10	3.60	0.21	0.40	0.27	86.67	73.33
Learn contemporary concepts in the research area being studied.	3.93	0.07	3.93	0.07	0.13	0.09	93.33	93.33
Frame a specific research question.	3.80	0.14	3.80	0.11	0.40	0.16	86.67	80.00
Formulate a research hypothesis based on a scientific question.	3.87	0.09	3.93	0.07	0.20	0.11	86.67	93.33
Design an experiment to test a hypothesis.	3.65	0.16	3.60	0.13	0.45	0.16	66.67	60.00
Observe and collect data.	4.00	0.00	3.93	0.07	0.07	0.07	100.00	93.33
Interpret data by relating results to the original hypothesis.	3.80	0.11	3.93	0.07	0.13	0.09	80.00	93.33
Understand the ethical implications of the research being done.	4.00	0.00	4.00	0.00	0.00	0.00	100.00	100.00
Relate research to the “bigger” picture within the research area being studied.	3.87	0.13	3.93	0.07	0.20	0.14	93.33	93.33
Retrieve information from the library and internet.	4.00	0.00	3.87	0.09	0.13	0.09	100.00	86.67
Present technical work effectively.	3.80	0.14	3.80	0.11	0.40	0.16	86.67	80.00
Explain technical work to someone who is not a scientist.	3.87	0.09	3.80	0.11	0.20	0.11	86.67	80.00
Write a scholarly article for publication.	3.13	0.17	3.47	0.13	0.60	0.16	26.67	46.67
Work effectively with others on a team.	3.93	0.07	4.00	0.00	0.07	0.07	93.33	100.00
Relate well to people of different races, cultures, or backgrounds.	4.00	0.00	3.93	0.07	0.07	0.07	100.00	93.33
Relate well to people of different races, cultures, or backgrounds.	3.93	0.07	4.00	0.00	0.07	0.07	93.33	100.00

Note. * Student version - my; Mentor version= student's

1 = Disagree, 2 = Slightly Disagree, 3 = Slightly Agree, 4 = Agree

‡Absolute value of difference between faculty - student ratings

Table 1. End of Program Results for Student Research Skills Comparison (SRSC, N=15).

their mentoring experience using a modified version of a mentorship survey developed by the Assessing Women and Men in Engineering Project (2010).

To measure the affective factors that have been shown to influence the retention and success of URM undergraduate students transitioning into scientific graduate programs, we employ a modified version of the self-efficacy subscale of the Motivational Strategies and Learning Questionnaire (MSLQ) (Pintrich et al., 1991), modified survey items related to sense of belonging in neuroscience (BIN) (Stout et al., 2013), and modified items from the Science Identity Scale (SIS) (Chemers et al., 2011).

To assess our overall goal of promoting educational advancement for these students, each May we send a brief survey to former participants. After asking for current contactin formation, the questions are open-ended asking for details about 1) current educational or employment status, 2) plans for future education or employment, and 3) aspects of the NeuroSTART program could be improved to better facilitate transition to graduate neuroscience programs.

RESULTS

Student Skills

We asked student participants and mentors from our first two cohorts to evaluate the research ability of each participant using the Student Research Skills Comparison (SCRC) at the end of the 7-month training period (Cox and Androit, 2009) (Table 1). Faculty and students generally had positive consensus on students' research abilities, except for confidence in ability to *analyze data using statistics* and *write scholarly articles for publication* (i.e., faculty rating < student rating). Notably, mastery of these skills typically requires additional education and training beyond the baccalaureate level. For all of the students, this was the first time they had conducted data analyses and written research manuscripts outside of a structured class environment, the latter of which typically included very detailed instructions for completing such assignments. This lack of experience in research design/analysis was also evident when asked to rate confidence in the student's ability to *design an experiment to test a hypothesis.* Consensus between the faculty and student ratings on this item was high, but the percent agreeing with this statement was relatively low (faculty = 66.67%, student = 60.00%) compared to other items.

Both faculty and students were in 100% agreement about confidence in the student's ability *to learn neuroscience techniques* and understand *the ethical implications of the research being done*. Students had considerable hands-on experience conducting research in the laboratories of their mentors, which allowed them to expand their technical skill set. The latter outcome regarding research ethics was likely influenced by students' attendance at RCR seminars that were a required part of the program. Other items that demonstrated a high percentage (i.e., $\geq$ 93.33%) of faculty and students that choose agree included confidence in the student's ability to *learn contemporary concepts in the research area being studied and relate research to the "bigger" picture within the research area being studied.* Students were required to explain the core concepts that were part of their research project and explain the broader implications of their findings in the poster they presented at a national research conference, and again in their final written manuscript. The items asking about the student's ability to *work effectively with others on a team,* and *relate well to people of different races, cultures, or backgrounds* also had a high percentage (i.e., $\geq$ 93.33%) of faculty and students that choose agree. The student participants were fully integrated into the labs of their mentors. They received assistance not only on their own project but were able to contribute to other lab activities being conducted by a diverse group of other graduate and undergraduate students in the lab.

Mentorship

We also asked participants about the nature and quality of their mentoring experience half-way through, and at the end of the program, using the mentorship survey developed by the Assessing Women and Men in Engineering Project (AWE, 2010). At mid-program, face-to-face contact was the most common form of mentor-mentee interaction, followed by contact via email. By program end, these contact methods were still the most common, although the gap between them narrowed such that they were equally utilized. See Table 2 (top) for means ± SEMs and supplemental Figure 1 for the frequency distribution. In-person contact was strongly promoted by the program organizers, so this was a favorable outcome. Email was used to clarify instructions, send data and results, and share paper drafts. Communication by phone was the least common form of contact. Anecdotal evidence indicated the mentees did not prefer to engage in professional communication on the telephone, instead opting for email or text, because they could edit the dialogue before delivering it.

The ratings of mentorship satisfaction were high (i.e., $\geq$3.73/4.00) both at mid-program and at the program's end in 6 of the 7 areas assessed: *ability to get answers to questions about the program, ability to get answers to questions about neuroscience careers, primary mentor's ability to create an ongoing relationship, quality of program mentoring activities, satisfaction with primary mentor,* and *satisfaction with all aspects of the program.* See Table 2 (bottom) for means ± SEMs and supplemental Figure 2 for the frequency distribution of scores. The lowest ratings of satisfaction were for *opportunities for contract with other mentees in the program* (mid-program = 3.47/4.00; end of program = 3.60/4.00). Notably, these data were collected in the midst of the Covid-19 pandemic when social distancing was in place, so some of the inclusive group events had to be cancelled or moved online.

Affective Factors

Lastly, we surveyed participants on the affective factors of self-efficacy (Pintrich et al., 1991), sense of belonging (Stout et al., 2013), and science identity score (Chemers et al., 2011) at the start and end of the 7-month training period. A summary of these results is presented in Table 3 and frequency distributions across these three affective factors are included as Supplemental Figures 3-5, respectively.

Since the beginning of the semester, approximately how often have you:	Mid-Program* Mean	Mid-Program* SEM	End Program* Mean	End Program* SEM
Been in face-to-face contact with your primary mentor?	4.87	0.09	4.57	0.30
Been in contact with your primary mentor by phone?	2.13	0.39	3.00	0.62
Been in contact with your primary mentor by email?	4.00	0.29	4.57	0.20
Been in contact with your primary mentor by instant messenger or text?	2.73	0.47	3.43	0.53
Been in contact with your primary mentor at a NeuroSTART sponsored activity?	3.27	0.38	3.86	0.40

How satisfied or dissatisfied are you with each of the items below?	Mid-Program§ Mean	Mid-Program§ SEM	End Program§ Mean	End Program§ SEM
The ability to get answers to your questions about the NeuroSTART program.	3.80	0.11	3.86	0.14
The ability to get answers to your questions about neuroscience careers.	3.87	0.13	3.71	0.18
Your primary mentor's ability to create an ongoing relationship.	3.80	0.11	3.71	0.18
The opportunities for contact with other mentees in the NeuroSTART program.	3.47	0.13	3.71	0.18
The quality of the mentoring program activities.	3.73	0.12	3.71	0.18
Your overall satisfaction with your primary mentor.	3.87	0.09	3.86	0.14
Your overall satisfaction with all aspects of the NeuroSTART program.	3.73	0.12	3.86	0.14

Note. * 1 = Not al all, 2 = Once, 3 = 2-4 times, 4 = 5-7 times, 5 = 8 or more times

§1 = Very dissatisfied, 2 = Somewhat dissatisfied, 3 = Satisfied, 4 = Very satisfied

Table 2. Assessment of Mentorship Quality (n-15).

Overall, the self-efficacy and sense of belonging scores were higher than the science identity scores, but sizeable gains from program start to end were found for the science identity scores. More specific detail about the results for each of these affective factors is presented below.

Self-Efficacy

Students began the program confident in their ability to learn and do well as the ratings on all six self-efficacy items were ≥ 3.47/4.00. Ninety-three percent of students chose "agree" at both the start and end of the program when asked if they were *confident they could learn/learned the basic concepts taught as part of the neuroscience training*, and if they *expected to do/did well in the program.* The biggest improvement in self-efficacy from start to end (increase = .20) was observed for the item that read, "*I am certain I can/was able to master the skills being taught as part of my neuroscience training*." Eighty percent of participants reported "agree" for this question by the end of the program, representing an increase of 13% from program start. By the program's end, only 60% of participants reported "agree" to the item that read, "*I am confident I understood the most complex material presented as part of my neuroscience training*." Likewise, only 67% reported "agree" for the item that read, "*I am confident I did an excellent job on the activities and milestones that were part of my neuroscience training*," which represented a 13% drop from the percentage of participants that agreed to the future tense of this statement presented at the start of the program. Based on informal conversations with program participants, we believe these latter two ratings are indicative of the fact that participants recognize that they still have a lot more to learn.

Sense of Belonging

At the end of the program, 93% of participants reported "agree" to the item that read, "*I see the value of neuroscience in my everyday life,"* which was a 13% increase from the start. In addition, 84.52% agreed with the item that read, "*People in neuroscience accept me,"* which was an increase of 15.38% from program, start. Only 7% of participants reported "agree" to the item that read, "*I feel like an outsider in neuroscience,"* at program end, with 40% disagreeing with this statement. This represented the biggest change from start to end of the program (i.e., 13% less agreement and 33% more disagreement). Surprisingly, the average score for the statement, "*I feel like I belong in neuroscience,"* decreased from the start to the end of the program, which corresponded to a drop in agreement of 13%. Thus, while participants saw value in the field and did not feel like they were being excluded, they didn't necessarily feel like they fully "fit into" the field either.

Science Identity Score

As previously mentioned, the scores on this assessment were lower, suggesting that efforts to enhance this affective factor may require more attention. Still, substantial gains

	Start of Program		Program End		Difference (End-Start)		At Program Start		At Program End		Difference (End-Start)	
Self-efficacy (SE)	**Mean**	**SEM**	**Mean**	**SEM**	**Mean**	**SEM**	**% Agree**	**%Disagree**	**% Agree**	**%Disagree**	**% Agree**	**%Disagree**
I am confident I [can learn/learned] the basic concepts taught as part of my neuroscience training.	3.87	0.13	3.93	0.79	0.07	0.15	93.33	0.00	93.33	0.00	0.00	0.00
I am confident I [can understand/understood] the most complex material presented as part of my neuroscience training.	3.47	0.17	3.47	1.00	0.00	0.28	53.33	0.00	60.00	6.67	6.67	6.67
I am confident I [can do/did] an excellent job on the activities and milestones that are part of my neuroscience training.	3.73	0.15	3.67	0.88	-0.07	0.18	80.00	0.00	66.67	0.00	-13.33	0.00
I [expect to do/did] well in the NeuroSTART program.	3.93	0.07	3.93	0.79	0.00	0.10	93.33	0.00	93.33	0.00	0.00	0.00
I am certain I [can/was able to] master the skills being taught as part of my neuroscience training.	3.60	0.16	3.80	0.87	0.20	0.20	66.67	0.00	80.00	0.00	13.33	0.00
Considering the difficulty of the NeuroSTART program, the instructors, and my skills, I think I will do/have done well in the NeuroSTART program.	3.73	0.15	3.87	0.81	0.13	0.19	80.00	0.00	86.67	0.00	6.67	0.00
	Start of Program		**Program End**		**Difference (End-Start)**		**At Program Start**		**At Program End**		**Difference (End-Start)**	
Sense of Belonging (SB)	**Mean**	**SEM**	**Mean**	**SEM**	**Mean**	**SEM**	**% Agree**	**%Disagree**	**% Agree**	**%Disagree**	**% Agree**	**%Disagree**
I feel like I belong in neuroscience.	3.67	0.13	3.40	1.07	-0.27	0.21	66.67	0.00	53.33	6.67	-13.33	6.67
People in neuroscience accept me.	3.62	0.36	3.85	1.50	0.25	0.13	69.23	0.00	84.62	0.00	15.38	0.00
I feel like an outsider in neuroscience (*REVERSE SCORED*).	*2.53*	*0.24*	*1.73*	*0.51*	*-0.80*	*0.20*	20.00	6.67	*6.67*	*40.00*	*-13.33*	*33.33*
I see the value of neuroscience in my everyday life.	3.67	0.21	3.93	0.79	0.27	0.23	80.00	6.67	93.33	0.00	13.33	-6.67
	Start of Program		**Program End**		**Difference (End-Start)**		**At Program Start**		**At Program End**		**Difference (End-Start)**	
Science Identity Score (SIS)	**Mean**	**SEM**	**Mean**	**SEM**	**Mean**	**SEM**	**% Agree**	**%Disagree**	**% Agree**	**%Disagree**	**% Agree**	**%Disagree**
Being a neuroscientist is an important reflection of who I am.	3.07	0.26	3.21	1.27	0.14	0.18	21.43	0.00	35.71	7.14	14.29	7.14
I think of myself as a "neuroscientist."	2.57	0.34	3.00	1.35	0.31	0.26	21.43	28.57	35.71	14.29	14.29	-14.29
I am a neuroscientist.	2.46	0.35	3.07	1.34	0.62	0.21	15.38	30.77	35.71	14.29	20.33	-16.48
In general, being a neuroscientist is an important part of my self-image.	3.38	0.36	3.43	1.36	0.23	0.20	53.85	0.00	64.29	7.14	10.44	7.14
Having more people with my background in the field makes me feel more like a neuroscientist.	3.67	0.13	3.69	1.51	-0.08	0.13	71.43	0.00	76.92	0.00	5.49	0.00

Note. 1 = Disagree, 2 = Slightly Disagree, 3 = Slightly Agree, 4 = Agree

Table 3. Assessment of Affective Factors Promoting Success and Retention in the Sciences (n-15).

were made. By program end, only 36% of participants reported "agree" to the item that stated, "*Being a Neuroscientist is an important reflection of who I am,"* but this represented an 14% increase of students who agreed with this statement since the start of the program. Likewise, 36% of participants also reported "agree" to the items *I think of myself as a neuroscientist* and *I am a neuroscientist* at program end, but this represented gains of 14% and 20%, respectively, of students who agreed with these statements compared to program start. In addition, the percentage of participants disagreeing with these statements decreased by 14% and 15%, respectively, since program start. Lastly, at program end, 77% of participants reported "agree" and 0% of participants reported "disagree" to the item that read, "*Having more people with my background in the field makes me feel more like a neuroscientist*," which reinforces that strong diversity representation in neuroscience promotes science identity.

Student Publications and Presentations

Two NeuroSTART students have received authorship on peer-reviewed publications, with additional manuscripts with NeuroSTART authors in preparation. All NeuroSTART alumni have presented at a national research conference, often multiple conferences. Students have been presenters on posters at the Society for Neuroscience Conference (18 posters), the National Conference for Undergraduate Research (NCUR; 4 posters), the Developmental Neurotoxicology Society Conference (1 poster), and Society for Psychophysiological Research Conference (1 poster).

Educational and Career Advancement of Participants

Of the 15 NeuroSTART alumni that have completed the program so far, 3 students (all of whom are first-generation, and two of whom are URM) have been admitted to PhD programs – two in Neuroscience and the other in Genetics, Genomics, and Informatics. One URM student was admitted to medical school. Two NeuroSTART alumni (one who is both first gen and an URM) are completing post-baccalaureate programs. Six students (all of whom are URM and 5 who are first-gen) opted to take a gap year to obtain more experience prior to applying to graduate school in clinical psychology or neuroscience, or prior to applying to medical school. Three of these are working as medical receptionists, and the other three just graduated and are currently seeking employment. One alumna who is both an URM and first-gen is employed full-time as a clinical assistant. Lastly, the final two alumni (both of whom are URM, with one also first-gen) are gainfully employed as a quality assurance operations interns at Charles River Laboratories and as an information technology recruiter at Acumen Technology.

CONCLUSIONS AND FUTURE DIRECTIONS

The Memphis NeuroSTART Program is an example of using the NSF REU grant mechanism to establish an intensive research training and professional development opportunity for undergraduates from multiple institutions. We have recently applied for a grant renewal, with the hopes of continuing the program and making a few adjustments based on the experience of our first three years. We hope to increase the number of participants from 8 to 10 and to include 2 additional neuroscience faculty mentors (which would bring the total to 6). This expansion is warranted based on our large and diverse applicant pool, and the additional faculty broaden the variety of research methods and neuroscience topics available for NeuroSTART students. In our experience, the NSF REU has been an excellent mechanism for compensating URM and first-generation undergraduates for research contributions to on-going projects. The Memphis NeuroSTART Program has been successful in transitioning students to neuroscience-related PhD programs, but also preparing students for applying to medical school, and for securing neuroscience-related employment after earning their bachelors' degrees. By promoting scientific literacy, engaging participants in hands-on research experience and technical skills training, and providing additional opportunities for professional development and networking to first-generation and URM students, the broader impact of the NeuroSTART program is an increase in the diversity of the health sciences workforce, particularly those specializing in neuroscience-related research and treatment.

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