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Undergraduate Neuroscience Education in the U.S.: Quantitative Comparisons of Programs and Graduates in the Broader Context of Undergraduate Life Sciences Education

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The impact of undergraduate neuroscience programs on the broader landscape of life sciences education has not been described. Using data from the National Center for Education Statistics, we found that the number of undergraduate neuroscience programs in the U.S. continues to grow. Within any given institution, neuroscience programs exist alongside a small number of other life sciences undergraduate programs, suggesting that neuroscience is one of few major options from which students can choose from at many institutions. Neuroscience majors constitute a substantial proportion of

all life sciences graduates at many institutions, and in several cases, neuroscience majors were the majority of life sciences graduates. Thus, neuroscience programs contribute substantially to life sciences education, and neuroscience is a highly attractive major among undergraduate students where these programs are available. These data have implications for institutions with existing neuroscience programs as well as for institutions seeking to establish a new program.

Key words: undergraduate neuroscience majors; life sciences majors

Both the number of colleges and universities with undergraduate neuroscience programs as well as the number of graduates from these programs indicate their continued growth in the U.S. (Ramos et al., 2011). However, the effects that new neuroscience programs and associated majors have at the departmental and institutional level have never been examined and remain poorly understood. For example, one prediction from these trends in undergraduate neuroscience education is that the establishment of a new neuroscience program may result in fewer numbers of majors in other pre-existing programs. However, the number of undergraduate neuroscience majors/graduates relative to other majors in life sciences has not been quantitatively examined.

With these open questions in mind, we use quantitative data to demonstrate that institutions with undergraduate neuroscience programs generally only offer 1-3 additional undergraduate life sciences programs. Neuroscience majors constitute a significant portion of graduates at these colleges and universities relative to other well-established majors such as biology, biochemistry and molecular biology. Remarkably, neuroscience majors are the most numerous of all life sciences graduates at several institutions. Taken together, these data provide a better understanding of the colleges and universities that have undergraduate neuroscience programs and further demonstrate the increasing popularity of undergraduate neuroscience programs. Our results have important implications for institutions considering developing a neuroscience program as well as institutions with existing programs.

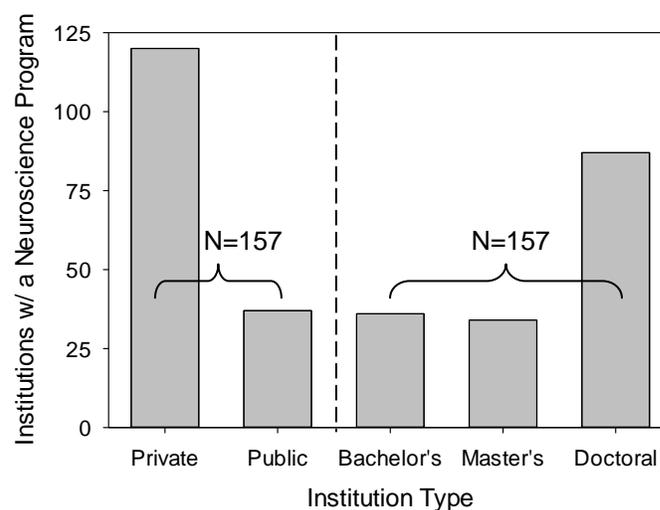


Figure 1. Profile of institutions with undergraduate neuroscience programs from among a total of 157. Private institutions and doctoral degree-granting institutions are the most commonly found institutions with undergraduate neuroscience programs.

MATERIALS AND METHODS

U.S. colleges and universities are federally-mandated by the Department of Education (DOE) to report data relating to all programs (i.e., formal majors) offered at all degree levels (for example, bachelor's, master's and doctoral) including the number of graduates from all programs. Therefore, we used data from the DOE National Center for Education Statistics (NCES; nces.ed.gov) in

order to estimate the number of institutions with undergraduate neuroscience programs, according to methods previously described (Ramos et al., 2011).

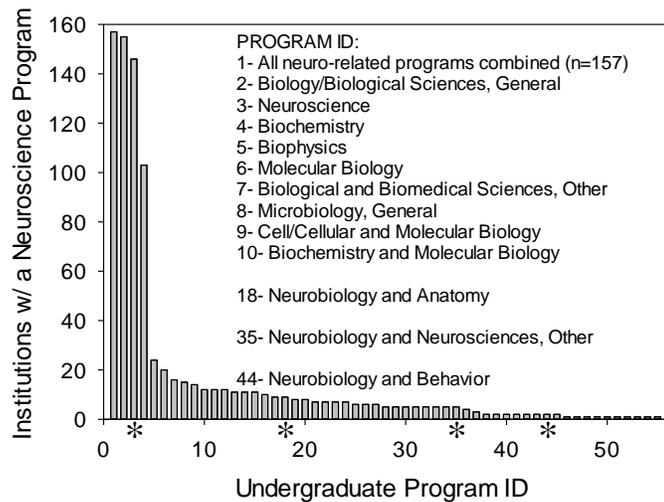


Figure 2. Distribution of undergraduate life sciences programs found at institutions with an undergraduate neuroscience program. Asterisks at positions 3, 18, 35, and 44 denote neuroscience-related programs. Program names are as listed in the NCES database.

Briefly, we searched the *College Navigator* database of NCES for the colleges and universities with undergraduate programs listed by term “neuro” in the program name which included: 1] Neuroanatomy, 2] Neurobiology & Anatomy, 3] Neurobiology & Behavior, 4] Neurobiology & Neurosciences, Other, 5] Neuropharmacology, 6] Neuroscience. Electroneurodiagnostic / Electroencephalographic Technology / Technologist was also a program category identified using the search term “neuro” but data from this category was not included because no undergraduate programs were identified. A total of 157 institutions with a program in one of these categories were identified using this approach. This list does not include institutions where neuroscience is a “concentration” in another formal program such as biology or psychology. From among these 157 institutions, data obtained and annotated included: 1] institution type (public vs. private), 2] number and types of programs in the “*Biological and Biomedical Sciences*,” 3] number of graduates of each program. Only data from those 157 identified institutions are included in the analyses described below. Database searches were performed in December 2015 and include data from the 2013-2014 academic year. Data used in these analyses are found as Supplementary Material. The strengths and limitations of using data from this database have been discussed previously (Ramos et al., 2011; Ramos et al., 2016).

RESULTS

A search of the *College Navigator* database for institutions with undergraduate programs with the term “neuro” in the program name revealed 1 of 6 different neuroscience-related programs found at 157 institutions. In the following

text, we use the term “neuroscience programs” when we refer to the undergraduate neuroscience-related programs (majors) we identified using our database search. This result includes 35 more undergraduate programs than was previously identified in similar searches of this same database (Ramos et al., 2011), indicating that there is continued growth in the establishment of undergraduate neuroscience programs. As shown in Figure 1, the majority (76.43%) of institutions identified by our search are private, institutions. In addition, we found that the majority (55.41%) of these institutions are doctoral degree-granting compared to those that are bachelor’s degree-only granting (22.93%) or up to master’s degree-granting (21.66%) institutions.

The analyses described below use data only from those 157 institutions with undergraduate neuroscience programs. As shown in Figure 2, a subset of 50 other undergraduate life sciences program are also offered by one or more of the 157 identified institutions. A complete list of all the undergraduate programs found in at least one institution with a neuroscience program is found in the Appendix. Remarkably, only two other programs were found to be offered by at least 100 of the identified institutions including 1] Biology/Biological sciences, General and 2] Biochemistry. The remaining life sciences programs (excluding neuroscience programs) were observed in fewer than 25 institutions. Despite the broad range of majors offered by institutions with neuroscience programs, we found that the majority of institutions offered only a total of 1-3 additional undergraduate majors in the life sciences.

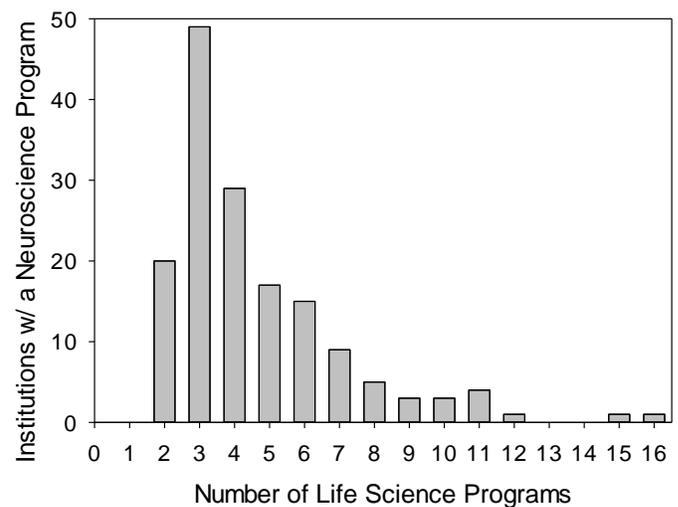


Figure 3. Cumulative histogram of the number of undergraduate life science programs (including neuroscience) found at institutions with undergraduate neuroscience programs.

The number and distribution of programs in the life sciences offered by institutions with neuroscience programs is shown in Figure 3. These data indicate that neuroscience programs are one of only very few life science programs offered at many colleges and universities in the U.S. In the majority of institutions only

three programs including neuroscience exist in the life sciences. These data also demonstrate that there currently exist greater numbers of institutions with neuroscience programs compared to other traditional life sciences programs such as microbiology, ecology, genetics, evolutionary biology, etc.

Figure 4 illustrates the number of graduates from undergraduate neuroscience programs at the institutions identified in our database search. The vast majority of institutions reported graduating between 0-25 neuroscience majors in 2014. Similar analyses were performed to determine the total number of graduates from all life science programs offered at each respective institution. We used this data to calculate the percentage of neuroscience graduates from among the total number of graduates from all life science programs for every institution we identified. When these data are plotted as a cumulative histogram as shown in Figure 5, it is clear that neuroscience graduates constitute a significant percentage of the total life science graduates at many institutions.

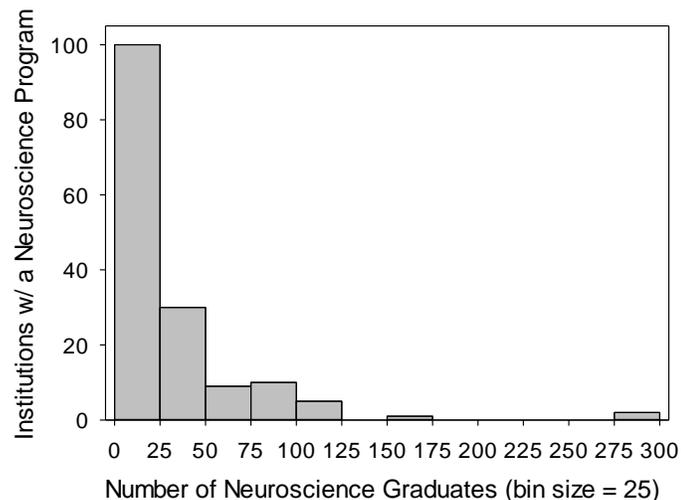


Figure 4. Cumulative histogram of the number of undergraduate neuroscience graduates at institutions with undergraduate neuroscience programs.

In light of the results described above, we examined the rank of undergraduate neuroscience programs based on number of graduates among each of the life science programs offered at each of the identified institutions with a neuroscience program. More specifically, the number of graduates from each life science program at each institution was calculated and rank-ordered from those with the highest number of graduates (most popular) to those with lowest number of graduates (least popular). As shown in Figure 6, there were 10 institutions with at least two life science programs, where neuroscience graduates outnumbered the graduates from any other program offered (i.e., neuroscience ranked 1st among other programs). In addition, we identified a total of 89 other institutions, many of which offered more than three life science programs, where neuroscience was ranked 2nd among total number of life science graduates. These data indicate that at some institutions, neuroscience is the most

popular, or one of the most popular, life sciences major.

DISCUSSION

In the present report, we provide novel metrics of the growth and popularity of undergraduate neuroscience programs in the context of the broader life science programs offered at 157 colleges and universities. For example, we are the first to quantitatively document that institutions with undergraduate neuroscience programs generally offer few additional undergraduate programs in the life sciences. This speaks to the institutional effort, resources, and energy committed toward the development of an undergraduate neuroscience program over other traditional programs in life science disciplines such as biology, microbiology and genetics. In addition, we show that relative to those additional programs offered in the life sciences, neuroscience majors constitute a significant, if not the largest, cohort of students among any of the programs offered at an institution with a neuroscience-related program.

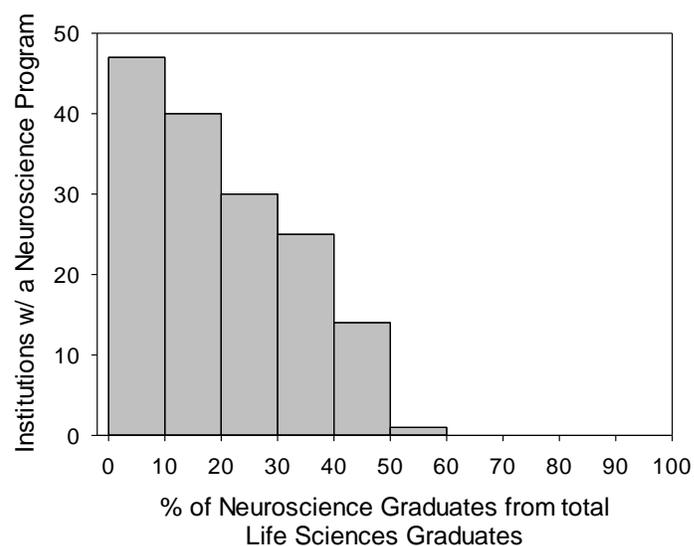


Figure 5. Cumulative histogram of the percentage of undergraduate neuroscience graduates from the total number of undergraduate life science graduates at each institution with an undergraduate neuroscience program.

Despite its novelty and quantitative nature, our data is limited in several ways. First, we have data only from those institutions identified by our search of the *College Navigator* database for programs with the term “neuro” in the program name. This omits institutions with programs that are listed by different categories (e.g., Interdisciplinary Studies) as well as programs where neuroscience is a *concentration* rather than a formal major. Despite this limitation, using this approach we still identified 157 institutions which is more than previously identified (Ramos et al., 2011) and which likely serves as a representative cohort. Second, our data is based on one time point (academic year 2013-2014) making it difficult to accurately describe the historical growth and change in our findings. Thus, we cannot use our data to accurately predict future growth or change; however, our current findings combined

with our previous observations (Ramos et al., 2011) indicate continued growth in the number of undergraduate neuroscience programs as well as graduates from these programs.

Our data extend an emerging literature demonstrating growth in undergraduate neuroscience education in the U.S. (Ramos et al., 2011; Ramos et al., 2016). Surprisingly, why undergraduates are motivated to pursue an undergraduate degree in neuroscience remains an open and unresolved question. Among several possible reasons why undergraduate neuroscience is a popular major includes an intrinsic interest about the brain on the part of undergraduates. In addition, students may believe that a neuroscience major will provide better preparation for graduate and professional studies, particularly for health-professions careers (Prichard 2015; Ramos et al., 2016). A greater understanding of why students pursue a neuroscience major should be the focus of future quantitative studies.

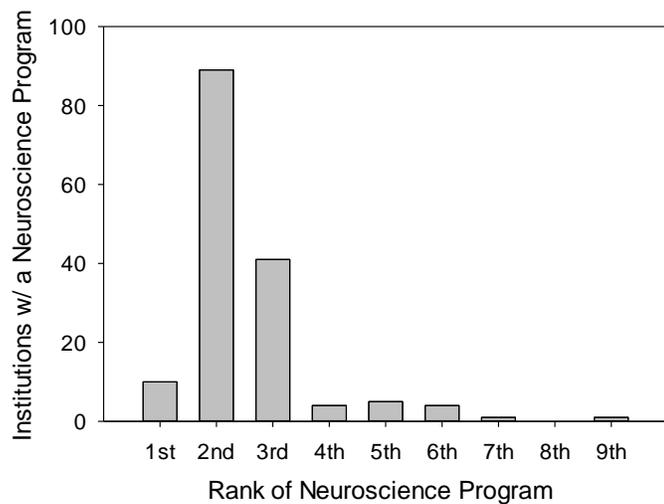


Figure 6. Relative ranking of number of graduates from undergraduate neuroscience programs relative to other undergraduate life science programs found at institutions with neuroscience programs.

Our data are relevant to faculty and administration at institutions with existing undergraduate neuroscience programs. For example, we provide several metrics of neuroscience programs in relation to other life science programs which can be used by institutions as a tool for program evaluation. Our data are also relevant to institutions that wish to develop novel undergraduate neuroscience programs. In particular, we demonstrate that the creation of a new undergraduate neuroscience program will likely be a successful endeavor attracting similar, if not more, majors than other life science programs.

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APPENDIX

List of all undergraduate majors offered by one or more of the 157 institutions identified.

Anatomy	Environmental Biology
Animal Behavior and Ethology	Environmental Toxicology
Animal Physiology	Epidemiology
Biochemistry	Evolutionary Biology
Biochemistry and Molecular Biology	Exercise Physiology
Biochemistry, Biophysics and Molecular Biology, Other	Genetics, General
Bioinformatics	Genome Sciences/Genomics
Biological and Biomedical Sciences, Other	Marine Biology and Biological Oceanography
Biology/Biological Sciences, General	Medical Microbiology and Bacteriology
Biomathematics, Bioinformatics, and Computational Biology, Other	Microbiological Sciences and Immunology, Other
Biomedical Sciences, General	Microbiology and Immunology
Biometry/Biometrics	Microbiology, General
Biophysics	Molecular Biochemistry
Biostatistics	Molecular Biology
Biotechnology	Molecular Genetics
Botany/Plant Biology	Neurobiology and Anatomy
Botany/Plant Biology, Other	Neurobiology and Behavior
Cell/Cellular and Molecular Biology	Neurobiology and Neurosciences, Other
Cell/Cellular Biology and Anatomical Sciences, Other	Neuroscience
Cell/Cellular Biology and Histology	Pharmacology
Computational Biology	Physiology, General
Conservation Biology	Plant Genetics
Developmental Biology and Embryology	Plant Pathology/Phytopathology
Ecology	Toxicology
Ecology and Evolutionary Biology	Vision Science/Physiological Optics
Ecology, Evolution, Systematics and Population Biology, Other	Wildlife Biology
Entomology	Zoology/Animal Biology

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