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Undergraduate Participation in the Society for Neuroscience

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Undergraduate neuroscience education has grown substantially in the US as well as participation in outreach and research activities by undergraduates. In line with these observations, undergraduates may also be seeking membership in the Society for Neuroscience (SfN) as well as attending the SfN annual meeting. Data in the present report show that undergraduate membership in SfN has increased between 2013 and 2019 as well as annual undergraduate SfN meeting attendance and abstract submissions for research presentations. Increases were observed for both US and international undergraduates.

These data are discussed in the context of motivations of undergraduates to pursue future academic training and/or careers in neuroscience. These data are important to faculty and administrators at institutions that currently have or seek to establish new undergraduate neuroscience programs given membership in a professional society and attendance at a major conference can positively impact academic and professional development.

Key words: Society for Neuroscience, neuroscience programs; neuroscience majors; neuroscience graduates

A number of quantitative measures have been used to show a growing interest in neuroscience education among undergraduates. For example, there are steady increases in the number of colleges and universities that now offer an undergraduate neuroscience major (Ramos et al., 2011; 2016a; Pinard-Welyczko et al., 2017; Rochon et al., 2019). In addition, there are steady increases in the number of students obtaining degrees from these neuroscience programs (Ramos et al., 2017; Rochon et al., 2019).

Undergraduates pursue a degree in neuroscience for a variety of reasons. For example, substantial numbers of neuroscience majors apply and gain acceptance to medical school (Prichard, 2015; Ramos et al., 2016b). Many students pursue an undergraduate neuroscience major in preparation for graduate studies in neuroscience (Boyette-Davis, 2018). Finally, it is likely that many students pursue neuroscience out of intrinsic interest in the field, though they may be uncertain of what career paths lay ahead.

Undergraduate neuroscience majors pursue a variety of extracurricular activities that build their professional portfolios and/or take advantage of opportunities for additional instruction or service. For example, outreach activities which engage preschool to high school students in introductory neuroscience have become popular with undergraduates (Deal et al., 2014; Brown et al., 2019, Flanagan-Cato, 2019; Vollbrecht et al., 2019). These programs provide the undergraduates with basic teaching and mentorship experiences while also exposing the audience of young students to neuroscience. More commonly, undergraduates often pursue research opportunities during the academic year or in the summer (Kreitzer and Malchow, 2013; Yates and Stavnezer, 2014). By engaging in research, these students gain first-hand experience in the research process/environment, learn

techniques not covered in coursework, and may potentially collect sufficient data for a conference abstract or publication.

The Society for Neuroscience (SfN; sfn.org) is the largest professional organization with over 37,000 scientists, physicians, educators, and students dedicated to the advancement of understanding the nervous system and nervous system disorders. Since 1971, SfN has hosted an annual meeting in the US (except in 1988 when the meeting was in Canada) attracting participants from all over the world. In the present report, we describe increases in the number of undergraduate students who become members of SfN between 2013 and 2019. The number of undergraduates who attended the SfN annual meeting and presented research over this same time is also examined. Comparisons between US undergraduates and international undergraduates are discussed. These data provide additional evidence of the popularity of neuroscience and participation in neuroscience research among undergraduates.

MATERIALS AND METHODS

All data described below were kindly provided by staff of SfN and are presented with permission. Data provided to the author included only summary tables generated by SfN and therefore contained no personal identifiable information. US and international undergraduate students are determined based on home address listed for each student.

In order to contextualize the SfN membership and annual meeting attendance data presented here, we collected similar data from smaller, regional meetings centered on undergraduate neuroscience research. Poster presentation data from the annual Faculty for

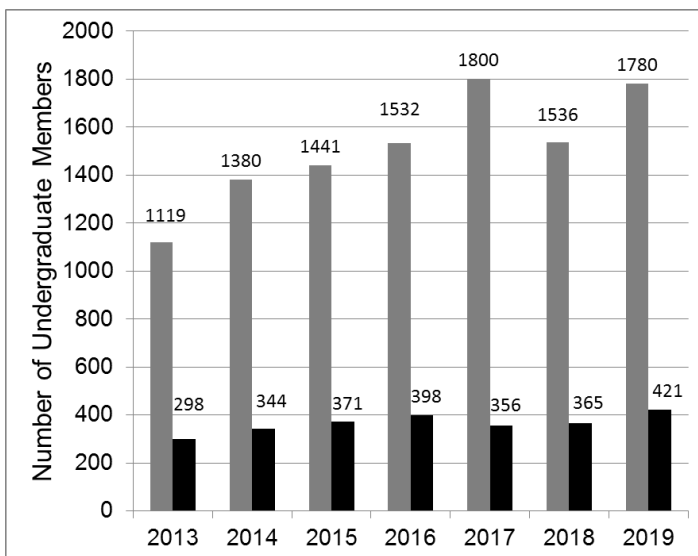


Figure 1. Number of US (gray bars) and international (black bars) undergraduate SfN members between 2013 and 2019.

Undergraduate Neuroscience (FUN) poster session which takes place at the annual SfN meeting as well as other regional neuroscience conferences (spanning 2013 to 2019) established by local neuroscience organizations were collected. Other regional meetings in our searches and analyses included the following: Northeast Under/graduate Research Organization for Neuroscience annual meeting (NEURON; Frye and Edinger, 2004; Goyette et al., 2007; McLaughlin et al., 2009); Symposium for Young Neuroscientists and Professors of the Southeast (SYNAPSE; synapse.cofc.edu; Hurd et al., 2011); Midwest/Great Lakes Undergraduate Research Symposium in Neuroscience (mGLURs; <https://mglurs.org/>); MidBrains Undergraduate Neuroscience Conference (midbrains.org/).

RESULTS

SfN has several membership categories including one specifically for undergraduates. The annual fee for undergraduate membership is currently \$31 USD and requires proof that the student is enrolled in an undergraduate program. Even after graduation, undergraduate membership status can be maintained for 2 additional years as long as the student has not enrolled in graduate/professional studies or has not otherwise become eligible for another member category due to employment.

The number of SfN undergraduate members is shown in Figure 1 for both US and international undergraduates. Between 2013 and 2019 US undergraduates membership numbers increased each year, except 2018. Increases have ranged between 4% and 23% compared to the previous year. Similarly, international undergraduate membership numbers increased every year during this same period except 2017, and annual increases have ranged between 2% and 17%. However, there have consistently been ~4 times as many US undergraduate members as international undergraduate members.

Individuals registering for the annual meeting complete

an online form and report their membership category (i.e., undergraduate, graduate, regular) and current education level. Using meeting registration data, the number of SfN undergraduate members attending the annual meeting is shown in Figure 2 for both US and international undergraduates. Between 2013 and 2019, the number of US undergraduates attending the SfN annual meeting increased for all years except 2018. Increases ranged between 2% and 35% compared to the previous year. Similarly, international undergraduates attending the SfN annual meeting increased every year during this same period except 2017, and annual increases ranged between 2% and 23%. However, there have been between approximately 4 and 7 times as many US undergraduate who attend the annual meeting compared to international undergraduate members.

The raw number of undergraduates attending the SfN meeting may reflect a general increase in meeting attendance by all groups (graduate students, faculty, etc.). Alternatively, undergraduates may represent a growing percentage of attendees at the annual SfN meeting. Using total annual meeting attendance numbers available on the SfN website (SfN 2020), we did indeed observe that the percentage of undergraduates in attendance has increased each year (except 2018). Thus, in 2013 the percentage of undergraduates at the annual meeting was 2.87% while in 2019 the percentage rose to 5.7%.

First authors who submit an abstract for presentation of research at the annual meeting complete an online submission form. As part of the submission process, these authors submit information regarding their membership category. In contrast, information about the membership status of other co-authors is not collected except for the sponsoring author who must be a regular member. Using abstract submission data, the number of SfN undergraduate members who presented research as the first author at the annual meeting is shown in Figure 3 for both US and international undergraduates. Between 2013

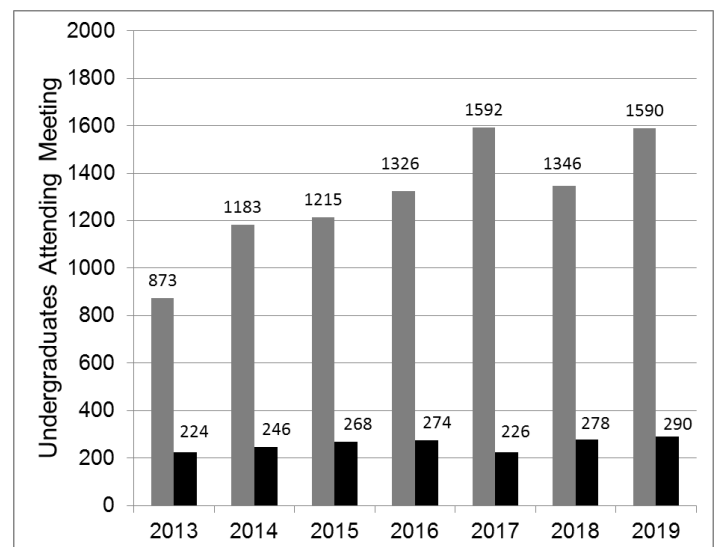


Figure 2. Number of US (gray bars) and international (black bars) undergraduate SfN members that attended annual meeting between 2013 and 2019.

and 2019, US undergraduates presenting research increased for all years except 2018. Increases have ranged between 6% and 28% compared to the previous year. Similarly, international undergraduates presenting research increased every year during this same period from 1% to 15%, except for 2016 and 2017. However, there have been between ~2 and 3 times as many US undergraduates who presented research compared to international undergraduate members.

At the SfN annual meeting, FUN organizes a research poster session exclusively for undergraduates which is sponsored by SfN. Attendance distinguishing undergraduates from other groups (faculty, graduate students, etc.) is not taken at this meeting and the number of posters is limited by the venue size designated by SfN ($n < 170$ posters between 2013 and 2019). For example, in 2018 and 2019, a total of 168 and 164 posters, respectively, were presented at the FUN poster session. We used first author data from posters presented at the 2018 and 2019 FUN poster session and cross referenced this to data from published SfN abstracts in those respective years. Our comparisons show that only 70 and 68 undergraduate authors who presented at the FUN poster session in 2018 and 2019 (respectively) were co-authors on an SfN abstract. Thus, 100 additional undergraduates at the SfN annual meeting present their research at the FUN poster session despite not being co-authors on an SfN abstract.

The primary focus of the current study was to examine undergraduate participation in SfN as it is the largest professional organization specific to neuroscience research in the US. Nevertheless, as a resource for broad comparisons with the SfN data, we used available data (2013-2019) from internet searches of attendance and poster presentations at regional undergraduate neuroscience meetings such as SYNAPSE, MidBrains,

NEURON and mGluRs. Published reports have already described increases in attendance and poster presentations at these meetings (Frye and Edinger, 2004; Goyette et al., 2007; McLaughlin et al., 2009; Hurd et al., 2011) and a detailed evaluation of trends in attendance and poster presentations at these meetings is the topic of future studies. However, our review of available data indicates only between 50-100 posters are presented at these regional meetings which vary according to venue/hosting institution on any given year. For example, from 2013 to 2019, the annual NEURON meeting has been held at the same location (Quinnipiac University) and with a range of as few as 88 posters presented in 2018 and as many as 120 posters in 2019. These data clearly demonstrate the differences in scale in undergraduate participation between the SfN annual meeting and other local/regional undergraduate neuroscience meetings.

DISCUSSION

The present report provides novel data demonstrating increases in undergraduate membership in SfN as well as undergraduate attendance and participation at the SfN annual meeting. Similar findings were found for US and international undergraduates, though there were many more US compared to international undergraduates. These observations broadly compliment other findings of popularity of neuroscience among students including increased undergraduate neuroscience programs and undergraduate neuroscience majors in US colleges and universities (Rochon et al., 2019).

There are a number of reasons why undergraduates may choose to become members of SfN. First, the cost of membership is inexpensive and there is a relatively simple process to join. Second, membership includes access to content such as NeurOnline (neuroline.sfn.org) and a subscription to the Journal of Neuroscience, the flagship publication of SfN. Membership to SfN also allows reduced registration price to the annual meeting. Students may feel that membership is a natural next step toward inclusion in the community of neuroscientists. Finally, students may feel that membership is an important indicator on their portfolio that they are truly committed to a career in neuroscience, either for job recruiters or graduate program/medical school admissions committees.

Data in the present report demonstrate increases in annual meeting participation by undergraduates. These students may attend the meeting not only to present their research but also to explore the cutting-edge research presented by others, attend professional development workshops, meet with potential employers or graduate school program representatives. Presenting research at the annual meeting is likely understood to be an important part of the students' portfolio/curriculum vita for future graduate or professional programs. Attending the meeting can even be the first time a student has been to a conference or even traveled alone and left their city/state. As discussed by Herzog and colleagues, there is no doubt that attendance at the annual meeting can be a transformative experience for undergraduates (Jose-Edwards et al., 2017).

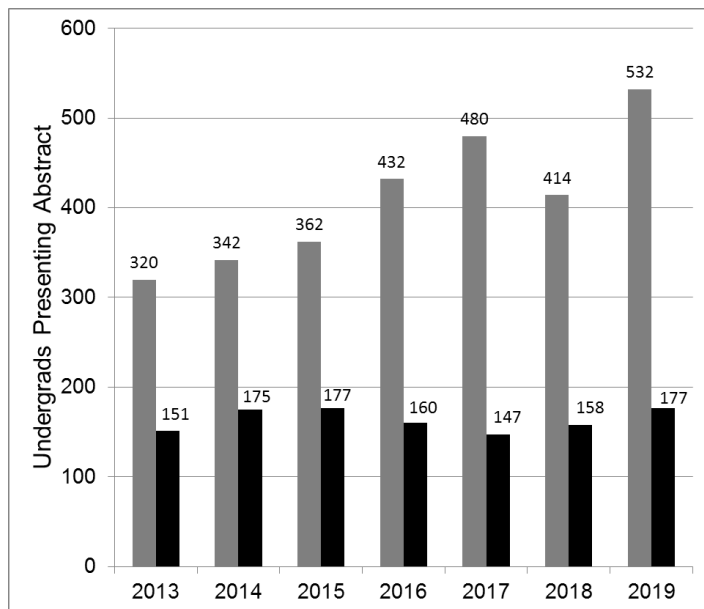


Figure 3. Number of US (gray bars) and international (black bars) undergraduate SFN members that submitted an abstract for presentation at the annual meeting between 2013 and 2019.

Membership in SfN and attendance at the annual meeting serve as additional indicators of the popularity of neuroscience as a field of study for undergraduates as well as a potential indicator of the desire for this population of students to pursue graduate education and/or potential career in neuroscience. Attending the meeting is likely associated with some financial cost to students (registration, housing, meals, food, transportation, etc.) which demonstrates that these students feel it is a worthwhile investment in order to advance their academic or professional goals. Because the annual meeting spans 5 days including the weekend and weekdays, students attending the meeting understand that they may be absent for classes and have to make up missed assignments. Taken together, data presented in the present report provide an additional perspective on the growing cohort of undergraduates with strong interest in neuroscience as part of their future profession.

The current study uses membership and annual meeting attendance data to make inferences about undergraduate interest in neuroscience. This approach only takes into account the number of students with the resources and opportunity to either become SfN members and/or attend the annual meeting. Future studies could use different methods such as surveys or questionnaires which can report the actual motivation of respondents as well as provide clues to the actual number of students who desire to become SfN members and attend the annual meeting but cannot. However, those methods are also vulnerable to low response rate or response bias and may not be able to capture cohorts of undergraduates spanning the 7 years of data present herein. Data in this study likely also under-reports the number of undergraduates that presented research at the meeting as only the first author is required to indicate their membership status during the abstract submission process. Consistent with this notion, we found that ~100 undergraduates present at the FUN poster session but are not listed on an SfN abstract. Thus, future studies could attempt to understand more clearly how many undergraduates attend the meeting as part of their involvement in research.

Due to limited access to primary data, undergraduate membership and meeting attendance data could not be compared to other membership categories. Additional interesting future comparisons could focus on whether undergraduate membership and meeting attendance numbers are increasing despite decreases among other membership categories such as graduate members or regular members. Note that each year, it is expected that some number of undergraduate members either drop their membership status (i.e., fail to pay their dues) or change their status when they become graduate student SfN members. Both of these factors would tend to keep undergraduate member numbers down which is opposite of our findings.

Data in the present report indicate steady increases over nearly all years examined. However, membership and annual meeting attendance declined substantially in 2018 compared to the previous year for US students but not international students. That year the annual meeting

was in San Diego, CA. Since membership is connected to meeting attendance, perhaps the fact that the meeting was on the west coast of the US affected the interest, cost, and/or ability for undergraduates to attend the meeting which then affected membership. That said, the annual meeting was also in San Diego in 2013 and 2016 where increased undergraduate attendance was observed compared to the previous year. Interestingly, international undergraduate numbers increased nearly all years except in 2017 when the annual meeting was held in Washington DC. This was also the site of the annual meeting in 2014. Future studies could examine what factors such as location, costs and funding, etc. affect the ability and/or interest of undergraduates to become SfN members and attend the annual meeting.

Data in the present manuscript allow for comparisons between US and international undergraduates indicating many times more US undergraduates who are members and who attend the meeting. These findings are not surprising given that SfN is a US-based organization and that there exist other neuroscience-related organizations found throughout the world (e.g., Federation of European Neuroscience Societies). Moreover, travel to the annual meeting by international undergraduates represents a much larger financial investment compared to US undergraduates. This study introduces a simple way for other national and international neuroscience organizations to understand growing interest on the part of undergraduates found in that nation/region.

The findings of the present report may be of interest to the undergraduate neuroscience education community including faculty and administrators at institutions with existing neuroscience programs as well as institutions seeking to establish new programs. These data suggest that neuroscience programs that include research opportunities and/or funding for travel to the SfN annual meeting would likely be very attractive to students. Increasing access to SfN resources and events to students may have transformative educational and career impact that affect the student personally, affect our nation by training the next generation of neuroscience educators, and affect humanity by training the next generation of neuroscientists who discover new treatment for brain or mental health disorders.

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