

Supplement

Additional interpretation of data presented from Tables.

Table 1

Gender

- The majority of undergraduate students were female (76.1%)

Race/Ethnicity

- The majority of undergraduate students were White (63.0%) or Asian (25.5%) and were not Hispanic or Latino (87.7%)

Current Class Standing

- The majority of undergraduate students were either juniors (33.5%) or seniors (36.6%)

Type of Institutions

- Students mainly attended urban institutions (72.3%)

Location of Institution

- The geographic distribution was throughout the U.S., with all 5 regions represented

Institution Type/Size

- Students mainly attended Public Research Universities (40.8%) with an undergraduate population above 5,000 (83.2%)

Table 2

- 93.6% of students surveyed were either currently majoring or planning to major in neuroscience
- First exposure to neuroscience was on average at age 16 with the earliest age students felt they should have been exposed to neuroscience at an average of 13

Decided to Major in Neuroscience

- 76.1% of students decided to major in neuroscience by the end of their first year of college with 50.5% prior to starting college and 25.6% during their first year

Reasons for Pursuing Neuroscience

- The top reasons for pursuing a neuroscience major included interest in the field (62.4%), high school exposure (59.4%), and future career interest (59.2%)

Skills Interested in Gaining from Major

- 72.1% of students wanted to understand how to present research findings and scientific topics, as well as gain wet-lab skills (66.8%)

Spoken with a Neurologist about Career Experience

- Most (93%) students who had not spoken with a neurologist were interested in doing so.
- Students that had spoken with a neurologist (28.8%), reported the interaction was helpful in characterizing the career of a neurologist (95.5%)

Clinical Neurology Experiences

- 43% of students had attempted to gain clinical neurology experience, most of those who tried (64.6%) were unsuccessful in gaining this experience.
- 25.4% of all respondents had an opportunity to shadow a neurologist/neuropsychologist and 13.6% had the opportunity to interact with neurology patient populations

Interests in (Likert Scale 1-5), mean $\pm$ SD (n)

- There was substantial interest in working with neurologic patient populations (4.69 ± 0.68), shadowing a neurologist (4.69 ± 0.76), and gaining clinical neurology experience (4.66 ± 0.74)

Neurologic Conditions Interested in Learning About

- Dementia (51.7%), traumatic brain injury (50%), and neuro-oncology (47%) were the most popular neurologic conditions that students were interested in learning about

Table 3

Topics Covered in Major Coursework

- Basic cellular biology (82.9%) was the most common topic covered in major coursework, followed by neurologic diseases (71.2%)

Undergraduate neuroscience curriculum or experience is lacking

- Less than half of students (34.5%) felt this to be true

Opportunity to engage with scientific literature

- 81.7% of students had this opportunity

Human Subjects Clinical Research

- 73.2% of students engaged in human subject's clinical research

Form of Engagement

- Instructor-led class discussion (59.9%) was the most popular form of engagement

Experience Conducting Research

- In neuroscience (42.9%)
- In non-neuroscience (34.5%)

How did students find research experience?

- Emailing/calling professor or lab about availability was the most successful (52.5%) for neuroscience research

Table 4

How students (n=274) obtained the opportunity to shadow a neurologist/neuropsychologist

- The most common way endorsed (65 students) was via personal relationships, specifically family connection/network (35 students)
- Formalized student/program/academic connections were endorsed by 62 students with the most popular being internship/fellowship (13)
- Self-initiated opportunities were also cited by 36, with cold calling/emailing local physicians/clinics being the most successful (26).

How students (n=147) obtained the opportunity to interact with neurology patient populations

- Academic connections were the most successful (78) with college/university programs/connections (33)
- Volunteering/internship/shadowing was second most popular at 63, with hospital volunteer program being most successful (30)
- Self-initiative was endorsed by 60, with self-initiated applying (29)
- Personal relationships were endorsed by 55, especially if a family member was a neurologic patient (16)
- Job-related (42), specifically specialized non-physician patient care providers such as medical scribe or EMT were most endorsed (22)

Table 5

Location of Most Recent Research

- A majority of students (75.4%) were conducting research at the educational institution they were attending

Barriers to Gaining Research Experience

- 76% of students felt that finding open/available research positions was a barrier to gaining research experience, followed by finding labs with a focus that matched their interest (49.7%)

Research Experience

- More students (45%) had experience in animal model research than patient-centered research (24.4%)

Research Interest

- 92.1% of students expressed that they would like to do research with 66.7% of students interested in patient-centered (clinical) research

eTable 1

More neuroscience course options

- A majority of students endorsed that specific neuroscience courses (122 students) and more neuroscience requirements or electives (67) were lacking in their curricula or experience.

Learning about Neuroscience Research

- 65 students expressed that research opportunities were lacking in their learning about neuroscience research.

Learning about clinical neurology/gaining clinical neurology exposure

Mentoring

- Most students felt that neurologic diseases, clinical neuroscience (37) as well as hands on experience, clinical exposure (37) were lacking in their curricula or experience.

Allow for earlier exposure to the neurosciences with more elective time

- 22 students expressed that additional faculty, or more guidance was needed.
- 20 students felt that career path information was lacking.

eTable 2

- The age first exposed to neuroscience for both current/planned majors and non-majors in neuroscience was between 15 to 16 years old.
- Whilst 29% of current/planned majors in neuroscience had spoken to a neurologist about career experience, only 20% of non-majors had done so.
- Most popularly nearly 45% of current/planned majors in neuroscience had attempted to gain clinical neurology experience compared to only 19% of non-majors.
- Only 24% of non-neuroscience majors had experience conducting neuroscience research, whereas 44% of planned/current majors had experience.
- At the second least popular, 25% of planned/current neuroscience majors had the opportunity to interact with neurology patients, similarly to only 20% of non-neuroscience majors.
- At the least opportune, only 14% of current/planned neuroscience majors had the opportunity to shadow a neurologist, and only 9% of non-neuroscience majors.

eTable 3

- Students who had spoken with a neurologist, or attempted to gain clinical neuro experience were exposed to neuroscience at around age 15. Alternately, students who had not spoken to a neurologist or attempted to gain experience were exposed to neuroscience around age 16.
- On average, all students felt that the earliest age they should be exposed to neuroscience was around age 13.
- On average, around 90% of the students planned to pursue graduate studies whether or not they had spoken to a neurologist, or gained clinical neurology experience.
- At the most popular, around 70% of students who had spoken with a neurologist or attempted to gain clinical neuro experience endorsed physician as a career goal and nearly half (50%) of those who had not also endorsed a career goal of physician.

- Most students (50%) expressed that they decided to major in neuroscience before college, whether or not they had spoken with a neurologist, or attempted to gain clinical neuro experience.
- 47% of students who had spoken to a neurologist were in their senior year, and 35% of students who had attempted to gain clinical neuro experience were in their junior year.
- A majority of students identified as White (around 63%) whether or not they had spoken to a neurologist or attempted to gain clinical neuro experience. The next most populous group were students identifying as Asian (25%).
- Female students were the most prevalent in all groups (75%).
- In all categories, most students endorsed attending a Liberal Arts institution (30%) and Private Research Institution (30%), but Public Research Institutions were the most popular (40%).
- A majority of all students attended school in the Northeast (32%) and the Midwest (26%). More students who had spoken with a neurologist, or attempted to gain clinical neuro experience went to school in the southeast (26%) than those who did not speak to a neurologist or attempt to gain experience (19%). Alternately, more students who did not speak to a neurologist or attempt to gain clinical neuro experience went to school on the West Coast (20%) than those that did (12%).
- A majority of students who had spoken with a neurologist (74%), or attempted to gain clinical neuro experience (78%) attended urban institutions. Around 70% of students that did not also attended urban institutions.
- Most students (42%) in all categories went to a school with 5,000-15,000 students, or with >15,000 students (around 40%).

eTable 4

If you have attempted to gain clinical neurology experience and were not successful why not?

- 185 students endorsed a lack of resources, with no opportunities as the main reasoning for their lack of success (95 students).
- Covid-19 disruptions were the second most popular reason (107) specifically Covid-19, impact on process (86).
- 43 students endorsed that they did not know where to start, 24 of which feeling like they did not know how to gain experience.
- 34 students did not meet application criteria/had difficulties with the application process, and cited needing pre-requisites or course work (9), lack of research experience (8), or rejection (6) as the main reasons.
- 72 students endorsed other reasons, specifically time, none, too busy, schedule, availability (35) and not interested or not ready to decide (20).

If you have attempted to gain clinical neurology experiences, what, if any, were the barriers to gaining this experience?

- Covid-19 disruptions were the most highly endorsed (158), with 156 students citing Covid-19, impact on process.
- 116 students endorsed that they did not meet application criteria/difficulties with the application process, with lack of research experience (26) and age and or education (22) as the main reasons.
- A majority of students (128) cited a lack of resources, specifically opportunities, limited (62).
- 42 students did not know where to start, specifically with connections, none or don't know who to reach out to (41).

If you have not attempted to gain clinical neurology experience, why not?

- A majority of students endorsed Covid-19's impact on the process (121) along with time, none, too busy, schedule, availability (95) and interest, or not ready to decide (81)

eTable 5

- At the most popular, 91% White and 89% Non-White/Multiracial students endorsed plans to pursue graduate studies.
- Career goal (physician) was more popular with 62% Non-White/Multiracial students than White students (52%).
- The next popular, interest in attending Neurology conference was endorsed by 87% White and Non-White/Multiracial students.
- Engaged with scientific literature was more popular with White (84%) than Non-White/Multiracial students (79%)
- Conducted Neuroscience research was endorsed by more Non-White/Multiracial students (47%) than White students (40%)
- Spoken to a neurologist about career experiences was one of the least popular options for White (30%) and Non-White/Multiracial (28%) students.
- Decided Neuroscience Major before college was cited by 49% White students and 45% Non-White/Multiracial students.
- Opportunity to interact with neurology patients was only endorsed by 25% White and 26% Non-White/Multiracial students.
- Opportunity to shadow a neurologist was the least popular with 14% White and 13% Non-White/Multiracial students
- Earliest age of exposure for was 14 on average for both White and Non White/Multiracial students.

E-Table1: Themes and Codes for what Undergraduates in the Neurosciences Find Lacking in their Neuroscience Curricula or Experience

More neuroscience course options	Add specific NS courses (122) More NS requirements or electives (67) Neuropharmacology (27) More focus on NS, less interdisciplinary courses (26) Earlier exposure, more time to take electives (20) Add NS curriculum or major (15) Neuroanatomy or neurocircuitry (17) Neuropsychology, Cognitive neuroscience (12) Computational neuroscience (9) Neurobiology, Neurogenetics or genetics (5) Neurology, behavioral neurology, neuroscience translation (5) Neuroimaging, technology (4)
Learning about Neuroscience Research	Research opportunities (65) Labs, Scientific methods (39)
Learning about clinical neurology/gaining clinical neurology exposure	Neurologic diseases, Clinical neuroscience (37) Hands on experience, Clinic Exposure (37) Internships, Shadowing, Volunteering opportunities (23)
Mentoring	Add faculty, more guidance (22) Career path information (20) Connections (6)
Allow for earlier exposure to the neurosciences with more elective time	Earlier exposure, more time to take electives (20)

* There were 22 responses that met the criteria for "Other"

*For main points extracted from eTable 1 please refer to eSupplement1

E-Table 2 Comparisons between Students with Current/Planned Major in Neuroscience versus Those Not Majoring in Neuroscience

Characteristic	Current/Planned Major in Neuroscience (n=1016), n (%)	Not majoring in Neuroscience (n=67), n (%)	p-value
Age First exposed to Neuroscience (Mean ± SD)	15.7±3.1	15.5±3.4	0.62
Spoken to a neurologist about career experience	298 (29.4)	14 (20.3)	0.11
Attempted to gain clinical neurology experience	453 (44.6)	13 (19.1)	<0.0001
Experience conducting neuroscience research	449 (44.2)	16 (23.9)	0.001
Opportunity to interact with neurology patients	260 (25.7)	14 (20.6)	0.35
Opportunity to shadow neurologist	141 (13.9)	6 (8.8)	0.24

*For main points extracted from eTable 5 please refer to eSupplement1

E-Table 3 Comparisons between Students who had Spoken with a Neurologist Versus those who had Not; Comparisons Between those who Attempted to Gain Clinical Neurology Experiences vs. those who had Not.

Characteristic Results are count and %	Spoken With Neurologist (n=312), n (%)	Have Not Spoken with a Neurologist (n=770), n (%)	p-value	Attempted to Gain Clinical Neuro Experience (n=458), n (%)	Did not Attempt to Gain Clinical Neurology Experience (n=610), n (%)	p-value
Age First Exposed to Neuroscience (Mean ± SD)	14.8±3.6	16.1±2.8	<0.0001	15.3±3.2	15.9±3.0	0.005
Earliest Age students should be exposed (Mean ± SD)	12.6±3.5	13.1±3.3	0.02	12.9±3.4	13.1±3.3	0.49
Pursuing Graduate Studies	280 (90.0)	691 (89.9)	0.93	429 (92.7)	541 (87.8)	0.009
Career Goals			0.0003			<0.0001
Physician	204 (65.6)	408 (53.3)		329 (70.9)	284 (46.3)	
Neuroscientist/ neurobiologist	50 (16.1)	115 (15.0)		47 (10.1)	118 (19.2)	
Neuropsychologist	20 (6.4)	74 (9.7)		39 (8.4)	55 (9.0)	
Clinical psychologist	8 (2.6)	31 (4.0)		7 (1.5)	32 (5.2)	
Pharmacist/ Pharmacology	0	14 (1.83)		2 (0.43)	12 (1.96)	
Other	29 (9.3)	124 (16.2)		40 (8.6)	112 (18.3)	
Decided to major in neuroscience...			0.13			0.17
Before College	163 (54.9)	349 (48.9)		237 (52.5)	274 (48.8)	
First Year	74 (24.9)	183 (25.7)		118 (26.2)	141 (25.1)	
Second Year	57 (19.2)	161 (22.6)		90 (20.0)	129 (23.0)	
Other	3 (1.0)	20 (2.8)		6 (1.3)	17 (3.0)	
Class Standing			0.0003			<0.0001
Freshman	32 (10.4)	116 (15.2)		33 (7.2)	115 (18.8)	

Sophomore	42 (13.6)	131 (17.2)		59 (12.8)	113 (18.5)	
Junior	91 (29.5)	266 (34.9)		181 (39.3)	178 (29.1)	
Senior	143 (46.4)	249 (32.7)		187 (40.6)	205 (33.5)	
Race						
White	200 (64.1)	483 (62.7)	0.67	281 (60.3)	401 (65.0)	0.11
Black	21 (6.7)	54 (7.0)	0.87	28 (6.0)	47 (7.6)	0.30
Asian	74 (23.7)	191 (24.8)	0.71	123 (26.4)	143 (23.2)	0.22
American Indian and Alaskan Native	8 (2.6)	13 (1.7)	0.34	8 (1.7)	13 (2.1)	0.64
Native Hawaiian and Pacific Islander	1 (0.3)	1 (0.1)	0.51	1 (0.2)	1 (0.2)	0.84
Other	11 (3.5)	35 (4.5)	0.45	16 (3.4)	30 (4.9)	0.25
Hispanic/Latino	25 (8.1)	91 (12.1)	0.16	43 (9.4)	73 (12.1)	0.37
Sex			0.19			0.051
Female	227 (72.8)	593 (77.3)		365 (78.3)	456 (74.3)	
Male	83 (26.6)	166 (21.6)		100 (21.5)	149 (24.3)	
Type of Institution						
Single Sex	10 (3.2)	21 (2.7)	0.67	16 (3.4)	15 (2.4)	0.33
Religious	38 (12.2)	148 (19.2)	0.005	71 (15.2)	115 (18.6)	0.14
Liberal Arts	92 (29.5)	227 (29.5)	0.998	140 (30.0)	180 (29.2)	0.76
Public Research	130 (41.7)	313 (40.6)	0.76	188 (40.3)	255 (41.3)	0.74
Private Research	92 (29.5)	221 (28.7)	0.80	159 (34.1)	156 (25.3)	0.002
Location of Institution			0.03			0.001
Midwest	78 (25.1)	203 (26.6)		132 (28.5)	149 (24.35)	
Northeast	99 (31.8)	238 (31.2)		144 (31.1)	194 (31.7)	
Southeast	83 (26.7)	150 (19.7)		116 (25.1)	117 (19.1)	
Southwest	12	27		14	25	

	(3.9)	(3.5)		(3.0)	(4.1)	
West (West coast + Northwest)	39 (12.5)	145 (19.0)		57 (12.3)	127 (20.7)	
Area of Institution			0.57			0.0006
Rural	26 (8.4)	68 (9.0)		30 (6.5)	64 (10.5)	
Suburban	53 (17.2)	150 (19.7)		70 (15.2)	132 (21.7)	
Urban	230 (74.4)	542 (71.3)		362 (78.3)	412 (67.7)	
Size of Institution			0.86			0.14
5,000 -15,000	129 (41.6)	322 (42.2)		195 (42.0)	257 (42.1)	
<5,000	55 (17.7)	125 (16.4)		89 (19.2)	91 (14.9)	
>15,000	126 (40.6)	316 (41.4)		180 (38.8)	262 (42.9)	

P-values <0.05 are bolded

*For main points extracted from eTable 4 please refer to eSupplement1

E-Table 4. Themes and Codes based on Qualitative Responses to Questions Asking Students about Barriers to Experiences in Obtaining Clinical Neurology Experiences and Reasons for Not Trying to Obtain Such Experiences

If you have attempted to gain clinical neurology experience and were not successful, why not?
(number in parentheses indicate number of codes)

Lack of resources (185)

- Limited opportunities (43)
- Location (4)
- No opportunities yet, but plan to (34)
- No opportunities (95)
- Resources, lack of accessibility (9)

Covid-19 disruptions (107)

- COVID, impact on process (86)
- Online school (9)
- Research experience cancelled (12)

Do not know where to start (43)

- Connections, none or do not know who to reach out to (7)
- Not aware of concept (8)
- Do not know how to do this (24)
- Do not feel qualified (4)

Do not meet application criteria/ difficulties with the application process (34)

- Need pre-requisites or course work (9)
- Lack of research experience (8)
- Rejected (6)
- Competitive (4)
- GPA (2)
- Research response, lack of (2)

Application Process (1)

Bureaucratic rules (1)

International Student (1)

Other (72)

Time, none, too busy, schedule, availability (35)

Not interested or not ready to decide (20)

Have had research experience (12)

Decision to be in NS (3)

Shadowed, but not neurologist (1)

Unsure N/A (1)

If you have attempted to gain clinical neurology experiences, what, if any, were the barriers to gaining this experience?

Covid-19 disruptions (158)

Covid19, impact on process (156)

Research experience, cancelled (2)

Do not meet application criteria/ difficulties with the application process (116)

Lack of research experience (26)

Age and or Education (22)

Research response, lack of (19)

Bureaucratic rules (10)

Need pre-requisites of course work (9)

Competitive (9)

Rejected (7)

International student (5)

GPA (4)

Application process (3)

Gender Race (2)

Lack of resources (128)

Opportunities, limited (62)

Location (7)

Resources, lack of or accessibility issues (7)

Research experience, have had (16)

Time, none, too busy, schedule, availability (14)

Shadowed, but not neurologist (4)

Interest, not or not ready to decide (2)

Do not know where to start (42)

Connections, none or don't know who to reach out (41)

Start, don't know how to do this start (1)

Unsure/ NA (6)

If you have not attempted to gain clinical neurology experience, why not?

Covid19, Impact on the process (121)

Time, none, too busy, schedule, availability (95)

Interest, not or not ready to decide (81)

Start, do not know how to do this start (77)

Opportunity, none (58)

Opportunities, limited (50)

Research experience, have had (33)

Age and or Education (27)

Awareness, not aware of concept (27)

Opportunities, none yet, but plan to (21)

Connections, none or do not know who to reach out to (20)

Decision to be in NS (12)

Resources, lack of or accessibility issues (12)

Location (9)

Need pre-requisites or course work (8)

Do not feel qualified (7)

International student (4)

Lack of research experience (4)

Online school (4)

Competitive (2)

Rejected (1)

Shadowed, but not neurologist (1)

Unsure NA (6)

*For main points extracted from eTable 2 please refer to eSupplement1

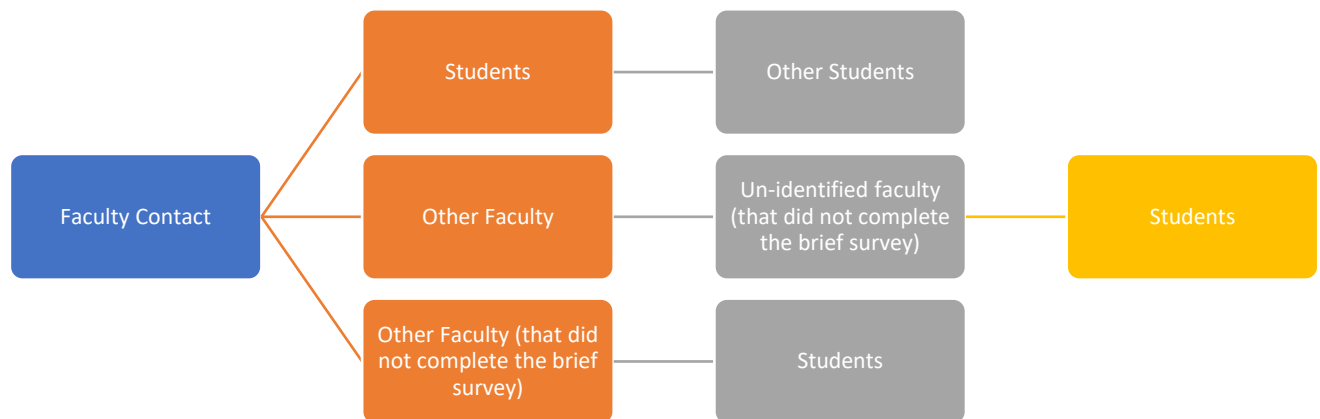
E-Table 5: Neurosciences Experiences and Exposure of Students from Different Races

	White Only (n=618), n, %	Non-white/Multiracial (n=467), n, %	p-value (OR; 95%CI)*
Plans to pursue graduate studies	558, 91%	414, 89%	0.4014
Career goal (physician)	323, 52%	291, 62%	0.0009 (0.66; 0.52-0.85)
Interest in attending Neurology conferences	538, 87%	405, 87%	0.9793
Engaged with scientific literature	517, 84%	368, 79%	0.0421 (1.38: 1.01-1.88)
Conducted Neuroscience research	248, 40%	217, 47%	0.0359 (0.77: 0.60-0.98)
Spoken to a neurologist about career experiences	183, 30%	129, 28%	0.4906
Decided Neuroscience Major before college	303, 49%	209, 45%	0.1625
Opportunity to interact with neurology patients	152, 25%	122, 26%	0.5453
Opportunity to shadow a neurologist	84, 14%	63, 13%	0.9446
Earliest Age (median [IQR] KW p-value)	14 [12-16]	14 [10-15]	0.0592

*Odds Ratios (OR) and Confidence Intervals (CI) s included for significant associations only.

*For main points extracted from eTable 3 please refer to eSupplement1

E-Figure 1, Participant Survey Snowball Effect



*Through this process we identified a snowball effect. Additional participants were emailed the survey beyond those who identified through our faculty contacts. Students forwarded it to other students, faculty who did not complete the brief survey forwarded it to students, and faculty forwarded it to other un-identified faculty (who did not complete the faculty survey) who forwarded it to students.