The 2003 ANDP Survey of Neuroscience Graduate, Postdoctoral, and Undergraduate Programs

Edward M. Stricker, Ph.D., University of Pittsburgh

Introduction

Neuroscience Departments and Programs are relatively new entities, being virtually unknown 35 years ago. By now they are plentiful, diverse in organization and goals, and still evolving. For years the ANDP has attempted to monitor that evolution by characterizing the departments and programs along several important dimensions so that we can know ourselves better (i.e., bench-marking) and present ourselves better to our colleagues, our deans, our students, and to the federal agencies that support our predoctoral and postdoctoral training programs.

The first ANDP surveys of graduate and postdoctoral training in the U.S and Canada were conducted in 1986 by Michael Zigmond, in 1991 by Linda Spear, and in 1998 by Lesly Huffman, Robert Fellows, and Ronald Schoenfeld.[1,2] In 2000, we wanted to initiate a series of annual surveys that focused on the most critical issues and allowed current information about the academic discipline to be readily available. Two versions of the survey were developed, one intended for graduate and postdoctoral programs and one intended for undergraduate programs. Programs were asked to complete and submit data electronically to the University Center for Social and Urban Research (UCSUR) at the University of Pittsburgh, which helped to design the surveys and was responsible for compiling the obtained responses. A report based on the obtained data, which focused on academic year 1999-2000 (AY2000), was posted on the ANDP web page in spring 2001.[3]

In early 2002, another survey was conducted which focused on AY2001. The new data were added to the pool of responses from the previous year, and a report based on the merged file of information spanning two consecutive years was posted on the ANDP web page in spring 2002.[4] The feedback we received in response to the AY2001 survey encouraged us to conduct surveys every other year rather than annually. Thus, the present survey was begun in fall 2003 and focused on AY2003. Responses were obtained from 86 of the 131 graduate training programs that were members of the ANDP, which represents an excellent 66% rate of participation.[5] Similarly, responses were obtained from 23 of the 35 undergraduate programs that were members of the ANDP (also 66%). As with the previous surveys, their value is not in the absolute numbers they provide but in their relative numbers and trends in comparison to the results of earlier surveys. In this regard, 70 (81%) of the graduate programs that participated in the 2003 survey, and 17 (74%) of the undergraduate programs, also had participated in the 2000/2001 surveys, which encouraged such comparisons.

A complete list of the 86 graduate programs and 23 undergraduate programs that participated in the 2003 survey is given below. A broad cross-section of graduate Neuroscience departments and programs were represented. That is, responses were obtained from older programs and relatively new programs, from programs with many students and programs with relatively few students,

and from programs located in medical schools and programs located in colleges of arts and sciences (or both, or neither). Almost all of the graduate programs were located in the United States, in 30 states plus the District of Columbia, but responses also were obtained from programs in three Canadian provinces. Similarly, the 23 institutions with undergraduate programs in the neural sciences were diverse in age, size, institutional affiliation, and administrative structure, and were located in 14 states in the U.S. The results reported below represent the full responses from these programs but for the responses from the graduate programs in Canadian institutions to questions regarding U.S. citizenship and U.S. racial and ethnic minority groups, which were excluded.

The results have been organized for presentation in the following nine categories. The first six categories summarize the results regarding graduate and postdoctoral training. Whenever possible, the results based on the 2003 survey were compared with those obtained from the ANDP surveys in 1986, 1991, 1998, and 2000/2001. The seventh category summarizes the responses regarding undergraduate training. The final two categories provide a summary of the major findings of the 2003 survey and the conclusions drawn. A specific index of these nine categories is as follows:

Results

[1]Zigmond, M.J. and Spear, L.P. Neuroscience training in the USA and Canada: observations and suggestions. *Trends in Neuroscience* 15: 379-383, 1992.

[2]Huffman, L., Fellows, R.E., and Schoenfeld, R.I. The 1998 ANDP survey of neuroscience graduate & postdoctoral programs.

[3]Stricker, E.M. The 2000 ANDP survey of neuroscience graduate, postdoctoral, & undergraduate programs.

[4]Stricker, E.M. The 2000 and 2001 ANDP surveys of neuroscience graduate, postdoctoral, & undergraduate programs.

[5]The expert advice and technical assistance of Mr. Diego Jarrin of the UCSUR is gratefully acknowledged.

Participating Institutions

Graduate and Postdoctoral Programs (*n* = 86)

Note that some institutions have multiple Neuroscience training programs (the number of which is indicated in parentheses), which participated separately in the survey.

U.S. *State*	*Institution*
AL	University of Alabama, Birmingham
AZ	University of Arizona
CA	Scripps Research Institute
CA	University of California, Los Angeles
CA	University of California, Riverside
CA	University of California, San Diego
CO	Colorado State University
CO	University of Colorado Health Science Center
CT	University of Connecticut
CT	University of Connecticut Health Center
DC	Georgetown University
DC	George Washington University
FL	Florida State University
FL	University of Florida (2)
FL	University of South Florida
GA	Georgia State University (2)
IA	University of Iowa
IA	University of Iowa College of Medicine (2)
IL	Finch University of Health Sciences
IL	Loyola University, Chicago
IL	Northwestern University
IL	University of Chicago
IL	University of Illinois
IL	University of Illinois at Chicago (2)
IN	Indiana University
LA	Louisiana State University Health Science Center
LA	Tulane University
MA	Boston University (2)
MA	Boston University School of Medicine
MA	Brandeis University
MA	Harvard University Medical School
MA	Massachusetts Institute of Technology
MA	Tufts University School of Medicine
MA	University of Massachusetts
MD	Johns Hopkins University
MD	Uniformed Services Univ. of Health Sciences
MD	University of Maryland
MD	University of Maryland, Baltimore

MI Michigan State University
MN Mayo Graduate School
MN University of Minnesota
MT Montana State University, Bozeman
NC Duke University
NC University of North Carolina
NC Wake Forest University
NY Columbia University
NY Columbia University College of Physicians and Surgeons
NY CUNY, Hunter College
NY Institute for Basic Research in Developmental Disabilities
NY Mt. Sinai School of Medicine
NY SUNY, Stony Brook
NY SUNY Health Science Center at Syracuse
NY Weill Medical College of Cornell University
OH Case Western Reserve University
OH Medical College of Ohio
OH Ohio State University
OK University of Oklahoma
OR Oregon Health Sciences University
PA Lehigh University
PA Temple University
PA University of Pennsylvania School of Medicine
PA University of Pittsburgh
SC University of South Carolina
TN Vanderbilt University
TX University of Houston
TX University of Texas, Austin
TX University of Texas, San Antonio
TX University of Texas Health Science Center, San Antonio
TX University of Texas Health Science Center, Houston
TX University of Texas Medical Branch, Galveston
UT University of Utah
VT University of Vermont
WA University of Washington
WA Washington State University
WI Marquette University
WI University of Wisconsin, Madison
WI University of Wisconsin, Milwaukee
WY University of Wyoming

CANADA

Prov. *Institution*

BC University of British Columbia
NS Dalhousie University
ON University of Toronto

Undergraduate Programs (n = 23)

State	*Institution*
CA	Pomona College
CA	Westmount College
CO	Colorado College
CT	Wesleyan University
GA	Emory University
LA	Tulane University
MA	Amherst College
MA	Boston College
MA	Brandeis University
MA	Massachusetts Institute of Technology
MD	Johns Hopkins University
MN	University of Minnesota
NC	Davidson College
NY	Ithaca College
NY	University of Rochester
PA	Cedar Crest College
PA	Lafayette College
PA	Lehigh University
PA	University of Pittsburgh
PA	Westminster College
UT	Brigham Young University
VA	Washington and Lee University
WA	Washington State University

1. Program Characteristics

Table 1a - School Affiliation

The locus of graduate education in the neural sciences continues to evolve. In the 1991 survey, graduate programs located in Schools of Medicine were most numerous, representing almost 40% of all programs. Relatively few programs involved multiple schools at the university. In the 2000 and 2001 surveys, however, the percentage of such broadly based programs had increased considerably and was comparable to that of programs located solely in Schools of Medicine, which had begun to decrease in number. In the 2003 survey, that trend continued and the institution-wide programs represented 40% of all programs, whereas the programs located solely in Schools of Medicine had decreased to 22%. In contrast, the programs located in Schools of Arts and Sciences remained at 28-30% of all programs throughout this period.

Survey Year	91	98	00/01	03
	Percent of Total			
School of Medicine	38	43	33	22
Arts & Sciences	30	30	29	28
Multiple Schools	17	21	34	40
Other	15	7	4	10

Table 1b - Administrative Structure and Degree Granted

The administrative structure of graduate programs in the neural sciences is quite varied. Only 18% of current programs are found exclusively in Departments of Neuroscience or Neurobiology (or in departments that had those words in their name, such as “Behavioral Neuroscience” and “Anatomy and Neurobiology”). In contrast, 60% of the programs link neuroscientists in multiple departments (or in a “Division” or “Institute” of Neuroscience) in a unified, degree-granting program, and only 22% are in departments that do not have Neuroscience or Neurobiology in their names. These numbers are similar to those obtained in the 2000/2001 ANDP surveys.

Perhaps in consequence of the administrative structure of graduate programs in Neuroscience, the degree awarded to graduate students trained in the neural sciences is three-times more likely to be a Ph.D. in Neuroscience or in Neurobiology (or in a discipline that had those words in their name) than a Ph.D. in another discipline. This situation represents a striking reversal from that which occurred 17 years ago, when the majority of such degrees were awarded in other disciplines. (The “Other” category in the table represents the relatively few graduate training programs in the neural sciences that do not offer a Ph.D. degree.)

Survey Year	86	91	98	00/01	03
	Percent of Total				
Ph.D. in Neuroscience	24	28	66	63	71
Ph.D. in another discipline	74	54	30	33	24
Other	2	18	4	4	5

Another consequence of the predominantly multidepartmental structure is that only 44% of graduate training programs in the neural sciences hire their own faculty. In the 2000/2001 ANDP surveys, 60% did so.

Table 1c - Undergraduate Activities

Graduate programs in the neural sciences now play a substantial role in the education of undergraduate students. Although only 15% of the graduate programs additionally administer an undergraduate program in Neuroscience, most graduate programs have faculty members who teach undergraduate courses (65%) and provide opportunities for undergraduate students to be involved in research projects (94%). These important contributions are much greater than those reported 12 years ago, a development which may result from the increasing number of graduate programs whose faculty members are drawn from multiple schools within an institution.

Survey Year	86	91	98	00/01	03
	Percent of Total				
Formal Program	-	23	24	26	15
Teaching	9	48	39	69	65
Research	-	68	62	91	94

2. Faculty

There are 3091 faculty members in the 75 graduate training programs in the neural sciences that responded to these questions in the 2003 survey, which computes to 41 faculty members per program. The 1998 and 2000/2001 surveys reported an average of 34 and 36 members per program, respectively, so a trend of increasing faculty size is now apparent. Thirty-seven (90%) faculty members per program have tenure-stream positions whereas 4 have nontenure-stream positions. These numbers are similar to those observed in the 1998 and 2000/2001 surveys.

There is considerable stability in the training faculty. In AY2003, only 3% of the tenure-stream faculty left their positions while only 6% arrived as new appointments. A similarly low turnover was observed in the two previous surveys. The turnover of nontenure-stream faculty was comparable (2% leaving, 10% arriving) and also was similar to that observed in previous years.

Table 2a - Number of Faculty per Program

The number of tenure-stream faculty members per graduate program varies widely, from less than 10 to more than 100 per program. However, 73% of the programs have 50 or fewer faculty members (the median number is 30).

Number	
0-10	17%
11-20	19%
21-30	17%
31-40	11%
41-50	9%
51-60	7%
61-70	9%
71-80	2%
81-90	3%
>90	6%

Table 2b - Distribution of Faculty by Academic Rank

The distribution of tenure-stream faculty across the three ranks is strikingly similar to that reported in the previous surveys; approximately half the faculty are full professors and one-fourth each are at the assistant and associate levels.

Survey Year	86	91	98	00/01	03
	Percent of Total				
Assistant Professor	23	26	24	23	23
Associate Professor	28	28	25	26	25
Full Professor	49	46	51	51	52

Ninety percent of faculty members who have tenure-stream positions at U.S. institutions are U.S. citizens. This number is similar to that seen in the 1991, 1998, and 2000/2001 surveys (93%, 97%, 95%, respectively). Similarly, eighty-one percent of faculty members holding nontenure-stream positions at U.S. institutions are U.S. citizens, which is less than that seen in the 2000/2001 surveys (90%).

The distribution by academic rank of faculty members who are not U.S. citizens (32% assistant professors, 26% associate professors, and 42% full professors) is similar to that of U.S. citizens (22% assistant professors, 25% associate professors, and 53% full professors) but is less skewed towards the full professors. Most of these tenure-stream faculty members are citizens of Latin America (39%), Europe (30%), or Asia (22%).

Table 2c - Percentage of Women by Academic Rank

Seventeen years ago women represented only 15% of all tenure-stream faculty members in graduate programs in the neural sciences. Since then their number has increased steadily, although in the 2003 survey it still is only 25% of the total, and the percentage of full professors who are women is only 21%. Consequently, women faculty members are distributed in more equal numbers across the three academic ranks (30% assistant professor, 28% associate professor, 42% full professor) than are men (21%, 24%, 55%, respectively).

Survey Year	86	91	98	00/01	03
	Percent of Total				
Assistant Professor	23	27	32	30	33
Associate Professor	20	22	27	30	28
Full Professor	9	13	19	17	21

In contrast, women represented 43% of nontenure-stream faculty members in AY2003. This number was greater than that seen in the 2000/2001 ANDP surveys (38%).

3. Graduate Education

Table 3a – Recruitment

The number of applications to graduate training programs in the neural sciences continues to increase; in the 2003 survey, it was more than three times the number per program than it was in the 1986 survey. Offers of admission rose similarly during the same time period, although the number of students matriculating per program increased at a slower rate. Much of these increases appear to have come in the past five years.

Women represented 39% of the applicants, 37% of the students admitted, and 54% of those who began graduate training in the neural sciences in AY2003. Students who are not U.S. citizens represented 44% of the applicants but only 15% of the students admitted and 18% of those who began graduate training. Although students who are members of U.S. racial and ethnic minorities represented only 6% of the applicants and 7% of the students admitted, they constituted 14% of those who began graduate training.

Survey Year	86	91	98	00/01	03
	Mean per program				
Number of students applied	24	42	61	66	82
Number of students admitted	6	10	12	14	22
Number of students entered	4	5	5	9	10

Table 3b - Academic Credentials of Entering Students

The academic credentials of students entering graduate programs in the neural sciences are similar to those of students characterized in previous surveys. Mean GRE scores in the quantitative and analytical sections of the exam have increased steadily over the years, whereas scores on the verbal section have decreased. The scores in the 2003 survey place incoming graduate students in approximately the 80th, 80th, and 76th percentiles, respectively, of all students who took the GRE exams. Ninety percent of the students had research experience before they began graduate training, as in previous years.

The incoming graduate students had a mean GPA in their college courses between B+ and A-, as was seen in the previous surveys. Only 14% of these students had an undergraduate major in Neuroscience, Behavioral Neuroscience, or Psychobiology. Other common undergraduate majors were Biology (29%), Psychology (17%), and Chemistry or Biochemistry (8%), and an additional 10% had dual majors including one or more of these disciplines. It seems plausible that many other entering students had undergraduate majors in computer science and/or mathematics, but unfortunately that choice was not available in the relevant survey question.

Survey Year	86	91	98	00/01	03
	Average GRE Scores				
Quantitative	624	630	658	689	698
Analytical	624	635	650	670	670
Verbal	590	600	577	567	563

Table 3c - Total Predoctoral Students, and Ph.D. Degrees Awarded, per Program

The number of graduate students per program varies widely, from less than 10 to more than 100; however, 86% of the programs have 50 or fewer students (the median number is 28). The number of faculty in a program, shown earlier in Table 2a, is shown again for purposes of comparison. Note that the first row in this table indicates that 17% of the programs have 0-10 faculty, while 16% of the programs have 0-10 students. The number of graduate students in a program is closely correlated with the number of tenure-stream faculty members in that program ($r = 0.616$, $P < 0.001$).

Number	Faculty	Students
0-10	17%	16%
11-20	19%	19%
21-30	17%	20%
31-40	11%	17%
41-50	9%	14%
51-60	7%	3%
61-70	9%	2%
71-80	2%	4%
81-90	3%	2%
>90	6%	3%

The mean number of graduate students per program has increased steadily since 1986, especially in the last 5 years, and is now 33. This increase undoubtedly reflects the increase in admission of new students that has occurred during the past 15 years (Table 3a, above), as well as the increase in time required for them to obtain a Ph.D. degree (Table 3d, below).

Women represent 50% of this population of graduate students in AY2003, while students who are not U.S. citizens represent 21% of predoctoral trainees in U.S. institutions. Both numbers are comparable to those observed in previous surveys. Among the population of students who are not U.S. citizens, the largest numbers are from Asia (70%) and Europe (15%).

The large increase in graduate students per program was not accompanied by a similar increase in Ph.D. degrees awarded by those programs, which rose from 2.6 per program in the 1986 survey to only 3.6 per program in the 2003 survey. This difference can be attributed in part to the students who left the graduate program without obtaining a Ph.D. degree, and in part to an increase in time to Ph.D. degree (Table 3d, below). Among the graduates, 44% were women, 29% were non-U.S. citizens, and 17% were members of U.S. racial and ethnic minorities, which resemble their representations in the total population of predoctoral trainees.

Survey Year	86	91	98	00/01	03
	Average per Program				
Total predoctoral trainees	12	16	20	25	33
Non-U.S. citizens (%)	---	20	19	20	21
Ph.D. degree awarded	2.6	2.8	3.2	3.6	3.6
Ph.D. degree not awarded	---	---	---	1.3	1.1

Table 3d - Years in Program

The number of years in graduate training that are required to obtain a Ph.D. degree increased substantially between the 1986 and 1991 surveys, but it has changed little since then. For students graduating in AY2003, it took 5.6 years on average to complete training, with 89% of the students doing so between 4 and 7 years. These numbers were virtually identical for U.S. and non-U.S. citizens, and for male and female students.

Only 3% of predoctoral trainees (~1.1 per program) left their graduate programs in AY2003 without obtaining a Ph.D. degree. Among them, the numbers of women (53%), U.S. racial and ethnic minorities (18%), and non-U.S. citizens (22%) were similar to their representations in the total population of predoctoral trainees. Students who left did so after 2.4 years of training, on average (92% within 4 years). Most students (53%) left with a M.S. degree. A surprisingly high number of the students who left (20% of US citizens, 14% of non-U.S. citizens) were in an M.D./Ph.D. program, and they either returned to medical school or began their medical internship or residency. All of these numbers are comparable to those observed in the 2000/2001 surveys.

Survey Year	86	91	98	00/01	03
	Average Years				
Ph.D. awarded	4.3	5.2	5.5	5.5	5.6
Ph.D. not awarded	---	---	2.2	2.5	2.4

Table 3e - Placement of New Graduates with a Ph.D. Degree

Upon receiving their Ph.D. degree, most graduates pursued further research training and accepted postdoctoral positions (71%), as was observed in the previous surveys. This was especially true among non-U.S. citizens (81%, vs 67% among U.S. citizens). Many graduates went to medical school or began a medical internship or residency (16%); this was especially true among U.S. citizens (19%, vs 7% among non-U.S. citizens). Relatively few graduates took faculty positions (3%) or jobs in industry (3%). As in previous years, very few graduates were employed outside of Neuroscience or were not yet employed (0% in the 2003 survey). Male and female graduates were similar in each of these respects.

Survey Year	91	98	00/01	03
	Percent of Total			
Postdoctoral position	60	70	62	71
Medical School	13	15	11	16
Faculty position	6	5	7	3
Industry	12	1	8	3
Other	6	5	8	7
Employed outside the field	2	3	2	0
Currently unemployed	1	1	2	0

4. Postdoctoral Training

Table 4a - Profile of Postdoctoral Trainees

Most of the postdoctoral trainees (87%) have only a Ph.D. degree, as has been observed since 1986.

Survey Year	86	91	98	00/01	03
	Percent of Total				
Ph.D.	78	63	88	83	87
M.D.	18	25	5	9	7
M.D./Ph.D.	4	12	6	6	5
Other	0	0	1	2	1

Only about one-fourth of the programs provided additional information about postdoctoral trainees beyond their prior doctoral training, certainly much less information than was provided about predoctoral trainees and faculty members in the programs. Perhaps such information is not yet commonly tracked by the administrative offices of graduate programs in Neuroscience. Inspection of the data from the past two surveys similarly indicates that programs provided much less information about postdoctoral trainees than about predoctoral trainees or faculty, and the same may be true of previous surveys as well. That caveat should be kept in mind when considering the results obtained over the years.

The number of postdoctoral trainees per program in the 2003 survey (11) is similar to the numbers (7-12) seen in previous surveys. Sixty-four percent of these trainees are not U.S. citizens, three times as many as there are among predoctoral trainees and progressively more than were observed in the 1991, 1998, and 2000/2001 surveys (40%, 49%, and 60%, respectively). Among that population, the largest portions are from Asia (56%) and Europe (31%). Women constitute 40% of the foreign postdoctoral trainees, 44% of the domestic trainees, and 42% of the overall population.

Table 4b - Placement from Postdoctoral Position

When postdoctoral trainees leave, they typically either take a faculty position (38%) or pursue additional training in another postdoctoral position (37%). This general outcome also was seen in the previous surveys, although it is now clear that a progressive increase has occurred in the numbers who take another postdoctoral position. As in previous years, very few postdoctoral trainees leave to take employment outside of Neuroscience or are not employed. This pattern of placements was similar for U.S. citizens and non-citizens. In addition, there were no apparent gender differences either in who left a postdoctoral position (i.e., 61% males, 39% females, numbers which are close to their representations among fellows) or in their subsequent placement (e.g., 35% of males and 39% of females took another postdoctoral position).

Survey Year	91	98	00/01	03
	Percent of Total			
Another postdoctoral position	21	30	34	37
Medical School	3	1	6	4
Faculty position	45	28	41	38
Industry	14	4	5	7
Other	14	29	9	14
Employed outside the field	2	1	3	0
Currently unemployed	1	6	1	0

5. Diversity

Table 5a - Minority Representation

The representation of U.S. racial and ethnic minorities as a percentage of all predoctoral trainees has almost doubled since the 1986 and 1991 surveys. Although a comparable increase in their representation among postdoctoral trainees does not appear to have occurred, it should be noted that the figures on the left side of Table 5a are confounded by the substantial increase in the number of postdoctoral trainees at U.S. institutions who are not U.S. citizens. When the figures are expressed as a percentage of only the postdoctoral trainees who are U.S. citizens (right side of the table), it becomes clear that the training of members of U.S. racial and ethnic minorities actually have followed similar trends at the pre- and post-doctoral levels. On the other hand, minority representation in tenure-stream faculty positions has increased much more gradually over the years, and it still remains quite low. It is distributed in roughly equal numbers across the three academic ranks (33% assistant professor, 29% associate professor, 38% full professor), as is true of women tenure-stream faculty members. However, unlike women, minority representation in nontenure-stream positions is similar to that in tenure-stream positions (8% of total, 10% of U.S. citizens).

Survey Year	86	91	98	00/01	03	91	98	00/01	03
	Percent of Total					Percent of Total U.S.			
Predoctoral	10	9	18	18	16	11	22	23	20
Postdoctoral	22	6	11	6	8	10	21	16	20
Tenure-stream Faculty	5	6	7	8	8	6	7	8	9

Table 5b - Minority Distribution

Among the U.S. racial and ethnic minority population, Asian-Americans represent the largest group of predoctoral and postdoctoral trainees, and of tenure-stream faculty, in the neural sciences. Hispanic-Americans are much less numerous in all three categories, while African-Americans are even fewer in number, and Native Americans are still fewer.

Survey Years	91	98	00/01	03	91	98	00/01	03	91	98	00/01	03
	Percent of Total Minority											
	Predoc				Postdoc				Faculty			
Asian Amer.	38	42	41	41	53	50	69	50	64	61	57	66
Hispanic Amer.	32	25	30	30	25	10	19	25	22	20	24	17
African Amer.	22	20	17	18	12	32	12	21	11	7	9	8
Native Amer.	0	8	2	1	0	4	0	0	0	5	1	0
Other	8	5	10	10	10	4	0	4	3	7	9	9

When funding trainees, the U.S. federal government places special emphasis on African-Americans, Hispanic-Americans, Native Americans, and Pacific Islanders among members of U.S. racial and ethnic minorities because they are under-represented in academia. Thus, it should be noted that when just these groups are considered and Asian-Americans are excluded, their representation in the 2003 survey is reduced to only 12% of predoctoral trainees who are U.S. citizens (10% of all predoctoral trainees), only 8% of postdoctoral trainees who are U.S. citizens (3% of all postdoctoral trainees), and only 3% of tenure-stream faculty members who are U.S. citizens (3% of all such faculty members).

6. Financial Support

Table 6a - Stipend Sources - First Year Graduate Students

Almost all predoctoral trainees in the neural sciences receive stipend support. First-year graduate students receive 57% of this support from University funds, often in the form of teaching assistantships. The balance of their stipend is derived from a combination of training grants, research grants, and fellowships, in much smaller amounts. Other than a gradual decrease in teaching assistantships and increase in training grant funds, these numbers have changed little during the past 17 years.

Survey Year	86	91	98	00/01	03
	Percent of Total				
Teaching assistantship	34	29	29	27	23
Other university funds	30	38	41	39	34
Training grants	9	10	10	15	18
Research grants	16	14	9	14	14
Fellowships	10	8	11	5	11

Table 6b - Stipend Sources - Advanced Graduate Students

Predoctoral trainees advanced beyond their first year receive only 35% of their support from the university. This amount has been decreasing steadily since the 1986 survey. To compensate for this change, research grants have provided increasing support of these advanced graduate students; indeed, in the 2003 survey research grants provided more than twice as much as any other single contribution to the pool of funds.

Survey Year	86	91	98	00/01	03
	Percent of Total				
Teaching assistantship	31	27	29	22	18
Other university funds	21	21	12	12	17
Training grants	12	9	6	12	11
Research grants	24	33	37	43	40
Fellowships	13	10	6	11	14

Table 6c - Stipend Sources - Postdoctoral Trainees

Research grants have been the major source of the stipends for postdoctoral trainees during the past 17 years. The first three ANDP surveys considered the support of all postdoctoral trainees collectively, whereas the 2000 and 2001 surveys and the present survey considered U.S. and non-U.S. citizens separately. The latter results indicate a growing dependence on research grants to support postdoctoral trainees, especially those who are not U.S. citizens; such grants now provide at least two-thirds of the stipends. Training grants and fellowships, which together once provided half of the total support, now provide only about 20% of the funds, and universities provide the balance (less than 10%).

Survey Year	86	91	98	00/01 (U.S.)	00/01 (Non-U.S.)	03 (U.S.)	03 (Non-U.S.)
	Percent of Total						
University funds	8	12	9	4	4	4	10
Training grants	22	16	12	11	1	19	4
Research grants	38	50	65	74	90	67	75
Fellowships	30	22	12	10	5	10	10

7. Undergraduate Programs

The existence of undergraduate programs in Neuroscience is a relatively recent phenomenon. Based on information available from 33 of the 35 undergraduate program members in the ANDP, 5 (15%) programs were founded before 1980, 8 (24%) were founded between 1980 and 1989, and 20 (61%) were founded after 1989. Roughly the same distribution was seen among the 23 programs that participated in the 2003 survey. Thus, a representative mix of older and newer programs participated in the present survey, as in the previous two surveys.

i. Institutional Affiliation. Thirteen (57%) of the 23 programs are located in undergraduate colleges that do not have a Ph.D. program in Neuroscience, whereas the other 10 programs are at universities that have a graduate program in Neuroscience.

ii. Administrative Structure. Sixteen (70%) of the 23 programs are interdisciplinary in nature, and offer a B.S. or B.A. degree in Neuroscience. Three programs offer a B.S. or B.A. degree either in Biology or Psychology, with a specialization in Neuroscience. Only four programs are located in Departments of Neuroscience or Behavioral Neuroscience.

iii. Faculty Hiring. Fifteen (65%) of the 23 programs hire faculty members for their program. This response is much greater than the number of graduate training programs that do so (44%).

iv. Faculty Appointments. The average number of faculty members with tenure-stream positions in AY2003 is 10 per program. That number has changed little during the previous few years, and there was only 7% turnover of positions (i.e., faculty members leaving and arriving as a percent of the total number of faculty affiliated with a program). An additional 4 faculty positions are outside the tenure-stream, and the turnover of faculty with such positions was 15%.

v. Faculty. In AY2003, the distribution of faculty members with tenure-stream positions is 24% assistant professors, 29% associate professors, and 47% full professors. Women occupy 30%, 41%, and 14% of these positions, respectively, for a total of 26% of all tenure-stream positions. They also hold 45% of the nontenure-stream faculty positions. These numbers are similar to those of faculty members in graduate programs in the neural sciences, with the exception that the relative portion of women is higher at the associate professor level and lower at the full professor level.

Among faculty with tenure-stream positions, 8% are members of U.S. racial and ethnic minorities, and only 2% are not U.S. citizens. Among faculty with nontenure-stream positions, 6% are members of U.S. racial and ethnic minorities, and 9% are not U.S. citizens.

vi. Undergraduate Students. The number of undergraduate students with Neuroscience majors continues to increase substantially, as was noted in the previous surveys. On average, there are now 85 Neuroscience majors per program, up from 55 two years ago. However, the number per program varies widely (range = 3 to 340), and the median number of majors per program is 58. There are approximately equal numbers of males and females among the undergraduate students with majors in Neuroscience (52% female), as also is true of predoctoral trainees.

These results must be considered with caution because of the relatively small size of the obtained sample. Nonetheless, it should be noted that each response was similar to the one provided in the 2000 and 2001 surveys, except as noted.

8. Summary

Graduate training programs in the neural sciences used to be located predominantly in Schools of Medicine or in Schools of Arts & Sciences. However, recently medical school programs have been evolving towards larger, university-wide programs that link neuroscientists in multiple schools on campus.

Although the administrative structure of graduate programs in the neural sciences is quite varied, most training now is conducted in interdisciplinary programs rather than in departments offering degrees in neuroscience or in other disciplines. Graduate students are much more likely to be awarded a Ph.D. degree in Neuroscience or Neurobiology than in another discipline.

Graduate faculty members in the neural sciences play a very substantial role in undergraduate education, both by teaching undergraduate courses and by providing opportunities for undergraduate students to become involved in their research projects.

There are ~41 faculty members per program, on average, in the graduate programs surveyed. Ninety percent of the faculty members have tenure-stream positions. The annual turnover in these positions is less than 10%. Approximately half of the tenure-stream faculty members are full professors while one-fourth each are assistant professors or associate professors.

The annual number of applications for graduate training in the neural sciences has more than tripled during the past 17 years and is now ~82 per program, while the number of matriculants has almost tripled and is now ~10 students per program. Nonetheless, the academic quality of incoming graduate students has remained high, as suggested by their undergraduate GPA (average = 3.49), their scores on the GRE (average = ~79th percentile), and their research experience.

Only 14% of the incoming students had an undergraduate major in Neuroscience or Behavioral Neuroscience. Other common majors were Biology (29%), Psychology (17%), and Chemistry (8%), and an additional 10% had dual majors including one or more of these disciplines.

The number of Ph.D. degrees in Neuroscience awarded annually per program has increased little in recent years and is now 3.6, while the time to degree has stabilized at ~5.6 years. Predoctoral students who are women, U.S. racial and ethnic minorities, or non-U.S. citizens are equally likely to obtain their Ph.D. degree, and in the same time frame, as one another and as the American Caucasian male majority. Most new graduates pursue further research training in postdoctoral positions (71%), while many others go to medical school (16%).

Only 3% of predoctoral trainees leave the program annually without obtaining a Ph.D. degree. They do so on average after 2.4 years of graduate study, often (53%) obtaining a terminal M.S. degree.

Almost 90% of postdoctoral trainees in the neural sciences have a Ph.D. degree. Postdoctoral trainees usually leave their position either to accept a faculty position or to pursue further training. Almost all graduates with a Ph.D. degree in Neuroscience are employed in scientific

positions, and very few are employed outside the field or are not employed at all.

Women represent 52% of undergraduate Neuroscience majors, 50% of predoctoral trainees, and 42% of postdoctoral trainees, but only 25% of tenure-stream faculty members and 21% of full professors. In contrast, women represented 43% of nontenure-stream faculty members.

Among U.S. citizens, members of U.S. racial and ethnic minorities represent 20% each of predoctoral trainees and postdoctoral trainees, but only 9% of tenure-stream faculty members and 10% of nontenure-stream faculty members. Most of these trainees and faculty members are Asian-American. When Asian-Americans are excluded and only under-represented U.S. racial and ethnic minorities are considered, the numbers shrink to 12%, 8%, 2%, and 1%, respectively, of U.S. citizens.

Predoctoral trainees who are not U.S. citizens come predominantly from Asia and Europe. They now represent 21% of predoctoral trainees, a number that has changed little during the past 13 years.

The number of postdoctoral trainees who are not U.S. citizens appears to have increased progressively, and they now represent almost two-thirds of that population. Nonetheless, they occupy only 10% of all tenure-stream graduate faculty positions in the neural sciences at U.S. institutions, although their numbers have been increasing gradually in recent years.

Almost all predoctoral students receive stipend support, primarily from university funds (first-year students) and from research grant funds (more advanced students). Research grant funds also appear to be the major source of support for postdoctoral trainees.

Much less information was available from undergraduate programs in the neural sciences, but available evidence indicates that most programs are interdepartmental in administrative structure, and most tenure-stream faculty are American, Caucasian, male, full professors (98%, 92%, 74%, 47%, respectively). Although the number of tenure-stream faculty positions is relatively small (~10 per program) and has not changed during the past 2-3 years, the number of undergraduate students with majors in Neuroscience has almost doubled during that same time period (to 85 per program, on average).

9. Conclusions

Neuroscience is a very attractive discipline. It is an unusually multidisciplinary in nature, and has drawn significantly from fields as diverse as molecular biology, cognitive psychology, computer science, and clinical medicine. Increased recognition and appreciation of Neuroscience certainly has been promoted by such recent developments as the "decade of the brain", the award of Nobel prizes to several neuroscientists, and conspicuous progress in the diagnosis and treatment of Parkinson's disease, Alzheimer's disease, and spinal injury. These and other developments have attracted a steady increase in the number of graduate students being trained in the neural sciences, and an even greater rate of increase in the number of undergraduate students who major in Neuroscience. Increased recognition and appreciation of the discipline also is reflected in the likelihood that graduate students trained in the neural sciences will receive their degrees in Neuroscience or Neurobiology rather than in some other discipline, as was true 17 years ago.

The finding that graduate training in the neural sciences is not confined to departments of neuroscience is in keeping with a similar trend in other biomedical sciences (e.g., Cell Biology, Pharmacology), but is in striking contrast to graduate training in the physical sciences (e.g., Chemistry, Physics). In explanation, not all schools with neuroscientists as faculty members have departments of neuroscience. Even in schools with such departments, neuroscientists may be found in many other departments, both clinical (e.g., Neurology, Psychiatry) and preclinical (e.g., Biology, Pharmacology). Neuroscientists in these other departments understandably want to interact with their colleagues elsewhere on campus, both in research centers and in graduate training programs. The resultant integration of neuroscientists across departments and across schools undoubtedly enhances the quality of those programs while making the community more collegial, more visible and attractive to students and faculty, and more influential on campus. In addition, it makes it more likely that faculty appointed in graduate and professional programs will participate in undergraduate education.

Because the NIH budget doubled in the last 5 years, there likely have been substantial increases in the number and size of federally funded research grants devoted to issues in Neuroscience. Traditionally such research depends heavily on the involvement of predoctoral and postdoctoral trainees, and so a secondary increase in the number of such trainees is likely to have occurred as well. In fact, the marked increases in the number of students in Neuroscience graduate programs, seen in these surveys during the past 5 years, are consistent with that possibility. It is important to emphasize that there is no evidence that the quality of the entering graduate students has been reduced in order to expand the size of the programs, or that the goals of increasing diversity among predoctoral trainees have been compromised, or that disproportionately large numbers of foreign students are matriculating, although the percentage of postdoctoral fellows who are not U.S. citizens does appear to have risen sharply. In any case, graduate and postdoctoral programs in Neuroscience appear to be flourishing.

Despite these clear indications that Neuroscience is a thriving discipline, its research and training programs face several significant challenges. Some are not unique to Neuroscience but are common within the biomedical sciences generally.[6] For example, despite modest increases during the past 17 years, women still are very under-represented as tenure-stream faculty members, especially at the full professor level, in comparison to their full representation among

predoctoral trainees. At that rate of increase, it will take 42.5 more years for women to comprise 50% of the tenure-stream faculty members in Neuroscience. Even if one assumes a more rapid rate of turnover in faculty positions – for example, 3% of the faculty members leave each year of which 80% are men, and 6% are added annually of which 50% are women - it will take 20 years before women represent 50% of the tenure-stream faculty members. In other words, there is so much inertia in the system, caused by a very high initial percentage of male faculty members and a low rate of turnover of tenure-stream academic positions, that it will take a long time to redress this inequality unless graduate programs become even more committed than they now are to a policy of increasing diversity in their faculty. That commitment may be seen in the more rapid trend for women to achieve parity in nontenure-stream faculty positions, which are fewer in number and have a higher turnover rate than the tenure-stream positions.

Similar statements can be made regarding members of under-represented U.S. racial and ethnic minorities among faculty in graduate Neuroscience programs. However, their relatively slow progress to date in receiving appropriate representation in graduate faculties has been further impeded by their continued under-representation among predoctoral and postdoctoral trainees in Neuroscience.

Other issues may be more specific to training in the neural sciences at the undergraduate, predoctoral, and/or postdoctoral levels. Here are some that were addressed in this survey.

Undergraduate. The finding that most tenure-stream faculty positions in undergraduate Neuroscience programs are at the associate or full professor levels suggests that Neuroscience is not being taught primarily by faculty who received graduate and postdoctoral training in recent years. This situation likely provides a challenge for faculty to provide contemporary research experiences to their students, especially in undergraduate programs located at institutions that do not have graduate programs in Neuroscience.

Predoctoral. The remarkable heterogeneity in background of students entering graduate programs in the neural sciences suggests that extensive expertise in Neuroscience generally is not a significant variable in the admission process. This heterogeneity in background presents a considerable challenge for programs to design a suitable curriculum of graduate courses. Relevant undergraduate courses in Neuroscience sometimes are available on the same campus and represent an opportunity for graduate students to improve their background in the subject, though the faculty may be reluctant to encourage that option. To further complicate matters, less than half the graduate programs in the neural sciences can hire their own faculty, and therefore it seems likely that such programs have difficulty in maintaining a stable curriculum of graduate courses and research specialties. This situation likely occurs in many undergraduate programs, as well.

Postdoctoral. The percentage of non-U.S. citizens among predoctoral trainees in Neuroscience has been relatively constant during the past 17 years, which indicates that their presence is not responsible for the net increase in the size of graduate programs in the neural sciences during this time. In contrast, the number of non-U.S. citizens among postdoctoral trainees in Neuroscience has been increasing steadily, especially during the past 5 years, and they now outnumber domestic postdoctoral trainees almost 2-to-1. The financial support of postdoctoral trainees (and

advanced graduate students) has become increasingly dependent on faculty research grants, especially trainees who are not U.S. citizens and therefore are not eligible for federal fellowships or support on federal training grants. Whether the National Institutes of Health will continue to allow research grants to support so many trainees is a controversial matter now under discussion.[7,8] If the NIH decides to change their policy and limit the use of research funds to support trainees, then alternative funds for this purpose will have to increase or else the size of training and research programs in the neural sciences will diminish. An attractive proposal to reduce the number of trainees without compromising the faculty research programs in which they are engaged is to develop new academic job titles and professional scientist positions for advanced postdoctoral fellows who in most respects are no longer "trainees".[8-10]

Finally, a problem that cuts across all levels of training results from the finding that faculty positions in the neural sciences appear to be increasing more slowly than the rate at which Ph.D. degrees in Neuroscience are being awarded. Perhaps in consequence, an increasing percentage of trainees are moving from one postdoctoral position to another rather than taking a job outside of academia. It would be of interest to know whether, over the years, there actually has been a progressive increase in the total period between the time when a Ph.D. degree was earned and the time when a faculty position was secured, as seems likely; unfortunately, this information has not been available from Neuroscience program administrators and therefore it has not been tracked by ANDP surveys. Note that such a trend has been documented in other biomedical sciences.[11,12] Recent evidence also indicates that a rising percentage of graduating students in the biomedical sciences are employed in industry,[12] although the present survey provides no evidence to support that trend among neuroscientists.

It has been a challenge to prepare postdoctoral fellows located in academic training programs for professional careers in nonacademic positions. It has been an even bigger challenge to develop a sound national policy regarding how many predoctoral and postdoctoral trainees there should be. One suggestion is to limit graduate training and thereby reduce the number of postdoctoral trainees seeking employment in academia.[7,13] However, the ANDP leadership has opposed that view, pointing out that it never has been possible to accurately predict future job markets, that numerous opportunities for employment besides faculty positions always have been available, and that postdoctoral trainees almost invariably find employment in science ultimately.[14] More generally, it seems inappropriate to prevent students from obtaining the training they seek in order to compete successfully for the jobs they want, it seems unwise to reduce graduate education in science at a time when life has become increasingly more complex and science-based, and it seems unfair to place limits on opportunities when some groups have not yet had a chance to take advantage of them. On the other hand, it also seems inappropriate for graduate programs not to educate trainees broadly while preparing them for diverse careers and for the uncertainty they may experience during possibly lengthy periods while they identify and begin to pursue their professional goals.

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