The 2007 ANDP Survey of Neuroscience Graduate, Postdoctoral, & Undergraduate Programs

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The report is also available in pdf format for printing as is a set of powerpoint slides that summarizes the main points of the survey. (See ANDP Spring 2008 meeting for the latter.)

Introduction

Neuroscience Departments and Programs are relatively new entities, being virtually unknown 40 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 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 next survey was begun in fall 2003 and posted in spring 2004,[5] and the survey after that one was begun in fall 2005 and posted in spring 2006.[6] The present survey was begun in fall 2007. Responses were obtained from 114 of the 158 graduate training programs that were members of the ANDP, which represents an excellent 72% rate of participation.[7] Similarly, responses were obtained from 29 of the 42 undergraduate programs that were members of the ANDP (69%). As with the previous surveys, the value of these responses is in the relative numbers they provide especially in comparison to the results of earlier surveys. In this regard, 73 (64%) of the graduate programs that participated in the 2007 survey, and 18 (62%) of the undergraduate programs, also had participated in the 2005 survey, which encouraged such comparisons.

A complete list of the 114 graduate programs and 29 undergraduate programs that participated in the 2007 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 114 graduate programs were located in the United States, in 38 states plus the District of Columbia, but responses also were obtained from programs in two Canadian provinces. Similarly, the 29 institutions with undergraduate programs in the neural sciences were diverse in age, size, institutional affiliation, and administrative structure, and were located in 19 states in the U.S. plus one Canadian province. 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 nine categories, as in previous years. The first six categories summarize the results regarding graduate and postdoctoral training. Whenever possible, the results based on the 2007 survey were compared with those obtained from the ANDP surveys in 1986, 1991, 1998, 2000/2001, 2003, and 2005. The seventh category summarizes the responses regarding undergraduate training. The final two categories provide a summary of the major findings of the 2007 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]Stricker, E.M. The 2003 ANDP survey of neuroscience graduate, postdoctoral, & undergraduate programs.

[6]Stricker, E.M. The 2005 ANDP survey of neuroscience graduate, postdoctoral, & undergraduate programs.

[7]The expert advice and technical assistance of Mr. Robert Keene of the UCSUR is gratefully acknowledged.

Participating Institutions

Graduate and Postdoctoral Programs (n = 114)

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

State	Institution
AL	University of Alabama, Birmingham (2)
AR	University of Arkansas for Medical Sciences
AZ	University of Arizona
CA	California Institute of Technology
CA	Stanford University
CA	University of California, Berkeley
CA	University of California, Davis
CA	University of California, Los Angeles
CA	University of California Los Angeles School of Medicine
CA	University of Southern California
CO	Colorado State University
CO	University of Colorado Health Science Center
CT	University of Connecticut
CT	University of Connecticut Health Center
DC	Georgetown University Medical Center
DE	University of Delaware
FL	Florida State University
FL	Miami University
FL	University of Florida
FL	University of Miami Miller Medical School
FL	University of South Florida College of Medicine
GA	Georgia State University
IA	University of Iowa (2)
IL	Finch University of Health Science, The Chicago Medical School
IL	Loyola University Medical Center
IL	Northwestern University
IL	University of Chicago
IL	University of Illinois
IL	University of Illinois, Chicago (2)
IN	Indiana University
LA	Tulane University Health Science Center
LA	Louisiana State University Medical Center
MA	Boston University (2)
MA	Harvard University Medical School
MA	Massachusetts Institute of Technology
MA	Tufts University School of Medicine
MD	Johns Hopkins University
MD	Uniformed Services University of Health Sciences
MD	University of Maryland
MD	University of Maryland, Baltimore (2)
MI	Michigan State University
MI	University of Michigan
MN	Mayo Graduate School
MO	Washington University School of Medicine
NC	Duke University Medical Center
NC	University of North Carolina (2)
NC	Wake Forest University School of Medicine

NH	Dartmouth College; Dartmouth Medical School
NJ	Rutgers, the State University of New Jersey, Newark, and UMDNJ
NJ	UMDNJ – Robert Wood Johnson Medical School, Rutgers University
NM	University of New Mexico Health Science Center
NY	Albany Medical College
NY	Albert Einstein College of Medicine
NY	Binghamton University
NY	Columbia University
NY	Columbia University College of Physicians and Surgeons
NY	Cornell University
NY	Cornell University, Weill Medical College
NY	Mount Sinai School of Medicine
NY	New York University
NY	SUNY, Buffalo
NY	SUNY, Stony Brook
NY	University of Rochester School of Medicine and Dentistry (2)
OH	Ohio State University
OH	University of Cincinnati College of Medicine
OH	Wright State University
OK	University of Oklahoma
OK	University of Oklahoma Health Science Center (2)
OR	Oregon Health Sciences University (2)
OR	University of Oregon
PA	Drexel University College of Medicine
PA	Lehigh University
PA	Temple University School of Medicine
PA	Thomas Jefferson University
PA	University of Pittsburgh
RI	Brown University
SC	University of South Carolina School of Medicine
TN	Meharry Medical College
TN	University of Tennessee Health Science Center
TN	Vanderbilt University
TX	Baylor University
TX	Baylor College of Medicine
TX	Texas A & M University
TX	Texas A & M University System Health Science Center
TX	University of Texas, Austin (2)
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	Brigham Young University
UT	University of Utah
VA	George Mason University
VT	University of Vermont
WA	University of Washington
WI	Marquette University
WI	University of Wisconsin, Madison
WV	West Virginia University School of Medicine
WY	University of Wyoming

CANADA

Prov.	Institution
ON	Queen's University
ON	University of Toronto
ON	University of Western Ontario
QU	McGill University (2)

Undergraduate Programs (n = 29)

State	Institution
CA	University of California, Los Angeles
CO	Colorado College
CT	Trinity College
CT	Wesleyan University
GA	Emory University
IL	Loyola University, Chicago
LA	Tulane University
MA	Brandeis University
MD	Johns Hopkins University
MD	Washington College
MN	Macalester College
NC	Davidson College
NY	Ithaca College
NY	University of Rochester
OH	Baldwin-Wallace College
OH	Oberlin College
PA	Cedar Crest College
PA	Franklin & Marshall College
PA	Lafayette College
PA	Temple University
PA	University of Pittsburgh
PA	Westminster College
RI	Brown University
TX	Baylor University
UT	Brigham Young University
VA	Washington and Lee University
WA	Washington State University
WI	Carthage College

CANADA

Prov.	Institution
ON	University of Windsor

1. Program Characteristics

Based on the information provided by 149 of the 158 graduate programs in the U.S. and Canada that are members of the ANDP, 81% of the programs were founded since 1975. In other words, most graduate Neuroscience programs began in the last generation or so, in parallel with the founding of the Society for Neuroscience in 1970. In considering the longitudinal comparisons presented in this report, it is important to note that only ~40% and ~60%, respectively, of the present graduate programs in Neuroscience had existed in 1986 and 1991(i.e., at the time of the first two ANDP surveys), whereas ~90% were in place when the third survey was conducted in 1998.

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. Less than 20% of the programs involved multiple schools at the university. In the 2000 and 2001 surveys, however, the percentage of such broadly based programs had doubled and become comparable to that of programs located solely in Schools of Medicine, which had begun to decrease in number. In many cases this change represented a consolidation of multiple programs at the same institution. In the 2003, 2005, and 2007 surveys, that trend continued and the institution-wide programs now represent more than half of all programs, whereas the programs located solely in Schools of Medicine or in Schools of Arts and Sciences had each decreased to less than a quarter of the total.

Survey Year	**91**	**98**	**00/01**	**03**	**05**	**07**
	Percent of Total					
School of Medicine	38	43	33	22	21	24
Arts & Sciences	30	30	29	28	17	18
Multiple Schools	17	21	34	40	53	55
Other	15	7	4	10	8	3

Table 1b - Administrative Structure and Degree Granted

The administrative structure of graduate programs in the neural sciences is quite varied. Only 17% 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, 66% of the programs link neuroscientists in multiple departments (or in a “Center”, “Division”, or “Institute” of Neuroscience) in a unified, degree-granting program, and only 16% are in departments that do not have Neuroscience or Neurobiology in their names. These numbers are similar to those obtained in the 2000/2001, 2003, and 2005 ANDP surveys.

In almost three-quarters of the programs, the degree awarded to graduate students trained in the neural sciences is a Ph.D. in Neuroscience or in Neurobiology (or in a discipline that had those words in their name). This situation represents a striking reversal from that which occurred 21 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	05	07
	Percent of Total						
Ph.D. in Neuroscience	24	28	66	63	71	74	71
Ph.D. in another discipline	74	54	30	33	24	22	25
Other	2	18	4	4	5	4	4

Perhaps in consequence of the predominantly multidepartmental structure, only 52% of graduate training programs in the neural sciences hire their own faculty. Note, however, that this number is gradually increasing (44% in the 2003 ANDP survey, 47% in 2005).

Table 1c - Undergraduate Activities

Graduate programs in the neural sciences now play a substantial role in the education of undergraduate students. Although only 19% of the graduate programs additionally administer an undergraduate program in Neuroscience, most graduate programs have faculty members who teach undergraduate courses (66%) and provide opportunities for undergraduate students to be involved in research projects (96%). These important contributions are similar to the findings in the last few surveys but are much greater than those reported 16 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	05	07
	Percent of Total						
Formal Program	-	23	24	26	15	15	19
Teaching	9	48	39	69	65	67	66
Research	-	68	62	91	94	94	96

2. Faculty

There are 5193 faculty members in the 101 graduate training programs in the neural sciences that responded to these questions in the 2007 survey, which computes to 51 faculty members per program. This number is identical to that reported in the 2005 survey, whereas mean faculty size was 34 members per program in the 1998 survey and it had increased steadily in subsequent years. Forty-eight (93%) faculty members per program have tenure-stream positions whereas 3 (7%) have positions outside the tenure stream. These percentages are similar to those observed in each of the past surveys.

There is considerable stability in the training faculty. In AY2007, only 2% 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 comparably small, as has been 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. The median number of faculty members is 37, and 37% of the programs have more than 50 faculty members.

Number	
0-10	15%
11-20	14%
21-30	14%
31-40	12%
41-50	8%
51-60	6%
61-70	10%
71-80	6%
81-90	3%
>90	13%

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	05	07
	Percent of Total						
Assistant Professor	23	26	24	23	23	24	23
Associate Professor	28	28	25	26	25	24	26
Full Professor	49	46	51	51	52	52	51

Ninety-two percent of faculty members who have tenure-stream positions at U.S. institutions are “U.S. citizens” (i.e., U.S. citizens or permanent residents). This number is similar to that seen in the last five surveys (range = 91- 97%). Similarly, 88% of faculty members holding nontenure-stream positions at U.S. institutions are U.S. citizens.

The distribution by academic rank of faculty members who have tenure-stream positions at U.S. institutions but who are not U.S. citizens (44% assistant professors, 30% associate professors, and 26% full professors) is not similar to that of U.S. citizens (21%, 26%, 53%, respectively); clearly a much larger percentage of faculty who are not U.S. citizens are assistant professors and a much smaller percentage are full professors. Most of these faculty members are citizens of Europe (36%), Asia (36%), Canada (14%), or Latin America (10%).

Table 2c - Percentage of Women by Academic Rank

Twenty-one years ago women represented only 15% of all tenure-stream faculty members in graduate programs in the neural sciences. Since then their number increased steadily through the 1998 survey (to 24%) but it stabilized at that level subsequently; in the 2007 survey, it still is only 26% of the total. Furthermore, 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 (31% assistant professor, 28% associate professor, 41% full professor) than are men (20%, 26%, 54%, respectively).

Survey Year	86	91	98	00/01	03	05	07
	Percent of Total						
Assistant Professor	23	27	32	30	33	32	36
Associate Professor	20	22	27	30	28	27	28
Full Professor	9	13	19	17	21	21	21

In contrast, women represented 44% of nontenure-stream faculty members in AY2007. This number was similar to that seen in the past three ANDP surveys.

3. Graduate Education

Table 3a - Recruitment

The number of applications to graduate training programs in the neural sciences is almost four times the number per program that it was in the 1986 survey. Offers of admission increased similarly during the same time period whereas the number of students matriculating per program rose much less rapidly, no doubt because students were applying to (and being admitted by) multiple programs. An apparent decrease in the number of applications that was seen in the 2005 survey was not observed in the 2007 survey.

Women represented 42% of the applicants, 53% of the students admitted, and 52% of those who began graduate training in the neural sciences in AY2007. Each of those numbers is higher than the figures reported in the AY2000-2001 surveys (38%, 44%, 47%, respectively). Students who are not U.S. citizens represented 35% of the applicants but only 17% of the students admitted and 20% of those who began graduate training. Although students who are members of U.S. racial and ethnic minorities represented only 7% of the applicants, they constituted 13% of the students admitted and 13% of those who began graduate training.

Survey Year	**86**	**91**	**98**	**00/01**	**03**	**05**	**07**
	Mean per Program						
Number of students applied	24	42	61	66	82	65	95
Number of students admitted	6	10	12	14	22	16	17
Number of students entered	4	5	5	9	10	8	9

Table 3b - Academic Credentials of Entering Students

The 2007 survey indicates that 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 generally increased over the years, whereas scores on the verbal section have decreased. The scores in the 2007 survey place incoming graduate students in approximately the 71st, 58th, and 80th percentiles, respectively, of all students who took the GRE exams, which is a little lower than the scores in the 2005 survey (average = 79th percentile). (Note that the new analytical writing component of the GRE led to a new scoring scheme.) Ninety-seven percent of the students had research experience before they began graduate training, as in previous surveys.

The incoming students had a mean GPA in their college courses of 3.52 (i.e., between B+ and A-). Only 20% of these students had an undergraduate major in Neuroscience, Behavioral Neuroscience, or Psychobiology. Other common undergraduate majors were Biology (27%), Psychology (14%), and Chemistry or Biochemistry (10%), and an additional 9% had dual majors including one or more of these disciplines. These numbers are similar to those seen in the previous surveys.

Survey Year	86	91	98	00/01	03	05	07
	Average GRE Scores						
Quantitative	624	630	658	689	698	689	694
Analytical	624	635	650	670	670	4.9	4.6
Verbal	590	600	577	567	563	563	576

Table 3c - Total Predoctoral Students, and PhD Degrees Awarded, per Program

The number of graduate students per program varies widely, from less than 10 to more than 100 per program; however, 83% of the programs have 50 or fewer students (the median number is 27). 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 15% of the programs have 1-10 faculty members while 11% of the programs have 1-10 students. The number of graduate students in a program is closely correlated with the number of tenure-stream faculty members in that program (r = 0.63, P <0.001).

Number	Faculty	Students
1-10	15%	11%
11-20	14%	26%
21-30	14%	18%
31-40	12%	21%
41-50	8%	7%
51-60	6%	4%
61-70	10%	4%
71-80	6%	4%
81-90	3%	2%
>90	13%	3%

The mean number of graduate students per program has increased steadily in the past 21 years, from 12 in 1986 to 40 in 2007. This increase undoubtedly reflects the combined effects of many developments: the consolidation of smaller programs at the same institution into a single large program, the increase in admission of new students, and the increase in time required to obtain a Ph.D. degree.

Women represent 52% of this population of graduate students in AY2007, while students who are not U.S. citizens represent 22% of predoctoral trainees in U.S. institutions. Among the population of students who are not U.S. citizens, the largest numbers are from Asia (65%) and Europe (15%). These numbers are comparable to those observed in previous surveys.

The increase in graduate students per program was accompanied by a proportionate increase in Ph.D. degrees awarded each year. These annual awards rose from 2.6 per program in the 1986 survey to 5.5 per program in the 2007 survey. Among the graduates, 52% were women, 22% were non-U.S. citizens, and 22% were members of under-represented U.S. racial and ethnic minorities, which resemble their proportions of the total population of predoctoral trainees.

The data shown in this table do not show the remarkable increase in doctoral degrees in Neuroscience that were awarded during the past few years. According to statistics compiled by the National Science Foundation[8], the total number of PhD degrees in Neuroscience awarded per year in U.S. institutions rose gradually from 404 in 1996 to 472 in 2003, but then increased to 584 in 2004 and 689 in 2005. We estimate that they were ~1100 in 2007, but even if they were only 950 that number represents a doubling in the past 4 years after increasing by only 18% during the previous 7 years. These numbers reflect the substantial increases that have occurred in the number of predoctoral students per program and in the number of doctoral programs, mentioned earlier.

Survey Year	**86**	**91**	**98**	**00/01**	**03**	**05**	**07**
	Average per Program						
Total predoctoral trainees	12	16	20	25	33	33	40
Non-U.S. citizens (%)	---	20	19	20	21	20	22
Ph.D. degree awarded	2.6	2.8	3.2	3.6	3.6	3.9	5.5
Ph.D. degree not awarded	---	---	---	1.3	1.1	1.1	1.7

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 AY2007, it took 5.7 years on average to complete training, with 79% of the students doing so between 5 and 7 years. These numbers are virtually identical for U.S. citizens and nonUS citizens, for U.S. racial and ethnic minorities, and for male and female students.

Only 4% of predoctoral trainees (~1.7 per program) left their graduate programs in AY2007 without obtaining a Ph.D. degree. Among them, the numbers of women (44%), U.S. racial and ethnic minorities (26%), and non-U.S. citizens (25%) were similar to their representation in the total population of predoctoral trainees. Students who left did so after 2.2 years of training, on average (83% within 3 years, 94% within 4 years). Half the students left with a M.S. degree. All of these numbers are comparable to those observed in the 2000/2001, 2003, and 2005 surveys, and they also are similar for U.S. citizens and nonUS citizens, for U.S. racial and ethnic minorities, and for male and female students. A surprisingly large number (27%) of the students who left were in an M.D./Ph.D. program, and they returned to medical school or began their medical internship or residency earlier than anticipated.

Survey Year	**86**	**91**	**98**	**00/01**	**03**	**05**	**07**
	Average Years						
Ph.D. awarded	4.3	5.2	5.5	5.5	5.6	5.7	5.7
Ph.D. not awarded	---	---	2.2	2.5	2.4	1.9	2.2

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 (69%), as was observed in the previous surveys. This was especially true of non-U.S. citizens (81% vs 64% of US citizens). Many graduates went to medical school or began a medical internship or residency (15%); this was especially true of U.S. citizens (18% vs 8% of non-U.S. citizens). Relatively few took faculty positions (4%) or jobs in industry (6%) soon after graduation. As in previous years, very few graduates were employed outside of Neuroscience (1%) or were not yet employed (1%). Male and female graduates were similar in each of these respects.

Survey Year	**91**	**98**	**00/01**	**03**	**05**	**07**
	Percent of Total					
Postdoctoral position	60	70	62	71	69	69
Medical School	13	15	11	16	14	15
Faculty position	6	5	7	3	5	4
Industry	12	1	8	3	4	6
Other	6	5	8	7	6	5
Employed outside the field	2	3	2	0	1	1
Currently unemployed	1	1	2	0	0	1

[8]S&E Doctorate Awards: 2005. http://www.nsf.gov/statistics/doctorates/

4. Postdoctoral Training

Table 4a - Profile of Postdoctoral Trainees

According to the 2007 survey, most of the postdoctoral trainees (85%) have only a Ph.D. degree and an additional 5% have both Ph.D. and M.D. degrees, whereas 9% have only a medical degree. Each of these values is similar to those of the four previous surveys. As with the predoctoral students, the number of postdoctoral trainees in a program is significantly correlated with the number of tenure-stream faculty members in that program ($r = 0.59$, $P < 0.001$).

Survey Year	86	91	98	00/01	03	05	07
	Percent of Total						
Ph.D.	78	63	88	83	87	87	85
M.D.	18	25	5	9	7	8	9
M.D./Ph.D.	4	12	6	6	5	4	5
Other	0	0	1	2	1	1	1

Only about one-third of the programs provided information about postdoctoral trainees other than the degree(s) they obtained, which is certainly much less information than was provided about predoctoral trainees and faculty members. Perhaps such information is difficult to obtain by the administrative offices of graduate programs in Neuroscience, especially in the interdisciplinary programs. Inspection of the data from the past four surveys indicates a similar shortage of responses, 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 2007 survey (~15) is similar to the numbers seen in the 2005 survey but greater than those seen in earlier surveys (7-12). Sixty percent of these trainees are not U.S. citizens, almost three times the percentage of predoctoral trainees but not a further expansion above the progressively increasing numbers that were observed in the 1991, 1998, 2000/2001, 2003, and 2005 surveys (40%, 49%, 60%, 64%, and 57%, respectively). Among that population, the largest portions are from Asia (53%) and Europe (26%). Women constitute 42% of the foreign postdoctoral trainees, 48% of the domestic trainees, and 44% of the overall population.

Table 4b - Placement from Postdoctoral Position

When postdoctoral trainees leave, they typically pursue additional training in another postdoctoral position (44%) or take a faculty position (32%; note, however, that in this case no distinction was made between positions at research universities or undergraduate colleges, or between positions inside or outside the tenure stream). 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 and a decrease in the numbers who take a faculty position. It would be of interest to know whether, over the years, there also has been a progressive increase in time between earning a Ph.D. degree and securing a faculty position, and in the number of postdoctoral positions held before a permanent job was taken; 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.[9,10]

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 except that fewer U.S. citizens left for another postdoctoral position (34% vs 54%, respectively) and more took a faculty position (42% vs 20%, respectively). Forty-five percent of the trainees who left a postdoctoral position were women and 53% were nonUS citizens, which is close to their representation among fellows.

Survey Year	**91**	**98**	**00/01**	**03**	**05**	**07**
	Percent of Total					
Another postdoctoral position	21	30	34	37	38	44
Medical School	3	1	6	4	3	1
Faculty position	45	28	41	38	29	32
Industry	14	4	5	7	11	7
Other	14	29	9	14	15	15
Employed outside the field	2	1	3	0	3	0
Currently unemployed	1	6	1	0	1	1

[9]Marincola, E., and Solomon, F. The career structure in biomedical research: Implications for training and trainees. The American Society for Cell Biology survey on the state of the profession. Molecular Biology of the Cell 9: 3003-3006, 1998.

[10]Garrison, H.H., Gerbi, S.A., and Kincade, P.W. In an era of scientific opportunity, are there opportunities for biomedical scientists? FASEB Journal 17: 2169-2173, 2003.

5. Diversity

Table 5a - Minority Representation

The representation of U.S. racial and ethnic minorities as a percentage of all predoctoral trainees has doubled since the 1991 survey, and a comparable increase in their representation among postdoctoral trainees also has 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 have increased more substantially 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 relatively low. Its distribution across the three academic ranks (36% assistant professor, 29% associate professor, 35% full professor) is like that of Caucasian women tenure-stream faculty members (27%, 29%, 44%, respectively) in being under-represented at the full professor level in comparison to Caucasian males (16%, 25%, 59%, respectively). However, unlike women, minority representation in nontenure-stream positions is similar to that in tenure-stream positions (11%, 10% of total, respectively).

Survey Year	91	98	00/01	03	05	07	91	98	00/01	03	05	07
	Percent of Total						Percent of Total U.S.					
Predoctoral	9	18	18	16	16	18	11	22	23	20	21	25
Postdoctoral	6	11	6	8	9	11	10	21	16	20	21	27
Tenure-stream Faculty	6	7	8	8	8	10	6	7	8	9	10	11

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	05	07	91	98	00/01	03	05	07	91	98	00/01	03	05	07
	Predoc						Postdoc						Faculty					
Asian Amer.	38	42	41	41	39	44	53	50	69	50	60	51	64	61	57	66	64	63
Hispanic Amer.	32	25	30	30	31	27	25	10	19	25	24	18	22	20	24	17	24	20
African Amer.	22	20	17	18	21	18	12	32	12	21	14	14	11	7	9	8	7	8
Native Amer.	-	8	2	1	2	4	-	4	0	0	0	6	-	5	1	0	0	2
Other	8	5	10	10	7	7	10	4	0	4	4	11	3	7	9	9	5	7

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 (i.e., Asian-Americans are excluded), their representation in the 2007 survey is reduced to only 12% of predoctoral trainees who are U.S. citizens (10% of all predoctoral trainees), to only 13% of postdoctoral trainees who are U.S. citizens (5% of all postdoctoral trainees), and to only 4% of tenure-stream faculty members who are U.S. citizens (4% 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 58% of this support from University funds, much less often in the form of teaching assistantships than previously. That decrease has been largely offset by an increase in training grant funds. The balance of their stipend is derived from a combination of research grants and fellowships, in smaller amounts that have changed little throughout the years.

Survey Year	86	91	98	00/01	03	05	07
	Percent of Total						
Teaching assistantship	34	29	29	27	23	14	17
Other university funds	30	38	41	39	34	42	41
Training grants	9	10	10	15	18	26	21
Research grants	16	14	9	14	14	12	11
Fellowships	10	8	11	5	11	6	10

Table 6b - Stipend Sources - Advanced Graduate Students

Predoctoral trainees beyond their first year received 24% of their support from the university. This amount has been decreasing steadily from the 52% support indicated in the 1986 survey. To compensate for this change, research grants have provided increasing support of these advanced graduate students; indeed, in the 2007 survey research grants provided 52% of the total funds for stipends, up from the 24% support indicated in the 1986 survey. In other words, research grants and university funds have traded places in support of advanced graduate students. The balance of their stipend is derived from a combination of research grants and fellowships, in smaller amounts that have changed throughout the years.

Survey Year	86	91	98	00/01	03	05	07
	Percent of Total						
Teaching assistantship	31	27	29	22	18	15	14
Other university funds	21	21	12	12	17	14	10
Training grants	12	9	6	12	11	11	11
Research grants	24	33	37	43	40	47	52
Fellowships	13	10	6	11	14	13	13

Table 6c - Stipend Sources - Postdoctoral Trainees

Research grants also are the major source of the stipends for postdoctoral trainees, as has been the case during the past 21 years. The first three ANDP surveys considered the support of all postdoctoral trainees

collectively, whereas the subsequent surveys considered U.S. and non-U.S. citizens separately. The latter results indicate the predominant dependence on research grants to support postdoctoral trainees; such grants now provide two-thirds of the stipends for U.S. citizens and almost 90% of the stipends for non-U.S. citizens.

Survey Year	**86**	**91**	**98**	**00/01**	**03**	**05**	**07**	**00/01**	**03**	**05**	**07**
				(U.S.)				**(Non-U.S.)**			
	Percent of Total										
University funds	8	12	9	4	4	8	9	4	10	1	5
Training grants	22	16	12	11	19	9	17	1	4	1	1
Research grants	38	50	65	74	67	69	69	90	76	89	84
Fellowships	30	22	12	10	10	11	5	5	10	3	5

7. Undergraduate Programs

The existence of undergraduate programs in Neuroscience is a relatively recent phenomenon. Based on information available from 36 of the 42 undergraduate program members in the ANDP, 3 (8%) programs were founded before 1980, 7 (19%) were founded between 1980 and 1989, and 26 (72%) were founded after 1989. A representative mix of older and newer programs participated in the present survey, as in the previous two surveys.

i. Institutional Affiliation. Seventeen (59%) of the 29 programs are located in undergraduate colleges that do not have a Ph.D. program in Neuroscience.

ii. Administrative Structure. Eighteen (64%) of the 28 programs responding to this question are interdisciplinary in nature and offer a B.S. or B.A. degree in Neuroscience. Five programs offer a B.S. or B.A. degree either in Biology or Psychology, with a specialization in Neuroscience. Only five programs are located in Departments of Neuroscience or Behavioral Neuroscience.

iii. Faculty Hiring. Fourteen (50%) of the 28 programs responding to this question hire faculty members for their program, which is similar to the percentage of graduate training programs that do so (52%).

iv. Faculty Appointments. The average number of faculty members with tenure-stream positions in AY2007 is ~13 per program (median = 8 per program). There was only an 8% turnover of positions (i.e., faculty members leaving or arriving as a percent of the total number of faculty affiliated with a program). An additional ~1 faculty position per program is outside the tenure-stream, and the turnover of faculty with such positions was 14%.

v. Faculty. In AY2007, the distribution of faculty members with tenure-stream positions is 24% assistant professors, 31% associate professors, and 46% full professors. Women occupy 36%, 32%, and 25% of these positions, respectively, for a total of 30% of all tenure-stream positions. They also hold 39% of the nontenure-stream faculty positions. These numbers are generally similar to those of faculty members in graduate programs in the neural sciences.

Among faculty with tenure-stream positions in U.S. institutions, 5% are members of U.S. racial and ethnic minorities and 99% are U.S. citizens. Among faculty with nontenure-stream positions, 15% are members of U.S. racial and ethnic minorities and 97% are U.S. citizens.

vi. Undergraduate Students. The number of undergraduate students with Neuroscience majors per program continues to vary widely (range = 2 to 373, but with equal numbers of males and females). The median program has 58 majors and only six programs have more than 100. The numbers of faculty members and undergraduate students were significantly correlated with one another ($r = 0.47$, $P < 0.05$).

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 2000/2001, 2003, and 2005 surveys.

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, in recent years these graduate 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 trained in the neural sciences 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 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 51 faculty members per program, on average, in the graduate programs surveyed. Forty-eight (94%) have tenure-stream positions. The annual turnover in these positions is small (2% leaving, 6% arriving). 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 quadrupled during the past 21 years and is now 95 per program, while the number of new matriculants has doubled and is now 9 students per program. The academic quality of incoming graduate students has remained high, as suggested by their undergraduate GPA (average = 3.52), their scores on the GRE (average = 70th percentile), and their research experience.

Only 20% of the incoming graduate students had an undergraduate major in Neuroscience or Behavioral Neuroscience. Other common majors were Biology (27%), Psychology (14%), and Chemistry (10%), and an additional 9% had dual majors including one or more of these disciplines.

The mean number of graduate students per program has increased steadily in the past 21 years, from 12 in 1986 to 40 in 2007. The mean number of Ph.D. degrees in Neuroscience awarded annually per program was 5.5, while the mean time to degree was 5.7 years. Only 4% of predoctoral trainees (1.7 per program) leave the program annually without obtaining a Ph.D. degree. Most new graduates pursue further research training in postdoctoral positions (69%) while many others go to medical school (15%).

Ninety percent 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.

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.

Women represent 50% of undergraduate Neuroscience majors, 52% of predoctoral trainees, 44% of postdoctoral trainees, and 44% of nontenure-stream faculty members. In contrast, women represent only 26% of tenure-stream faculty members and 21% of full professors.

Among U.S. citizens in U.S. institutions, members of U.S. racial and ethnic minorities represent 25% of predoctoral trainees and 27% of postdoctoral trainees but only 11% 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%, 3%, 4%, and 6%, respectively, of U.S. citizens.

Predoctoral trainees who are not U.S. citizens come predominantly from Asia and Europe. They now represent 22% of predoctoral trainees, a number that has changed little during the past 16 years.

The number of postdoctoral trainees who are not U.S. citizens increased progressively, from 40% in 1991 to 60% in the 2000/2001 survey, and it has remained at approximately that level subsequently. Nonetheless, they occupy less than 10% of all tenure-stream graduate faculty positions in the neural sciences at U.S. research universities.

Almost all predoctoral students receive stipend support, primarily from university funds (first-year students) and from research grants (more advanced students). Research grants are 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 members in U.S. institutions are Caucasian male Americans (95%, 70%, 99%, respectively). The number of tenure-stream faculty positions is 8 per program, and the median number of undergraduate students with majors in Neuroscience is 58 per program.

9. Conclusions

Neuroscience is a very attractive discipline. It is unusually multidisciplinary in nature and it 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 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. 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 21 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 it 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 on the same campus.

When the NIH budget doubled several years ago, substantial increases occurred 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 trainees, and so a secondary increase in the number of such trainees occurred as well. It is important to emphasize that there is little 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. Instead, graduate programs in Neuroscience have been 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.[11] For example, despite modest increases during the past 21 years, women still are very much under-represented as tenure-stream faculty members, especially at the full professor level, in comparison to their full representation among predoctoral trainees. At the most recent rate of increase (i.e., only 2% in the past 10 years), it will take generations, not decades, before women comprise 50% of the tenure-stream faculty members in Neuroscience unless graduate programs become even more committed than they now are to a policy of gender equality in their faculty.

A similar statement can be made regarding members of under-represented U.S. racial and ethnic minorities among faculty in graduate Neuroscience programs. Moreover, 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 decisive 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 a special opportunity for graduate students to improve their background in the subject, although the faculty may be reluctant to encourage that option and the students may be reluctant to take advantage of it. To further complicate matters, only half the graduate programs in the neural sciences can hire their own faculty, and therefore the programs that cannot do so likely have difficulty in maintaining a stable curriculum of graduate courses and research specialties. This situation no doubt occurs in many undergraduate programs, as well.

Postdoctoral. The percentage of non-U.S. citizens among predoctoral trainees in Neuroscience at U.S. institutions has been relatively constant during the past 21 years. In contrast, the number of non-U.S. citizens among postdoctoral trainees in Neuroscience has increased substantially and, according to the surveys in 2000/2001 and subsequently, non-U.S. citizens constitute more than half of the total population of postdoctoral trainees. During this same time period, the financial support of postdoctoral trainees (and of 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.[12,13] If the NIH decides to 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 drastically. The problem is, of course, exacerbated by the relatively slow increase in federal funds that are available to support faculty research. An attractive proposal to reduce the number of postdoctoral 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 in training.[13-15] These new positions would have to be funded from sources other than research grants in order to provide some financial relief. For example, they might be funded by the universities and associated with traditional academic teaching, research, and committee responsibilities. (Similarly, the universities might contribute more to the support of advanced graduate students, as they once did.)

Finally, a problem that cuts across all levels of training stems from the finding that faculty positions in the neural sciences are increasing more slowly than the number of postdoctoral fellows in Neuroscience who seek such positions. Although this survey does not provide precise numbers of postdoctoral fellows or job openings the way a census would, it is possible to use the survey data to estimate those numbers. If the 158 graduate programs that constitute membership in the ANDP represent 80% of all such programs, then there are ~200 of them in the U.S. and Canada at present. If there are 40 graduate students and 15 postdoctoral fellows per program, then there are ~8,000 graduate students and ~3,000 fellows in Neuroscience. If there are 50 tenure-stream faculty per program, then there are ~10,000 such positions. If new faculty hires amount to 6% annually, then there are only ~600 new jobs each year in graduate programs (even less, actually, since some positions are filled by faculty members transferring from one institution to another). If 5.5 graduate students per program receive their doctoral degree each year and 70% become postdoctoral fellows, and 80% of them are U.S. citizens, then there are ~600 new domestic fellows each year. Although the latter number has never been higher, it seems that graduate students with doctoral training in Neuroscience at U.S. institutions, with U.S. citizenship, have been produced at only slightly higher rates than can be absorbed into academia, and that the great excess in postdoctoral fellows in comparison to faculty positions at research universities results from the large influx of recently graduated scientists from abroad who seek additional training and, in many cases, employment opportunities in the U.S. Those postdoctoral fellows greatly enhance the research productivity (and training of predoctoral students) in the laboratories they join and generally strengthen the scientific workforce, but it has been difficult for them to gain employment in academia at U.S. institutions; more

than 90% of faculty members in graduate or undergraduate Neuroscience programs in the U.S. are U.S. citizens. On the other hand, not all postdoctoral fellows in Neuroscience (regardless of their citizenship) wish to have tenure-stream faculty positions, and many pursue other academic positions, jobs in industry and at research institutes, and other opportunities that are not in scientific laboratories but make good use of scientific training. And not all foreign fellows wish to remain in the U.S. Consequently very, very few scientists with doctoral training in Neuroscience have been unable to find employment.

It has always been a challenge to prepare graduate students and 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.[12,16] 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.[17] In addition, as mentioned, most postdoctoral fellows in Neuroscience at U.S. institutions did not receive their doctoral training domestically. 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 major problems of life have 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 does seem appropriate for graduate programs to educate trainees broadly while preparing them for diverse careers and for the uncertainty they may experience while they clarify their professional goals and evaluate relevant opportunities.

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