CHAPTER 8 – CHANGES IN THE ACADEMIC LABOR MARKET AND SOME TRENDS IN THE GENERAL WORKFORCE

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I am pleased to be at this workshop representing the National Science Foundation's Division of Science Resources Statistics (SRS).

I would like to begin the presentation by looking at changes in the academic labor market. Most of the data from this part of the presentation come from the NSF/SRS *Survey of Doctorate Recipients*, a biennial sample survey of those receiving their doctorate degrees from a U.S. university. As mentioned in other presentations at this workshop, any reference to the participation of either foreign born or non-U.S. citizens in academic employment are actually underestimates of unknown size because the *Survey of Doctorate Recipients* does not count people who received their doctorate from a foreign university.

Average growth rates for employment of S&E doctorate-holders in U.S. economy: 1975–2001
(Percent)

Sector	1975–2001	1975–81	1981–91	1991–2001
All sectors	3.1	5.0	3.4	1.7
Academia	2.4	3.7	2.3	1.5
Research universities	1.9	3.6	2.1	0.7
All others	2.8	3.8	2.7	2.4
Business	4.2	7.5	2.2	4.2
Government	3.7	5.0	2.3	4.4
Others	3.3	5.1	8.7	-2.9
Others	3.3	5.1	8.7	-2.9

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Doctorate Recipients, unpublished tabulations. *Science & Engineering Indicators – 2004*

Let me begin by putting the academic doctoral labor force in the context of the overall doctoral labor force. As you can see from the first column of numbers in the table above, which shows 1975 to 2001, long-term growth in the number of science and engineering (S&E) doctorate holders employed in academia over the past quarter century was slower than growth in the number employed in business, government and other sectors. If you compare the growth rates in the last three columns, you will see that overall growth and growth in the academic sector were much lower in the 1990s than either the 1980s or the 1970s. If you compare the two rows under academia—"research universities" and "all others"—you can see that the growth rate for major research universities was slower than the growth rate for other academic institutions throughout the entire period, but particularly in the 1990s.

Share of S&E doctorate-holders employed in academia, by years since doctorate: Selected years, 1975–2001
(Percent)

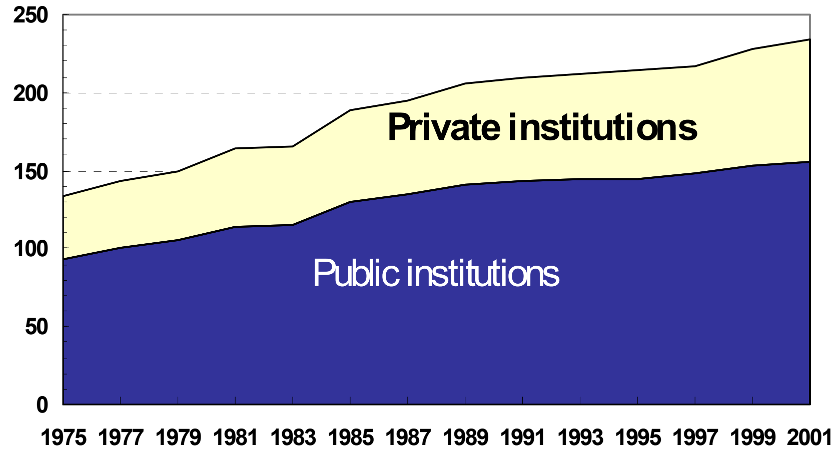
Years since doctorate	1975	1981	1991	2001
Employed doctorate-holders	53.4	49.7	44.7	44.0
3 or fewer	51.9	49.2	47.5	48.8
4–7	52.6	46.9	42.7	41.6
More than 7	54.3	50.6	44.7	43.9

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Doctorate Recipients, unpublished tabulations. *Science & Engineering Indicators – 2004*

As a result of this slower growth in the academic sector, the share of all S&E doctorate holders employed in academia dropped by almost 10 percentage points between 1975 and 2001, as seen in the table on page 45. I should note that unlike Charlotte Kuh's presentation this morning, when I refer to academic S&E doctorate holders employed in academia, I *am* including postdocs. As can be seen in the last two rows of the table, a similar decline in the proportion of doctorate holders in academia was seen for those four or more years out from their PhD. However recent recipients—within three years—are entering the academic labor force in higher proportions (almost 50 percent), and the drop over time has been much less precipitous.

As you can see from the chart to the right, the majority of S&E doctorate holders are employed in public institutions. However, growth between 1975 and 2001 was much faster at private institutions, about 92 percent, compared to 68 percent at public institutions. I should note, though, that this pattern of growth only held at the research universities. It did not hold at other academic institutions. (Distinctions between research and other universities were made using the 1994 Carnegie classifications.)

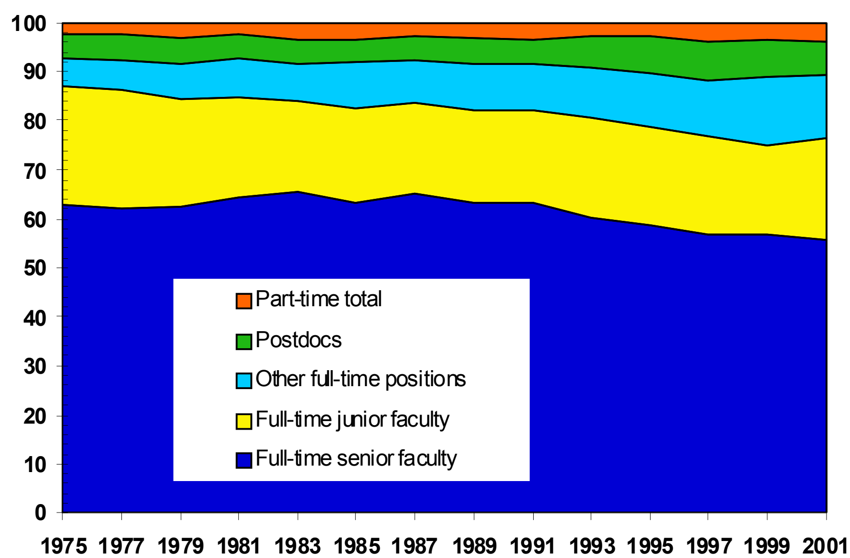
S&E doctorate holders employed in public and private universities and colleges: 1975-2001 (numbers in thousands)



Source: National Science Board, *Science & Engineering Indicators - 2004*

The next chart shows the trend in academic doctoral employment away from the full-time faculty position as the academic norm, with full-time faculty positions increasing much more slowly than postdoc and other full-time and part-time positions. The trend accelerated, actually, during the 1990s.

S&E doctorate holders, by type of academic appointment: 1975-2001



Source: National Science Board, *Science & Engineering Indicators - 2004*

The table on the following page shows the changes more clearly. Between 1991 and 2001, the number of junior faculty (defined as assistant professors and instructors)

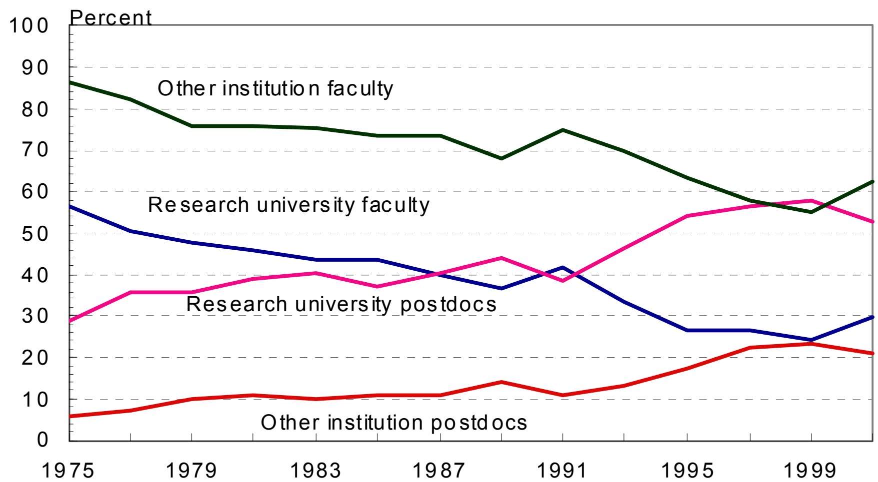
Average annual growth rates for S&E doctorate-holders, by academic position: 1975–2001
(Percent)

Academic position	1975–2001	1975–81	1981–91	1991–2001
All positions	2.4	3.7	2.3	1.5
Full-time faculty	1.8	3.4	2.0	0.8
Professors	2.2	5.1	2.5	0.3
Associate professors	1.4	2.8	1.6	0.3
Junior faculty	1.8	1.3	1.5	2.3
Other full-time positions	5.3	7.2	4.8	4.6
Postdocs	4.1	5.4	1.5	5.8
Part-time positions	4.0	3.8	6.3	1.9

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Doctorate Recipients, unpublished tabulations. *Science & Engineering Indicators – 2004*

rose only modestly, while the number of full and associate professors remained static. Postdocs, in full-time, non-faculty positions (defined as adjunct faculty, lecturers, research and teaching associates, and administrators) grew considerably during this period. Part-time employees accounted for between 2 and 4 percent of all academic S&E doctoral employment throughout the entire 1975 to 2001 period.

Recent S&E doctorate holders employed at research universities and other academic institutions, by type of position: 1975-2001

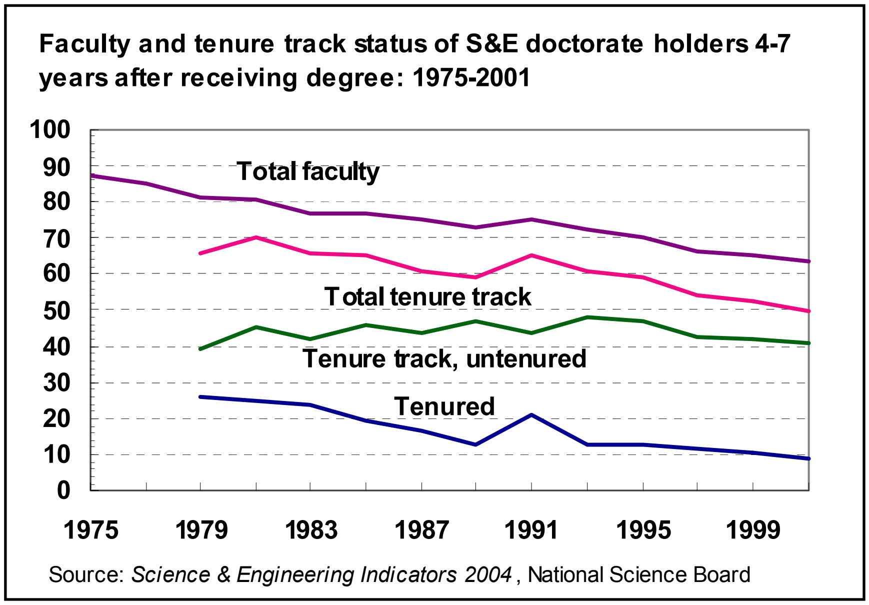


Source: *Science & Engineering Indicators 2004* , National Science Board

Recent doctorate holders—those who earned their doctorate in the preceding three years—who entered academic employment were about as likely to receive postdoc employment as faculty positions. However, as the chart to the right shows, those at research universities were much more likely to be in postdoc positions, especially during the 1990s. So, we are seeing the growth that is talked about, except we do not have 2002 and 2003 data to see the big jumps that were reported this morning in physics and chemistry. We will have to wait for the new data, to see if NSF's data back that up.

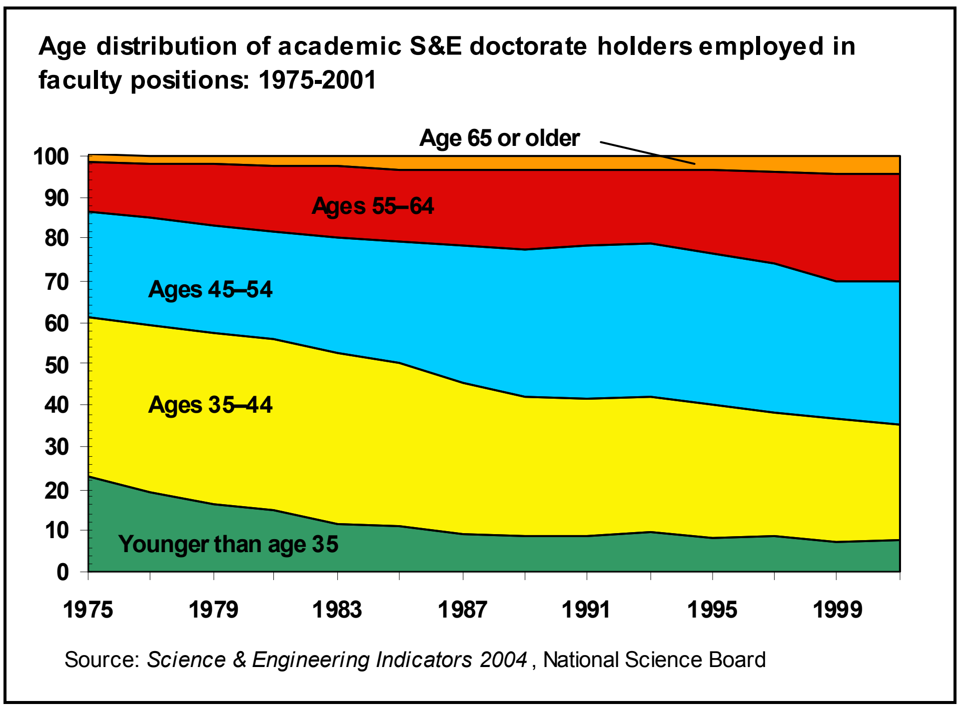
Since 1975, the share of recent doctorate holders hired into full-time faculty positions fell from 70 to 44 percent, with a steeper decline from 57 to 30 percent at research universities. The share reporting being in postdoc positions rose from 18 to 39 percent, more than doubling, and from 29 to 53 percent at research universities. So over half of the recent PhDs who are going to research universities are going in as postdocs.

The chart on the following page shows the same results for those employed in academia four to seven years after receiving their degree. The share of both those in tenure-track positions and those with



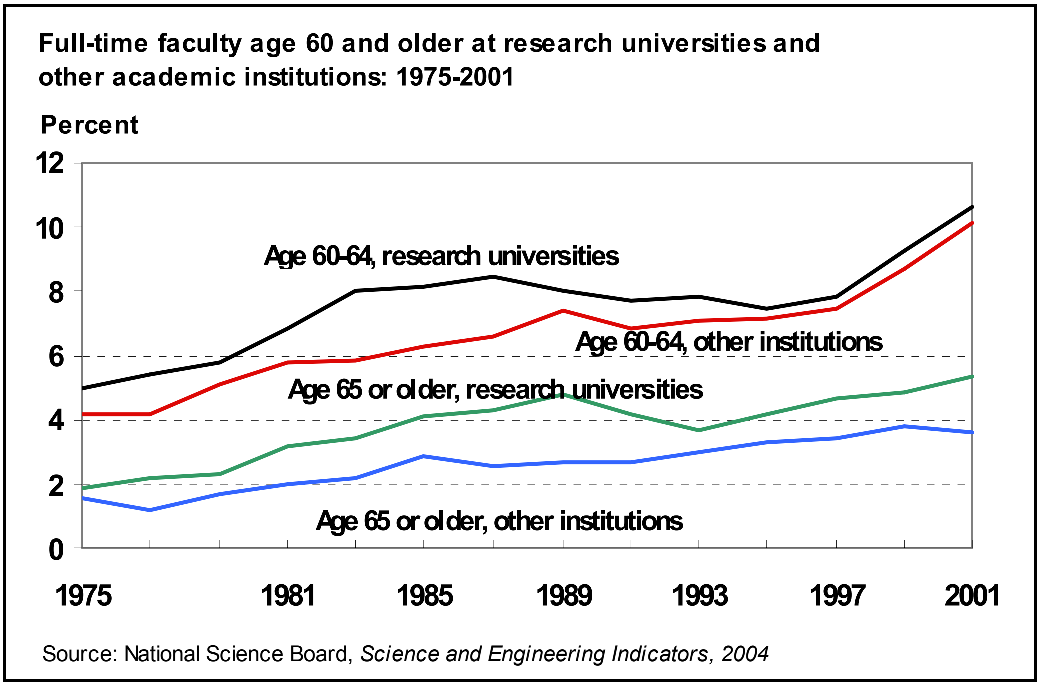
tenure has been declining since 1991, suggesting a continuing shift towards forms of employment outside traditional tenure-track positions. About 63 percent had faculty rank in 2001, compared to about 87 percent in the mid-1970s—a rather large decline.

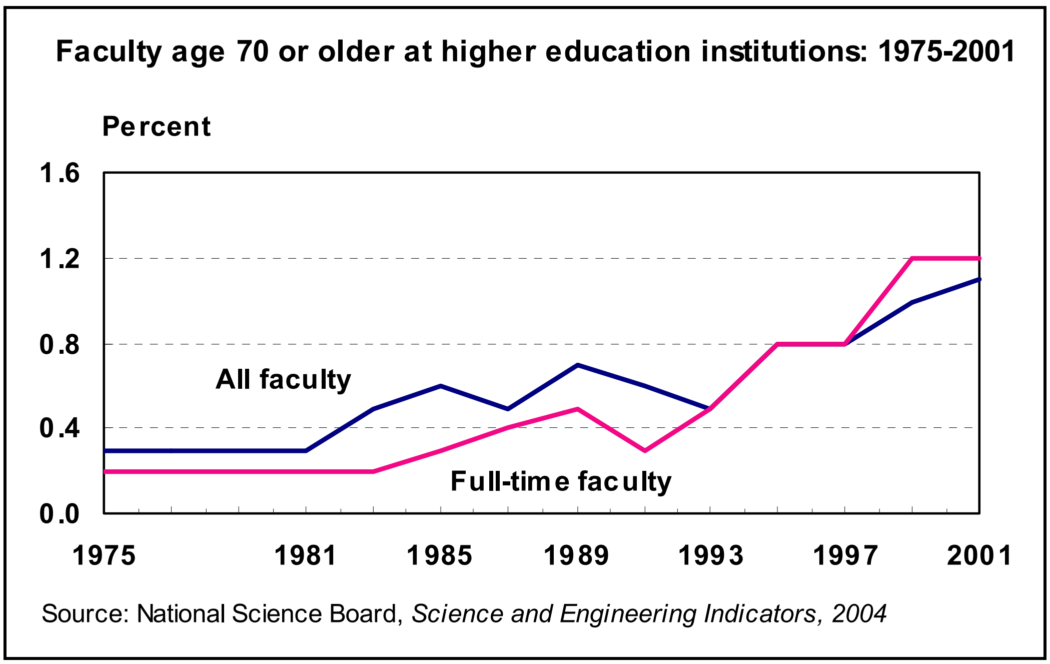
The age discrimination in employment act of 1967 became fully applicable to universities and colleges in 1994. The act prohibits the forced retirement of faculty at any age, raising concerns about the potential ramifications of an aging professoriate for scholarly productivity and the university's organizational vitality, institutional flexibility and financial help.



As the chart above depicts, faculty are getting older, with increasing numbers of faculty—as well as others in other non-faculty positions—reaching or nearing retirement age.

Individuals 65 years or older constitute a growing share of the S&E doctorate holders employed in academia, as shown on the chart on the following page. In 2001, they made up just over 5 percent of research universities' full-time faculty, and 60- to 64-year-olds also began rising around the mid-1990s, reaching just over 10 percent of full-time faculty by 2001.





And if you are interested in those over 70 and older, though a small percentage, their numbers have also been rising, to about 1 percent, as seen in the chart above.

Now, let's talk about demographics. Not only has the academic employment of women, underrepresented minorities and Asian/Pacific Islanders risen over the past quarter of a century, but as the table on the following page shows, the share of each of these groups has also increased substantially between 1975 and 2001.

Women and minorities among S&E doctorate-holders employed in academia, by Carnegie institution type: Selected years, 1975–2001
(Percent)

Group and institution type	1975	1981	1991	2001
Women				
Research universities	8.8	12.9	18.8	28.1
Other academic institutions	12.1	15.0	21.2	29.3
Underrepresented minorities				
Research universities	1.8	2.6	3.8	5.9
Other academic institutions	3.1	4.5	5.7	7.8
Asians/Pacific Islanders				
Research universities	4.9	7.0	8.9	13.3
Other academic institutions	4.1	5.9	6.9	9.3

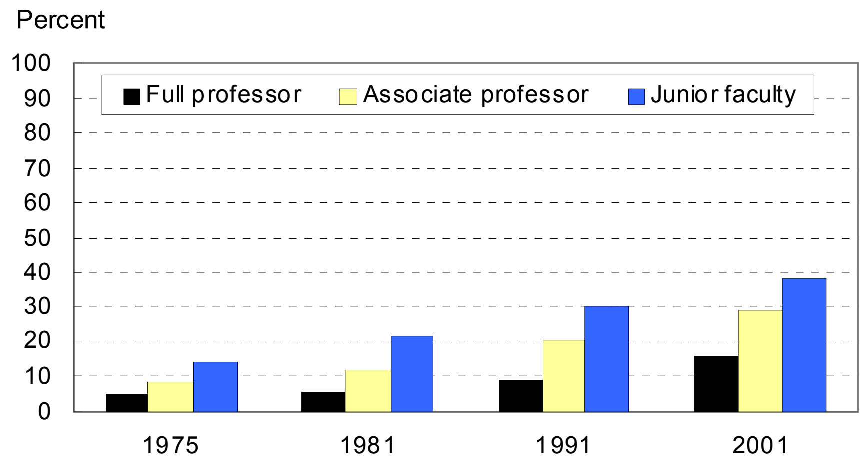
SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Doctorate Recipients, unpublished tabulations. *Science & Engineering Indicators – 2004*

The table also shows that the share of women and underrepresented minorities has been higher at other academic institutions than at research universities, although the differential for females had almost entirely disappeared by the end of the period. Asian/Pacific Islanders, however, make up a larger share of total employment at research universities than at other academic institutions, and that differential has been increasing over the period.

The number of women doctorate holders employed in academia increased more than five-fold between 1975 and 2001, constituting about 30 percent of all academic employment in 2001, up from 10 percent in 1975. Compared with male faculty, female faculty remain relatively more concentrated in life sciences and psychology, with correspondingly lower shares in engineering, physical sciences and mathematics.

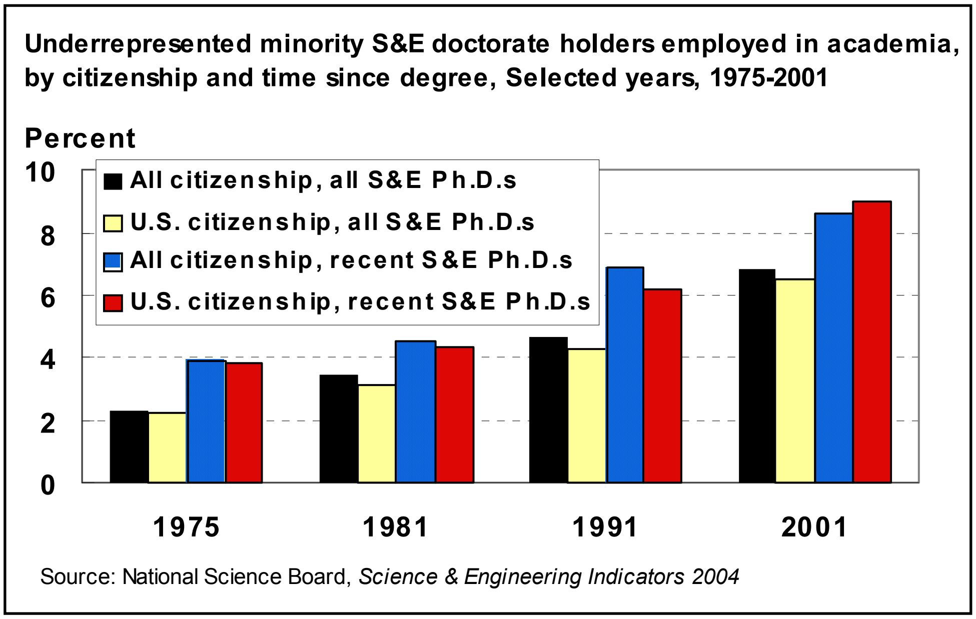
While the number and relative share of women decreases absolutely from the junior to the senior faculty ranks, the reverse occurs with men. You can see the female proportion of each rank here. Although not shown in the chart, the male proportion is 100 minus the female proportion. The contrasting pattern indicates the recent arrival of significant numbers of female doctorate holders in full-time academic faculty positions.

Female share of doctoral S&E faculty positions, by rank: Selected years, 1975-2001



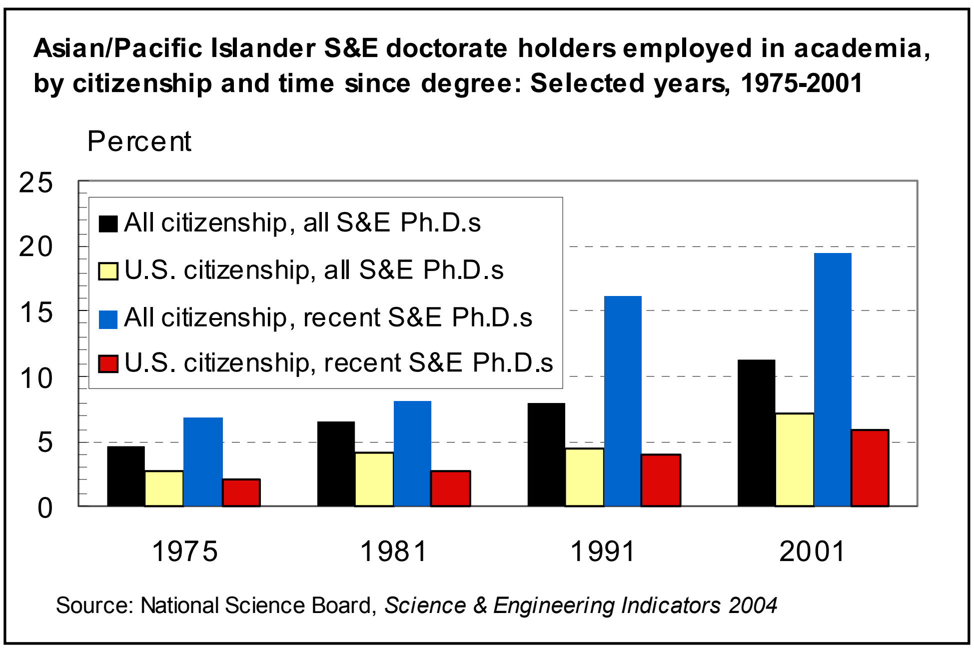
Source: National Science Board, *Science & Engineering Indicators 2004*

Underrepresented and minority groups tend to be less likely than whites or Asian/Pacific Islanders to earn S&E degrees or to work in S&E occupations. While the absolute rate of conferral of S&E doctorates to members of these groups has increased, as well as academic employment, they still remain a small percentage of the S&E doctorate holders employed in academia, constituting less than 7 percent of both total employment and full-time faculty positions in 2001.



Source: National Science Board, *Science & Engineering Indicators 2004*

As you can see from the chart to the right in the two left-most bars, the trends are similar for all underrepresented minorities and for those who are U.S. citizens. So using either U.S. citizens as the denominator or all, you get about the same movement. Recent PhDs, represented by the two right-most bars, are entering at higher rates, thus, pulling up overall participation. Compared with whites, African Americans tend to be relatively concentrated in the social sciences and psychology and relatively less represented in the physical sciences; earth, atmospheric and ocean sciences; math; and the life sciences. The field distribution of Hispanic degree holders is similar to that of white degree holders.



Source: National Science Board, *Science & Engineering Indicators 2004*

Asian/Pacific Islander S&E doctorate holders more than doubled their academic employment share between 1975 and 2001. For this group, a distinction needs to be made between those who are U.S. citizens and those who are not, as can be seen by the difference in the heights of the two left-most bars in the chart to the right. Non-U.S. citizens constituted more than 40 percent of this group's doctorate holders in the academic workforce in 2001 and even a larger percentage of recent PhDs entering the workforce.

Compared with whites, Asian/Pacific Islanders, as a whole, are more heavily represented in engineering and computer sciences and represented at very low levels in psychology and the social sciences. In

2001, Asian/Pacific Islanders constituted nearly one-fourth of academic doctoral computer scientists and 18 percent of engineers.

Whites and white males among S&E doctorate-holders employed in academia, by years from degree: Selected years, 1975–2001
(Numbers in Thousands)

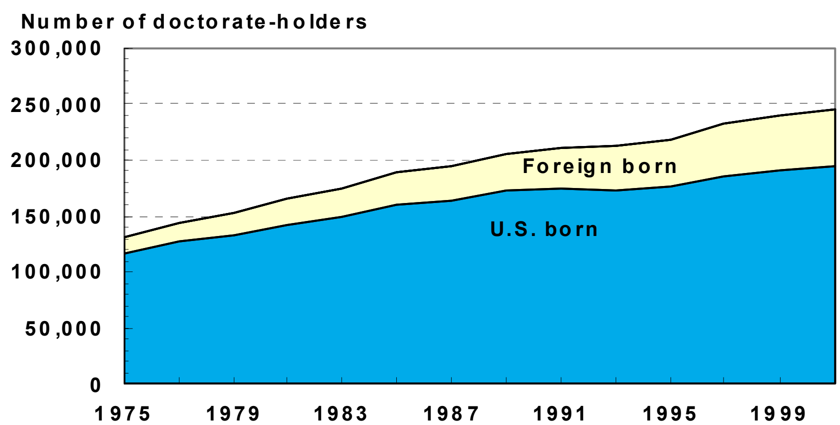
	1975		1981		1991		2001	
Group	No.	%	No.	%	No.	%	No.	%
All S&E doctorate holders	134.1	100	167.1	100	210.6	100	245.5	100
White	121.6	91	149.9	90	183.5	87	201.0	82
White male	109.0	81	129.3	77	147.1	70	144.0	59
Recent S&E doctorate holders	23.4	100	20.7	100	25.5	100	28.3	100
White	20.4	87	18.0	87	19.5	77	20.2	72
White male	17.0	73	13.5	65	12.3	48	11.5	41

NOTE: Recent doctorate-holders are those who earned their degrees within 3 years of the survey year.
SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Doctorate Recipients, unpublished tabulations. *Science & Engineering Indicators -- 2004*

The role of whites, particularly white males, in the academic S&E doctoral workforce, diminished between 1975 and 2001, as seen above. The share of white males declined from about 81 percent to about 59 percent during this period. Part of the decline is because of the increasing roles played by women, underrepresented minorities and Asian/Pacific Islanders, but it also reflects a fall in the absolute number of white males in the academic doctoral S&E workforce during the 1990s. The decline in the share of white males who recently received their doctorates was even greater than the decline of whites overall, from 73 to 41 percent.

An increasing number and share of S&E doctorate holders employed at U.S. universities and colleges are foreign born. Participation in education by foreign-born individuals has increased continuously both in number and shares since the late 1970s. However, the chart to the right, indicating about 20 percent foreign born, only shows those foreign-born individuals who hold S&E doctorates from U.S. institutions, as I mentioned before, so it is an underestimate.

Academic employment of U.S. S&E doctorate holders, by place of birth: 1975-2001



Source: National Science Board, *Science & Engineering Indicators 2004*.

To get a little idea of the possible effects of the undercounting, we can examine the table on the following page. The table reports on the percentage of foreign-born individuals in S&E occupations, such as those with job titles of chemists, physicists, statistician, etc. However, this is a very narrow definition which, for

Comparison between NSF and Census estimates of foreign-born individuals in S&E occupations, by level of education: 1999 and 2000
(Percent)

Level of education	1999 NSF/SRS SESTAT	2000 Census 5-Percent PUMS
All college educated	15.0	22.4
Bachelor's	11.3	16.5
Master's	19.4	29.0
Doctorate	28.7	37.6

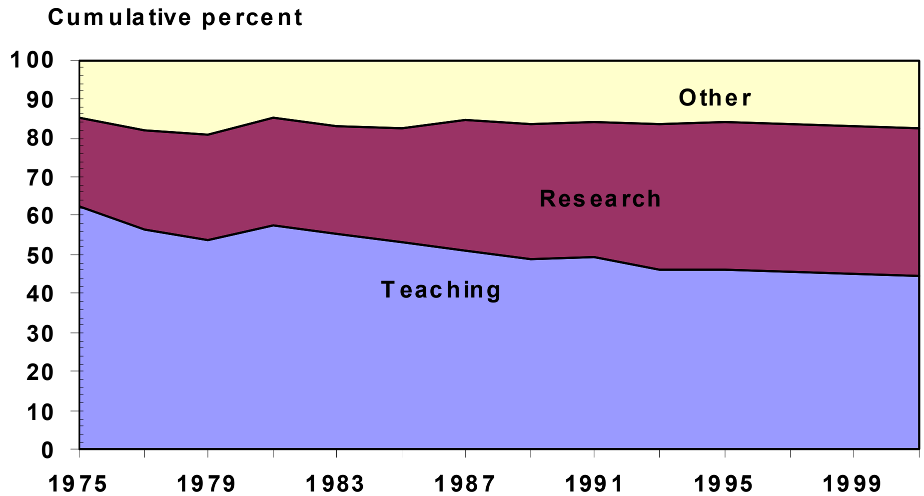
Note: Excludes S&E doctorate holders employed at academic institutions.
Source: National Science Board, *Science & Engineering Indicators 2004*

technical reasons, excludes all those in academia. Census data are coded so that those employed in academia are classified as postsecondary teachers regardless of fields, so you cannot get a field breakdown.

The NSF/SRS column indicates only those receiving U.S. degrees, while the Census column includes those foreigners getting degrees from foreign institutions, and it gives you some idea of the possible undercounting that we get from this.

Now, let's look at work activities reported by those working in the academic sector. During the 1975 to 2001 period, the number of those with teaching as their primary activity increased much less rapidly than the number with research as their primary activity. However, after many years of increase, the proportion of those reporting research as a primary activity leveled off in the mid 1990s, as did a drop in those reporting teaching as their primary activity.

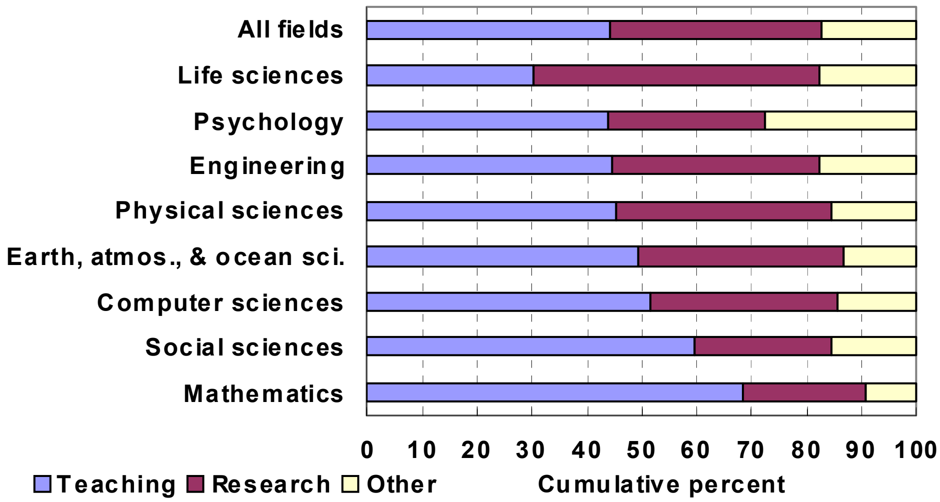
Primary work activity of S&E doctorate holders employed in academia: 1975-2001



Source: National Science Board, *Science & Engineering Indicators, 2004*

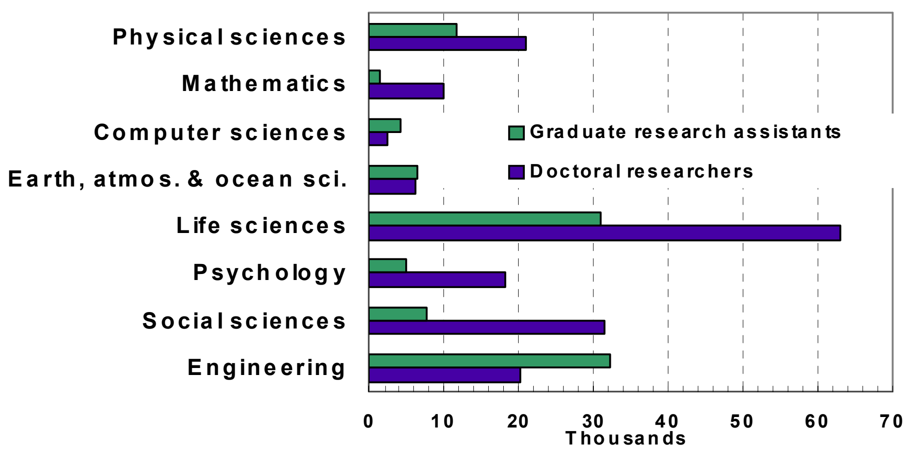
Although the shapes of the overall trends are probably the same, different disciplines have distinct patterns of relative emphasis on research, as seen in the chart on the following page. The life sciences, which are shown in the second bar in the chart, stand out, with a much higher share identifying research as their primary activity and, correspondingly, a much lower share reporting teaching. In the bottom two bars, you can see that math and the social sciences have the largest shares identifying teaching as a primary activity and lowest shares reporting research.

Primary work activity of academic S&E doctorate holders employed in academia, by degree field: 2001



Source: National Science Board, *Science & Engineering Indicators, 2004*

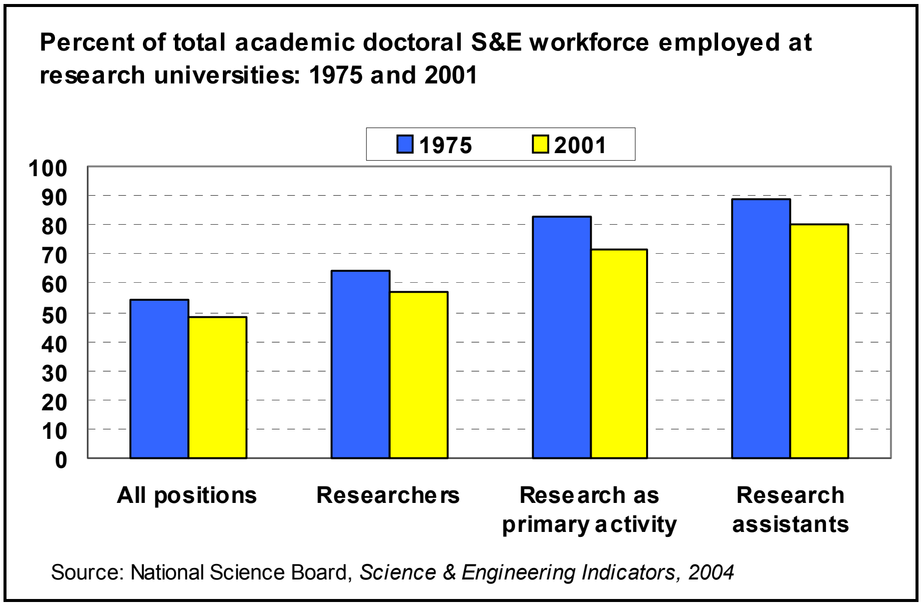
Estimated number of graduate research assistants and doctoral researchers in academia, by degree field: 2001



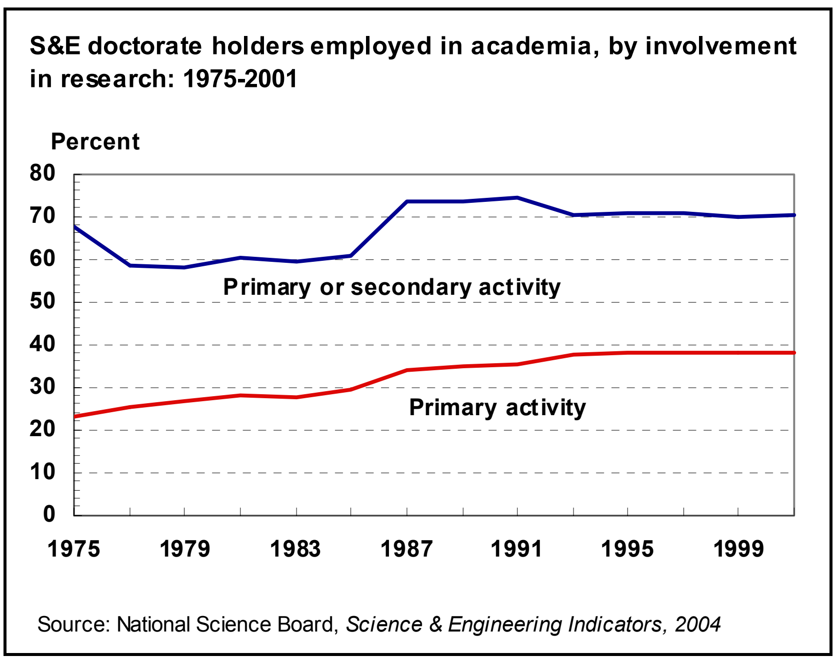
Source: National Science Board, *Science & Engineering Indicators, 2004*

We should not neglect the role of graduate students at U.S. academic institutions. A lot of the research carried out in U.S. colleges and universities is done by graduate students and the close coupling of advanced training with hands-on research experience is a key strength of U.S. graduate education. In 2001, graduate research assistantships were the primary means of support for slightly more than one-quarter of all S&E graduate students.

As seen above, in both computer sciences and engineering, the number of graduate research assistants actually exceeds the number of doctoral researchers. (Doctoral researchers are defined as those who report research as either their primary or secondary activity.)



Now, let's look at where the academic S&E workforce is located. The majority of the research workforce in academia is concentrated at the research universities. Over the years, however, the research university shares of a number of different categories of academic employment have declined. As you can see in the chart above, there have been declines in the shares of all employed S&E doctorate holders, of researchers, of those identifying research as their primary activity, and even of research assistants. So there has been a shift in relative proportions from research universities to other academic institutions.



As I mentioned earlier, the proportion of S&E doctorate holders in academia who indicate research as their primary activity experienced a long-term upward trend from the mid 1970s to the mid 1990s. The trend for those reporting research as their primary or secondary activity is sort of an upward trend, but it is a step ladder—certainly a different trend, but again upward and flattening out.

S&E doctorate-holders employed in academia who reported research as primary activity, by degree field: Selected years, 1975–2001
(Percent)

Field	1975	1985	1995	2001
All fields	23.0	29.4	38.2	38.2
Physical sciences	27.1	34.8	42.9	39.1
Mathematics	13.6	19.9	22.6	22.1
Computer sciences	na	50.0	32.3	34.5
Earth, atmos., and ocean sciences	20.5	30.8	40.6	37.7
Life sciences	36.8	46.2	52.7	51.9
Psychology	14.9	19.9	28.4	28.6
Social sciences	11.4	13.6	23.1	24.9
Engineering	17.2	22.1	36.6	37.9

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Doctorate Recipients, unpublished tabulations. *Science & Engineering Indicators – 2004*

Differences are seen by field, as shown in the table above, but the same sort of trend holds, with an increase in research as primary activity between 1975 and 2001, except in the computer sciences, which is a really relatively new field. In the computer sciences, the percentages bounce around.

S&E doctorate-holders employed in academia who received Federal support, by degree field: 1981, 1991, 2001
(Percent)

Field	1981	1991	2001
All fields	42.8	50.3	45.4
Physical sciences	50.4	56.6	53.2
Mathematics	21.3	34.5	31.9
Computer sciences	29.7	49.4	47.2
Earth, atmos., and ocean sciences	50.2	66.2	64.1
Life sciences	59.6	65.5	56.6
Psychology	32.7	34.7	34.3
Social sciences	21.8	28.4	21.5
Engineering	51.0	63.2	56.8

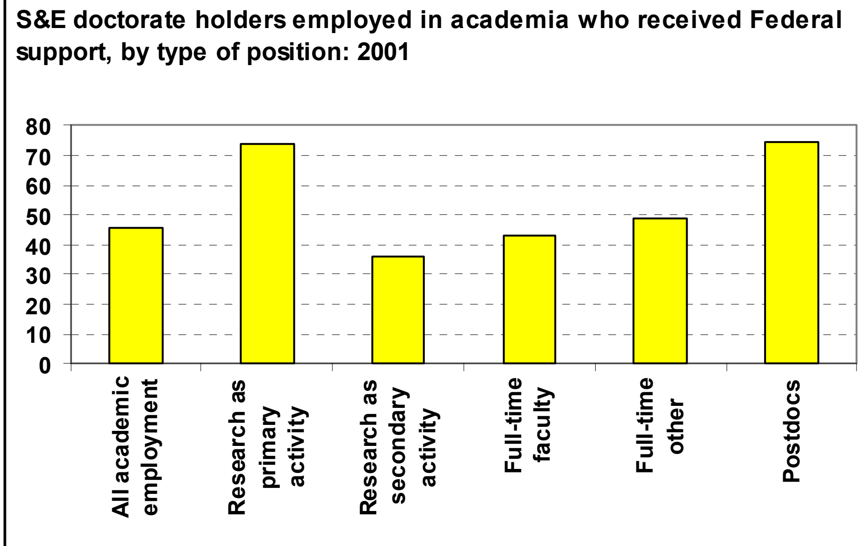
SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Doctorate Recipients, unpublished tabulations. *Science & Engineering Indicators – 2004*

Overall, in all broad fields, a larger proportion of doctorate holders employed in academia received federal support in 1991 than in 1981, as seen in the table above. However, by 2001, these proportions had declined from their 1991 levels, though in most cases were still higher than in 1981.

Once again, the life sciences stand out by virtue of both showing a big drop in the proportion reporting federal support between 1991 and 2001, and being one of only two fields (the other being social sciences) with 2001 proportions lower than those in 1981. That is a bit of an anomaly given the large increase in NIH support, but that is what the data say.

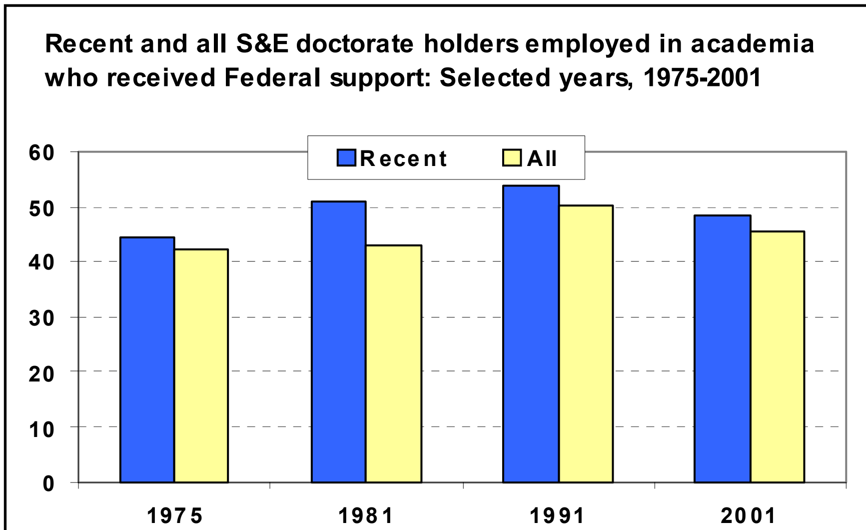
The percentage of S&E doctorate holders who received federal support differs greatly across fields, ranging from about 64 percent in the earth, atmospheric and ocean sciences to only about 22 percent in the social sciences.

The percentage of doctorate holders who receive federal support also differs by type of position. As seen in the chart to the right, postdocs and those with research as their primary activity—which includes many, many postdocs—were more likely to receive support than full-time non-faculty who, in turn, were more likely to receive support than full-time faculty or those with research as their secondary activity.



Source: National Science Board, *Science & Engineering Indicators, 2004*

As seen in the next chart, recent S&E doctorate holders—again those within three years of their degree—employed in academia are more likely to receive federal support probably mainly due to the fact that a much greater proportion of that group is in a postdoc position.



Source: National Science Board, *Science & Engineering Indicators, 2004*

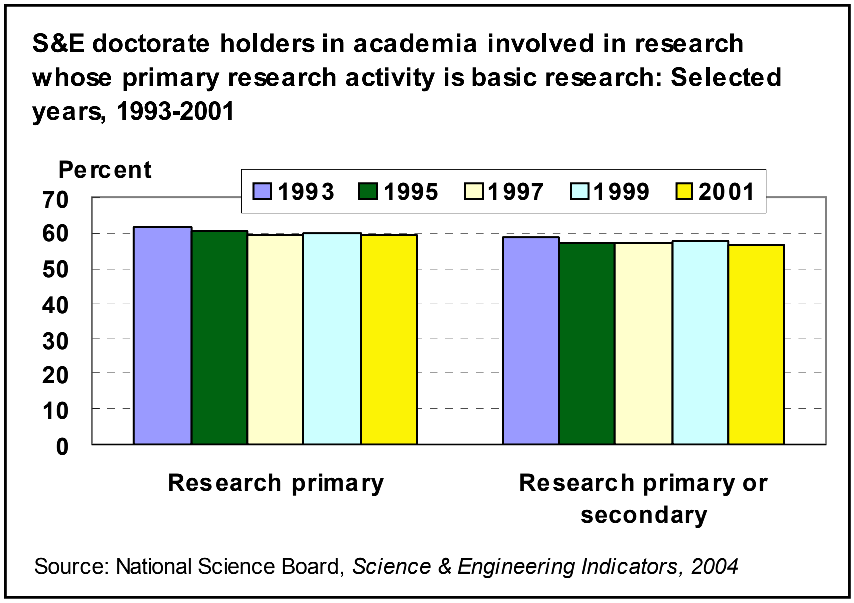
As seen in the table below, the proportion of doctorate holders who reported federal support from more than one agency was higher in 1991 and 2001 than it was in previous periods. However, although we saw before that recently awarded doctorates were more likely to receive federal support, they are less likely to receive funding from more than one agency.

S&E doctorate-holders employed in academia receiving Federal support who received it from multiple agencies: Selected years, 1975–2001
(Percent)

S&E doctorate holders	1975	1981	1991	2001
All	20	19	30	26
Recent	15	13	20	17

[a] Doctorate received at U.S. university within 3 years of survey.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Doctorate Recipients, unpublished tabulations. Science & Engineering Indicators, 2004



The chart to the right shows a declining percentage of S&E doctorate holders involved in basic research between 1993 and 2001. Several indicators not shown on the chart suggest that emphasis on exploring the intellectual property that results from the growing conduct of academic research is growing. One concern raised about this development may distort the nature of academic research by focusing away from basic research towards more problem-oriented research. Although the hypothesis is difficult to analyze for a number of reasons, the percentage of those who reported their research as basic is one indicator. And this suggests there has not been any real shift towards more applied work during the 1990s. And another indicator not portrayed here—the share of all academic R&D expenditures directed towards basic research which NSF collects—suggests a similar conclusion.

I now move to the second part of my talk, to some trends in the general workforce.

Measures of S&E workforce: 1999

Measure and degree status	Workforce
BLS Current Population Survey	
All employed in S&E	5,294,000
With bachelor's degree or higher	4,021,000
SESTAT data system	
Employed S&E degree holders	10,480,000
In S&E occupation	3,259,000

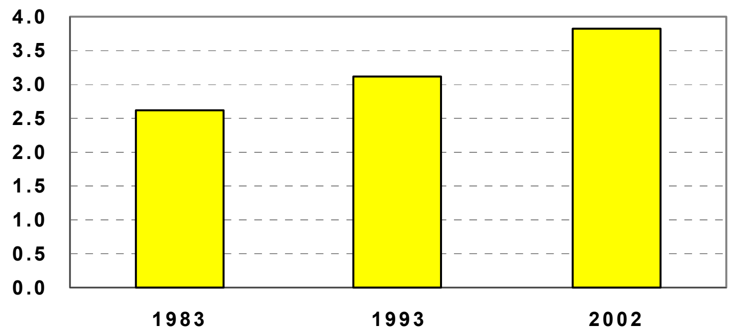
SOURCES: National Science Foundation, Division of Science Resources Statistics, Scientists and Engineers Statistical Data System (SESTAT), 1999; and National Bureau of Economic Research's Merged Outgoing Rotation Group Files from the Bureau of Labor Statistics' Current Population Survey.

One question we may want to ask is how large is the U.S. science and engineering workforce? As can be seen from the table above, estimates of the size of the S&E labor force vary based on the criteria used to define scientists and engineers. Education, occupation, field of degree and field of employment are all factors that may be considered. You can see the size of the workforce in 1999 varied between approximately 3 and 10 million individuals, depending on the definition and perspective used.

In the past two decades, the number of those in science and engineering occupations—those with job titles of mathematician, chemist, physicist, etc.—has risen three to four times as fast as the general workforce. As a consequence, as you can see from the chart on the following page, S&E occupations have represented a steadily increasing proportion of the U.S. workforce. But remember that this is a narrow definition of the workforce. Using the broader one—those with at least a bachelor's degree in a science and engineering field—would yield a much higher estimate and a much larger proportion of the workforce.

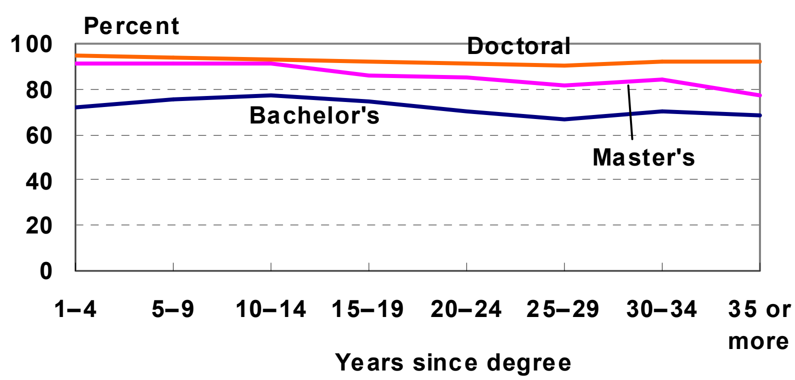
Many of those with S&E degrees work in jobs not classified as "science," such as managerial, marketing and sales, planning and quality control positions. But although most individuals with S&E degrees do not work in occupations with formal S&E titles, as you can see from the next chart, most of them, even at the bachelor's level, report doing work related to their degrees even in mid and late career, which probably reflects the technical content of the non-S&E jobs.

S&E occupation share of total civilian employment: 1983, 1993, and 2002



Source: National Science Board, *Science & Engineering Indicators, 2004*

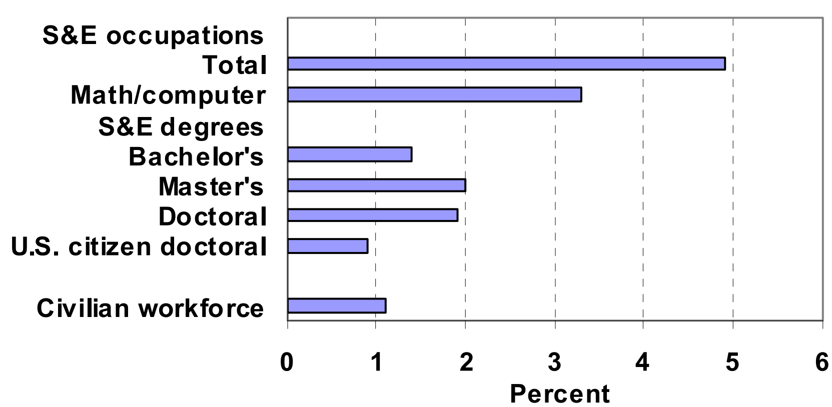
S&E highest degree holders employed in jobs closely or somewhat related to highest degree, by years since degree: 1999



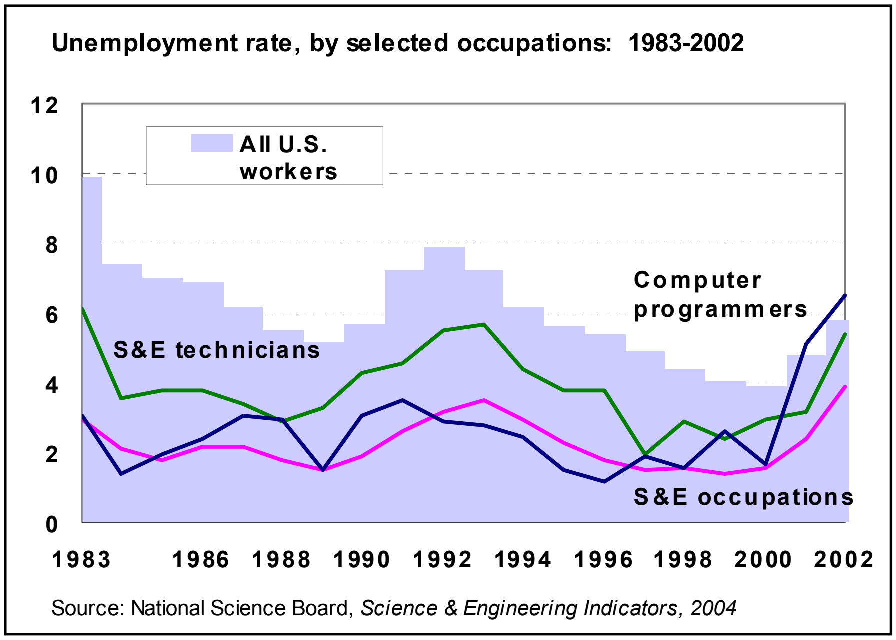
Source: National Science Board, *Science & Engineering Indicators, 2004*

As previously noted, the long-term growth of the S&E labor force has been considerably stronger than that of the civilian labor force, indicating a trend towards growing technical sophistication. As you can see from the chart below, even without mathematician and computer scientist jobs, growth in the remaining S&E occupations outpaced that of the civilian labor force. However, although the growth rate of U.S. S&E degree production has exceeded the growth rate of the civilian labor force, it has lagged behind the growth rate of S&E occupations. This is indicative of the key role of foreign scientists and engineers in the U.S. S&E labor force. In fact, the number of S&E doctorates earned by U.S. native-born and naturalized citizens has grown more slowly than the growth of the overall civilian labor force.

Average annual growth rate of S&E occupations and degrees and U.S. civilian workforce: 1980-2000

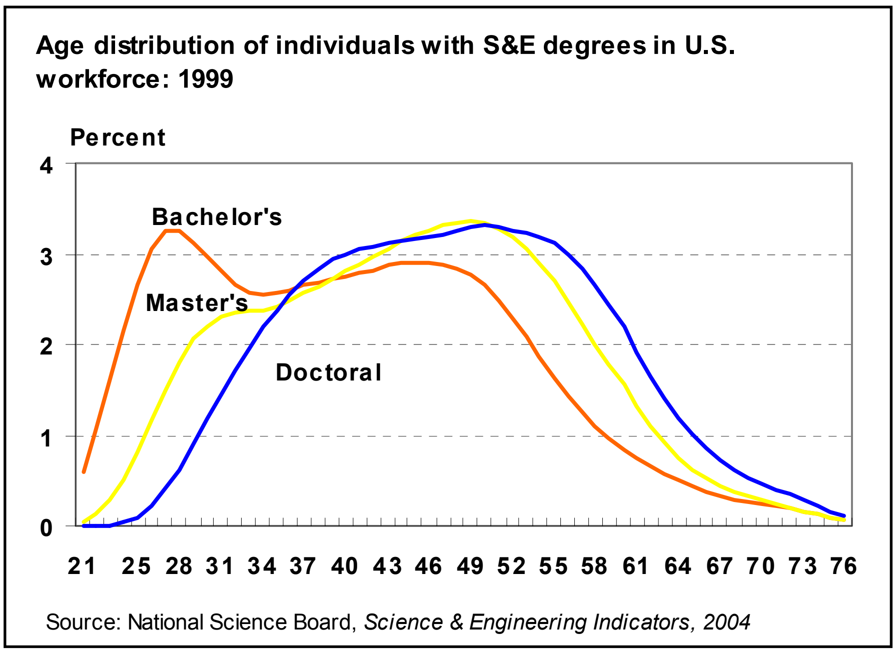


Source: National Science Board, *Science & Engineering Indicators, 2004*



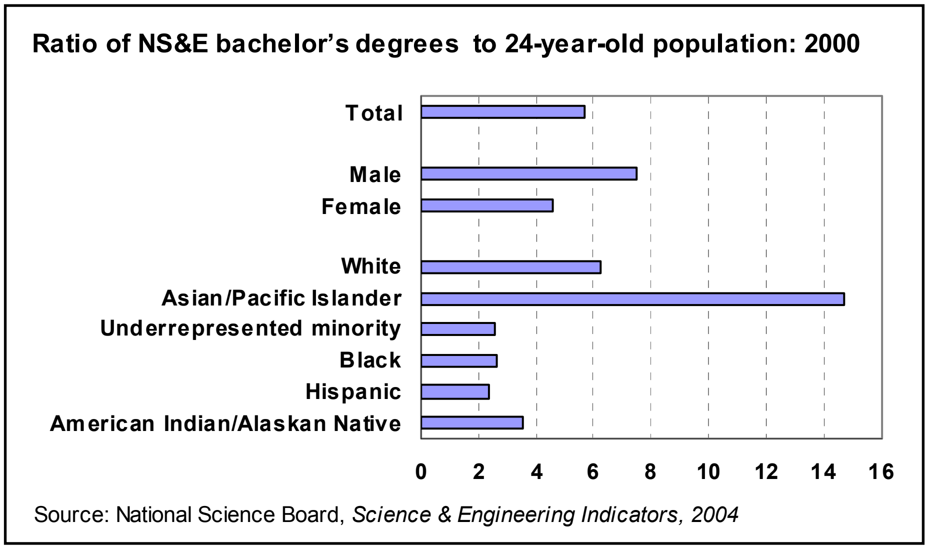
As you can see from the chart to the right, the unemployment rate for those in S&E occupations, including S&E technicians and computer programmers, has generally been considerably lower than the overall unemployment rate for the U.S. labor force. However, an indication of the difficulties that the IT sector and S&E employment in general currently faces can be gleaned from the recent employment and unemployment trends reflected in the Bureau of Labor Statistics' (BLS) *Current Population Survey*. BLS figures not shown on the chart would illustrate that employment in S&E occupations rose strongly throughout the 1990s, until 2001, when it reached a record 5.6 million people and then declined to 5.4 million in 2002.

Unemployment rates for S&E occupations, which traditionally have been lower, rose strongly between 1999 and 2002. Also, breaking precedent, the unemployment rate for computer programmers exceeded the national average in 2002, and the rate for S&E technicians approached the average.



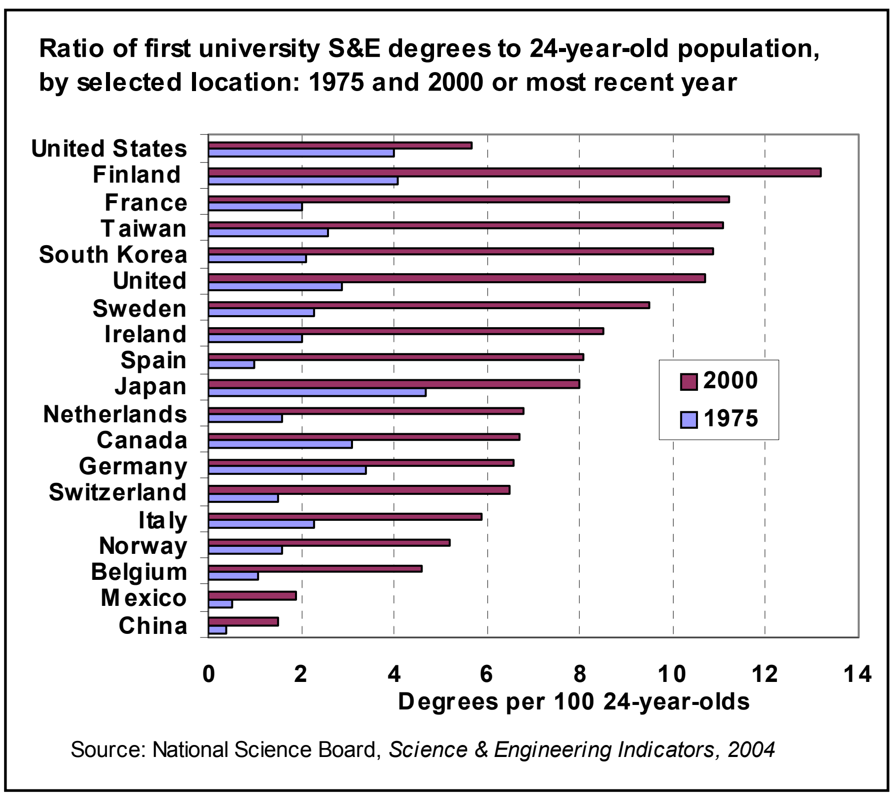
Unless current retirement rates change dramatically, the S&E workforce in the U.S. will experience rapid growth in total retirements over the next two decades. In 1999, 24 percent of those with bachelor's degrees, 36 percent of those with master's degrees, and 45 percent of those with doctorates were 50 years old or older.

Without changes in degree production, retirement behavior or immigration, these figures imply that the U.S. S&E workforce will continue to grow, but at a slower rate than before and that its average age will increase over the next two decades. These trends have placed attention on the needed replenishment of the U.S. S&E workforce with a focus on domestic degree production.



Degrees in natural sciences and engineering (NS&E), which include math and computer science, have been relatively invariant relative to the size of the college-age cohort for about a quarter of a century, varying from 4 to 5.7 per 100 24-year-olds. Demographic changes in the United States complicate the task of increasing the number of NS&E degrees relative to the relevant age cohort. The proportion of non-Hispanic whites among 24-year-olds has been under steady multi-decade decline, falling from 74 percent in 1985 to a projected 58 percent by 2020.

The shift largely reflects strong growth of population groups, especially Hispanics, that traditionally have been underrepresented in S&E. Students from these groups earned associate degrees more often than they earned bachelor's degrees. In recent years, their overall attainment rate for bachelor's degrees has been about half that of whites, and in natural science and engineering, it has been less than half that of whites.

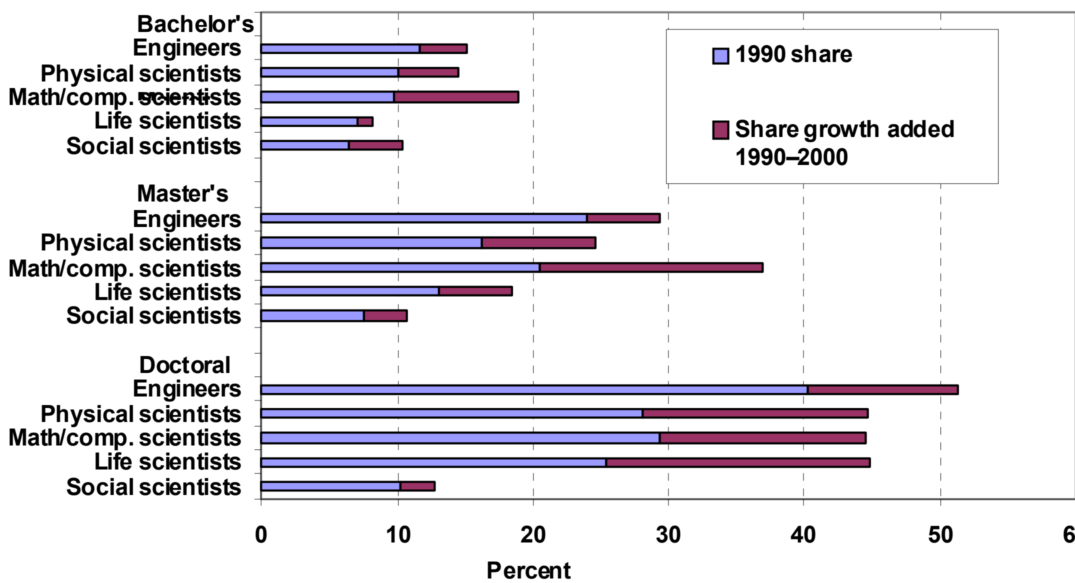


Complicating the picture, S&E attainment rates by white and non-Hispanic men have been on a long-term downward trend that has been approximately counterbalanced by the rising participation of women.

Even as larger proportions of U.S. citizens avail themselves of higher education, the nation has lost the advantage it held for several decades as the country offering by far the most widespread access to higher education. Starting in the late 1970s, and accelerating in the 1990s, other countries built up their postsecondary education systems, and a number of them now provide a first-level college degree to at least one-third of their college-age cohort.

There is evidence that many countries are trying to increase production of degrees in natural sciences and engineering. As you can see in preceding chart, from both the comparative position of the United States, as well as the level of the United States in 2000, as compared to 1975, the other countries appear to be succeeding in that goal well beyond what the United States has been able to achieve over the past 25 years.

Foreign-born scientists and engineers in U.S. S&E occupations, by degree level and field: 1990 and 2000



Source: National Science Board, *Science & Engineering Indicators, 2004*

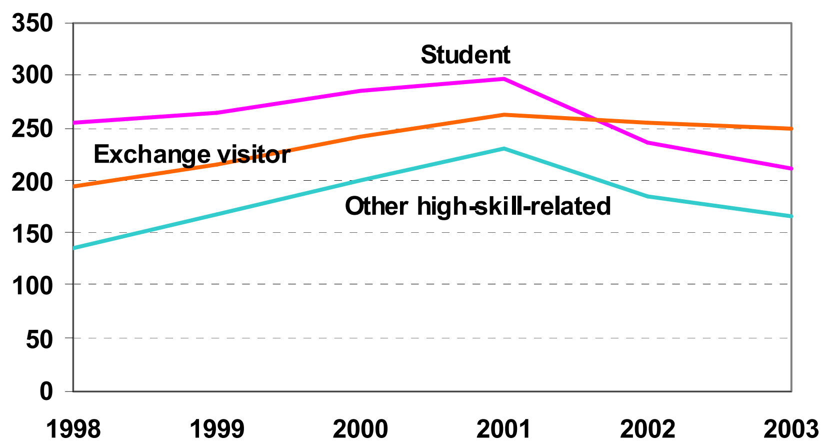
The share of foreign-born individuals in S&E occupations in the U.S. varies according to their occupation and degree level. In 2000, half or nearly half of all doctorate holders among engineers; physical, life, and computer scientists; and mathematicians were foreign born, as seen in the chart above. This data also excludes postsecondary teachers.

Among computer scientists and mathematicians, more than one-third of master's degree holders and approximately one-fifth of bachelor's degree holders were foreign born. The 10-year increases are particularly large for mathematical computer scientists across all degree levels and for life sciences and physical sciences at the doctoral level.

The terrorist attacks of September 2001 have added a security dimension to ongoing discussions about the future of the U.S. S&E workforce. Available data indicate an initial reaction to the new security environment, as seen in the chart on the following page. The number of high skill-related visas issued to students, exchange visitors and others in 2002 were significantly lower than the number issued in 2001 and continued to decline in 2003. These data reflect both a drop in applications for all visa classes except exchange visitors and higher U.S. Department of State visa refusal rates.

In conclusion, all of the information in this presentation is available in the NSF publication, *Science and Engineering Indicators, 2004*, available online at http://www.nsf.gov/sbe/srs/seind04/start.htm/ .

Student, exchange visitor, and other high-skill-related temporary visas issued: FY 1998-2003



Source: National Science Board, *Science & Engineering Indicators 2004*

Audience Questions/Comments:

- Clinton Parks, Science's Next Wave and Minority Scientists Network – You mentioned the difference between representation for minorities in the hard sciences versus psychology and the other social sciences. Did you tease apart immigrants from that data set?

  Response – No, I did not, but one can do that. I suspect that for underrepresented minorities there is not going to be much of a difference. There is a big difference on the Asian/Pacific Islander side because of so many Asians from outside the country coming to the U.S. to study.

- Clinton Parks, Science's Next Wave and Minority Scientists Network – Looking at the greater representation for the category of other academics versus research institutions, do you have any speculation as to why that is, as far as why minorities are better represented in other academics?

  Response – No, I do not. Does anybody want to take that?

- Roberta Spalter-Roth, American Sociological Association – There are a variety of reasons, such as who your connections are, who your mentors are, where you go to graduate school, what kinds of grants you might have had or worked on in graduate school, how many publications you had with a mentor in graduate school, so that there is, even at that initial step, a real sorting process.

  Response – I do not know if the sample size is large enough, but one of the things we could look at is where people who got their degrees from research universities went, relative to those who got their degrees elsewhere.

- Roberta Spalter-Roth, American Sociological Association – I think even among those who got their degrees from research universities you are going to find differences. We know those data from our minority fellowship program.