RECONCILING ESTIMATES OF U.S. DOCTORATES

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Executive Summary

Problem

Two different NSF surveys can be used to produce estimates of doctorates in the United States in 1993. One of these, the National Survey of College Graduates (NSCG), is a resurvey of persons responding to the 1990 Census of Population. The other, The Survey of Doctorate Recipients (SDR) surveys recipients of research doctorates from U.S. universities as identified by those universities.

The total number of doctorates identified by the Census based survey, the NSCG, should be larger than the number identified by the SDR, as the SDR omits foreign doctorates. However, the NSCG count of doctorates exceeded that of the SDR by more than 20 percent, even when tabulations are restricted to persons who have a doctorate from a U.S. university. This report attempts to understand the reasons for these differences.

Findings

The NSCG count of doctorates granted by U.S. universities exceeds the comparable estimate from the SDR by 20.7 percent, that is, 106,174. About two-thirds of this difference arises from the higher estimates in the NSCG for Life Science and Psychology.

Table 1. NSCG and SDR Estimates of Doctorate Population in 1993, by Degree Field

Field of Doctorate	NSCG	SDR
Math/Computer Science	38,818	29,485
Life Science	173,773	139,398
Psychology	114,734	77,005
Engineering	86,290	81,573
Physical Sciences	121,696	112,427
Social Science	84,451	73,700
Total, all fields	619,762	513,588

Source: Table 2.1

There are several reasons why the SDR produces lower estimates of the doctorate population with U.S. degrees.

1. The SDR includes only "research doctorates." Operationally this means that it excludes known doctorates who have practice rather than research oriented degrees. Most of these practice oriented degrees are in education or psychology and carry titles such as EdD, or PsyD rather than PhD. The NSCG does not attempt to make this kind of discrimination among doctorates.

2. The SDR does not include doctorates from non-accredited schools; the NSCG attempts no such exclusion.

3. The SDR excludes about 44,000 foreign-born persons who indicated at the time they received their U.S. doctorates that they intended to go abroad after graduation. Not all of these went or stayed abroad.

4. The SDR has probably missed a few doctorates who should be in the population it samples but were left out due to errors of omission. While errors of this type are infrequent, the design of the SDR is such that it is more likely to exclude a doctorate who should be included than it is to include a non-eligible doctorate.

5. Respondents to the NSCG almost certainly overstate their credentials. The Census Bureau can edit out obvious absurdities, but in nearly all cases the word respondents regarding degree level is accepted. It would require only a very small proportion of the total NSCG respondents to falsely report doctorates to produce a significant overstatement in the NSCG doctorate population estimates.

6. The NSCG had a degree classification problem: some with professional degrees incorrectly reported their degrees as doctorate degrees. This problem was confined to persons reporting life science doctorates, and within that group to the sub-field of degrees classified by NSF as health professions. The problem was mostly corrected by a coding change. However, even after this change the relatively small health professions degree field accounts for nearly one-third of the total discrepancy between the two survey estimates—mostly because some medical professional degrees are still misclassified as doctorates in the NSCG.

Overall, the NSCG estimates of the doctorate population exceed the SDR estimates by 20.7 percent. We believe that the six reasons given above can plausibly explain this difference. While we cannot precisely estimate the contribution of each of these reasons, Table 2 summarizes our judgment about the relative contribution of each one. The mid-case estimate is given for the total of all of these factors and it nearly matches the amount by which the NSCG estimates exceed the SDR estimates. A mid-case estimate is not provided for each of the individual factors in Table 2. We know that they need to add up to 20.7 percent of the SDR total, but there is considerable uncertainty about the relative contribution of each of these factors.

Table 2. Six Reasons Why NSCG Totals Exceed SDR Doctoral Totals, with Estimates of the Relative Contribution Each Makes to the Total NSCG/SDR Difference

(expressed as percent of SDR total)

		Low	Mid-Case	High
1.	Doctorate not counted by SDR	2		6
2.	Doctorate from Non-accredited School	2		5
3.	SDR excluded because of plans to emigrate	1		3
4.	SDR undercount due to errors of omission	0		2
5.	NSCG respondents claim doctorates they don't have	2		9
6.	Misclassification of doctorate degree in NSCG	4		6
	Total, all six reasons	11	21	31

Source: Figure 2.1

Introduction

This report is documentation of an effort to understand and reconcile differences between the National Science Foundation's two major surveys that contain information on doctorate scientists and engineers. The effort it describes was prompted by the fact that one of these surveys, the census-based National Survey of College Graduates, initially produced much larger estimates than the other survey, the Survey of Doctorate Recipients.

The report is organized in three sections:

This introduction gives an overview of the reasons why the two surveys could differ.

Chapter 1 describes our initial effort to understand the problem.

Chapter 2 documents the changes that were made to partially correct the problem, and shows how close the two survey estimates are before and after a coding change was made in response to the analysis of Chapter 1. It also provides a minor correction of estimates made for Chapter 1, and it provides estimates of the contribution that each of several possible causes of difference are thought to make to the remaining difference in the total estimate of the two surveys.

Reasons for Differences in Survey Results Examined in this Report

The National Survey of College Graduates (NSCG) produces larger estimates of the population of doctorate recipients from U.S. universities than does the Survey of Doctorate Recipients (SDR). There are several possible explanations for this. In the chapters that follow, each of the following is considered as a possible contributor to the difference in estimates between the surveys.

The SDR excludes persons whose doctorate is not a "research" doctorate.
The SDR excludes persons whose doctorate is not from an accredited university.
The SDR excludes some foreign recipients of U.S. doctorates.
The SDR might have an undercount due to errors of omission.
The NSCG may have an overcount because of persons reporting doctorates they have not really completed.
The NSCG may have an overcount because of persons confusing the doctorate degree category with the professional degree category.
The timing of the two surveys was slightly different.

We are not able to state with precision how much each of these different factors contributes to differences in survey estimates, but we do attempt estimates of the relative contribution of each.

Chapter 1

Introduction

The National Science Foundation supports two different surveys of scientists that can be used to produce estimates of the number of science and engineering doctorates. The 1993 Survey of Doctorate Recipients (SDR) is conducted by National Research Council. It includes only doctorates awarded by U.S. universities who were not over age 75 in 1993. The other survey is the 1993 National Survey of College Graduates (NSCG) and is conducted by the U.S. Bureau of the Census. This survey excludes persons who were not resident in the United States in the Spring of 1990, and persons over age 75 in 1993, but it includes doctorate recipients from foreign universities as well as from U.S. universities.

The NSF relies on the NSCG primarily to estimate the portion of the science/engineering doctorates who received their degrees from foreign institutions. However, if this population is excluded, then the NSCG can be used to estimate essentially the same population as the Survey of Doctorate Recipients. When this is done, however, the two surveys still do not agree. This report explores the extent and causes of this disagreement.

The Problem

The NSCG produces an estimate of the number of doctorate scientists and engineers in the United States in 1993 (732,402) that is almost 40 percent higher than the SDR estimate (513,273). (Table 1-1.) The NSCG is a resurvey of 1990 Census of Population respondents who indicated that they had a bachelors or higher degree. It is a very large survey and persons reporting doctorate degrees in science or engineering are only a small part of it. There are about 6,000 respondents to the NSCG who report having received a doctorate in science or engineering from a U.S. university. The NSCG also has information on scientists and engineers with doctorates from foreign universities.

The NSF intends that the SDR will be the primary source of information on doctorates who reside in the United States and who received their degrees from U.S. universities. The SDR has no information on doctorate residents in the United States, but possessing only a foreign doctorate—for that the NSCG is the only choice.

The other NSF sponsored survey, the Survey of Doctorate Recipients (SDR), can also be used to produce estimates of the number and characteristics of science and engineering doctorates from U.S. universities. By design, the SDR has a larger number of respondents who received science or engineering degrees from U.S. universities, almost 40,000. The SDR population estimate of doctorates was over 500,000 in 1993.

One possible explanation for different estimates is that the surveys summarized above are not strictly comparable. For example, people earning a doctorate from a U.S. university between 1990 and 1993 are definitely included in the SDR. However, they are included in the NSCG only if they were resident in the United States at the time the Census was conducted in Spring of 1990. Another way in which the estimates differ is that the SDR estimate includes all doctorates granted as recently as the 1992-1993 academic year—which ends in August of 1993. The NSCG did not permit us to identify the month the degree was awarded. Our NSCG estimates of 1993 doctorate recipients were made roughly comparable to the SDR estimates by the expedient of including only one-half of all doctorates reported to the NSCG for 1993.[1] These non-comparability issues are real, but could account for only very small differences in the estimates. Further, the two problems mentioned above would certainly cause the NSCG estimates to be slight underestimates of the total, not overestimates. Our concern is to understand why the

[1]It was learned after this Chapter was written that the above statements are not exactly correct; the 1993 SDR includes only doctorates awarded before July of 1992. Thus, a comparable NSCG estimate would include only about half of the 1992 graduates and none of those receiving doctorates in 1993. Chapter 2 estimates which supersede those of Chapter 1 are based on this understanding but the estimates in Chapter 1 have not been changed. Thus while the SDR estimates referred to in Chapter 1 are correct, the NSCG estimates in Chapter 1 are overstated by an average of nearly 4 percent because of this.

NSCG produces estimates of doctorate recipients from U.S. universities that are much larger than those from the SDR.

For U.S. degreed doctorates we might expect the SDR to provide better estimates because of its clearly larger sample size. In addition, the SDR has other attributes not possessed by the NSCG that are generally viewed as positive. The SDR samples the population identified by a separate but related survey. Each year the Survey of Earned doctorates is administered to new doctorates by the graduate schools of accredited universities in the United States. This produces the doctorate record file, a data bank which contains information on all the doctorates earned in the U.S. from accredited universities. The SDR samples the subset of the doctorate record file population reporting a science or engineering field of study, and certified by their graduate school as having received a research doctorate. Research doctorates are usually Doctor of Philosophy (PhD) degrees. However, a number of other degrees are classified as "research doctorates." These include, but are not limited to, degrees such as Doctor of Science, (DScD), Doctor of Chemistry (DChem), Doctor of Engineering (DEng), Doctor of Medical Science (DMSc), Doctor of Nursing Science (DNSc), and Doctor of Education (EdD). Any recipient of a research doctorate who indicates to the Survey of Earned Doctorates that his/her field of study is in the sciences or engineering is included in the population sampled for the SDR.[2] Thus, the SDR screens out people who do not appear on the rolls of universities as having received a doctorate; it screens out persons graduating from non-accredited universities, and it screens out persons graduating from accredited universities, but whose doctorate does not qualify as a research doctorate.

The NSCG, in contrast, simply queries each person as to their degree level and degree field. Thus, it defines doctorate in a less restrictive manner. NSCG also requires no institutional corroboration.

For all of the above reasons, we would expect the NSCG to produce estimates that are higher than the SDR. We are not sure how much higher to expect the NSCG would be because we do not have good estimates of the number of non-research doctorates awarded, the number awarded by non-accredited schools, or the extent to which respondents self report are likely to exaggerate their educational credentials. Some information on non-research doctorates is presented in our discussion of psychology degrees below. Before getting to that more detailed discussion, we note that the research literature does offer some insights into the exaggeration of educational credentials.

Lawrence Hamilton surveyed university students and compared their responses about their SAT scores with the scores on file in university records. He found that students reporting their own SAT scores exaggerate by an average of 10 points on the math SAT and 40 points on the verbal SAT. Those in his survey who did not answer the question on SAT scores had scores on file that were much lower than the average scores reported by students. Hamilton found that the errors made by students in estimating their SAT scores were correlated with other variables. In particular, he found that undergraduate students reporting that they aspire to ultimately obtain a doctorate or professional degree over-reported their SAT scores by nearly twice as much as those who aspire to no more than a bachelors degree (about 60 points total versus about 30 points total for those seeking only bachelor's degrees). We may expect that most of the students who exaggerate their SAT on a confidential survey will be unable to gain admission and ultimately complete a doctorate or professional degree. However, if some of them later in life also exaggerate their educational attainment, we would expect to see false reports of doctorate degrees in surveys like the NSCG that have no way of verifying claims to educational credentials.

False reports of educational credentials is a problem that is receiving increasing attention. Recent issues of personnel journals have contained a number of articles on "Resume Fraud" [e.g., Bachelor, 1995]. Van Tol reviews evidence suggesting that about 20 percent of all employees have something untruthful in their academic credentials. [Van Tol, 1995] While some fraction of this 20 percent claim degrees or certificates they do not have, others have exaggerated grades. About all we can learn from this literature is that false degree claims are

[2]One exception is the EdD recipients. At most universities, the College of Education awards both PhD and EdD degrees. The EdD degrees are classified as research doctorates by the National Research Council. However, in consultation with NSF, they decided many years ago to exclude recipients of the EdD degree from the SDR survey.

frequently made, but that the proportion of employees making those claims is less than 20 percent (because many are exaggerating only their grades).

One could speculate as to whether survey respondents would exaggerate their credentials less or more frequently than employees actually misrepresenting their credentials. The studies reviewed cannot help us make a good estimate. However, based on those studies one should not be surprised if NSCG respondents were to report doctorates they do not actually have perhaps 5 to10 percent of the time. In addition, because there are doctorates received from non-accredited schools and there are doctorates from accredited schools that are not research doctorates, we should expect an even larger deviation between the NSCG estimates and the more restrictive SDR estimates. Thus, when the NSCG estimates exceed the SDR estimates by only 10 percent or even 15 percent, it probably makes sense to ignore that on grounds that it could be attributed to expected differences in the two survey methods. We cannot be sure the NSCG estimates will exceed the SDR estimates by this amount, but if they do, the factors discussed above can provide a ready explanation.

In most broad categories of science and engineering the NSCG estimate of persons with science or engineering doctorates from U.S. universities is higher than the SDR estimate, but not by more than 10 to 15 percent. However, the NSCG estimates for life sciences, computer sciences, and psychology do exceed the SDR estimates for these three fields by larger percentages, much larger in the case of life science. (Table 1-1.) Therefore, we have examined these fields in detail below.

The examination of these broad fields requires that we look in further detail at the fine fields making up the broad fields. This requires a word of caution. The NSCG sample size is not sufficient to produce estimates for fine fields that contain only a few thousand doctorates. For fine (3 digit) fields and even for small groupings of those fine fields, sampling error (differences between the sample and the population it represents) could be expected to produce frequent deviations between the NSCG estimate and the SDR estimate that are substantially larger than 10 to 15 percent. We will only try to explain fine field differences when they are much larger than that.

Specific Conclusions/Comments

Table 1-1 gives estimates of science/engineering doctorates residing in the U.S. in 1993 who received their degrees from U.S. universities. Tables 1-2 to 1-7 provide the same estimates disaggregated by fine degree fields. There are four disciplines, or discipline groups, where the NSCG estimates differ substantially from the SDR estimates. Two of these disciplines, life sciences and psychology, vary by a great deal. The estimates for computer and information science and social science are also of concern.

Computer and Information Sciences (671-677)

The NSCG estimate is 11,957 versus only 5,163 for the SDR. (Table 1-2.) We are so far unable to come up with a convincing explanation for this. An examination of school names reported to the NSCG suggests that only a trivial portion of this is due to persons reporting degrees to the NSCG from schools that are not on the SDR list of accredited schools granting research doctorates.

One partial explanation of the higher numbers in the NSCG for computer science is that the NSCG taxonomy offers no explicit choice for a person who earned a mathematics degree with a specialization in computing; the SDR does. Consider the aggregation of Mathematics and Computer sciences. A person answering the NSCG saw five degree fields containing the word computer (e.g., computer science, computer systems analysis, etc.). All five of these were computer science fields, not mathematical science fields. A person answering the 1993 SDR was not asked his/her degree field in 1993. Rather the SDR used the responses given to the Survey of Earned Doctorates at the time of graduation. How many choices did that person see with the word computer when answering the Survey of Earned Doctorates? Only two: He/she could have chosen Computer Sciences or Computer Theory and Practice. One of these is classified as a sub-field of Computer and Information Sciences, while the other is classified as a sub-field of Mathematics. Over the years, 1,553 persons in the SDR totals were classified by the Survey of Earned Doctorates as having the degree field of Computer Theory and Practice. These persons are all shown in category 845, Other Mathematics, in the SDR column of Table 1-2. It seems likely that many of these

persons would choose a computer science field if they were faced today with the choices that respondents to the NSCG are faced.

Another possible explanation of the computer and information science difference is the more general one that people who answered the Survey of Earned Doctorates were describing their educational field at the time they graduated. Computer and information science is a relatively new field that has experienced great change. What the words computer and information sciences mean today is different from what they meant in the past. The field probably has more academic respectability and recognition as a distinct discipline. Many of the college professors teaching computer science today reported a different degree field when they graduated. Given the changes that have occurred, it seems likely the number of SDR doctorates who would choose one of the Computer Science and Information Science categories (671-677) to describe their doctoral education field would be closer to the NSCG number if the SDR doctorates were presented with the same set of choices at the same time (1993).

Mathematical Sciences (841-845)

Operations Research (843)

The NSCG estimate is 2,728 versus only 500 in the SDR. A large part of the difference seems to result from the fact that the SDR includes many recipients of Operations Research degrees under the category 741, Other Engineering. Operations Research degrees are reported by people receiving doctorates from mathematics departments, but also from colleges of Business and Engineering. Neither the NSCG, nor the SDR estimates include persons who indicated that their degree was received in the business area. The SDR estimates are based on the Survey of Earned Doctorates which has been administered to new doctorates for many years. Respondents to the Survey of Earned Doctorates who did not select operations research under a business category had an opportunity to select Operations Research under either Engineering or Mathematics, and by a factor of more than 2 to 1 they chose the Operations Research category under engineering rather than the category under Mathematics. However, the 1993 taxonomy used for both SDR and NSCG (illustrated in Tables 1-2 to 1-7) does not list operations research as a sub-category of engineering. A person with an operations research degree from an engineering school could check “Engineering, Other” if they insisted on identifying with an engineering field. Most who answered the NSCG in 1993 seem to have chosen the code 843 which is listed as a sub-field of mathematics. This could explain most of the discrepancy in NSCG versus SDR estimates for the category 843. Many of the missing operations researchers in the SDR are classified in the category 741, Other Engineering.

Table 1-11 contains information on the number of doctoral awards in Operations Research from 1970 through 1991. The total, 2401, is very close to the NSCG estimate (2,432) of the Operations Research doctorate population in 1993. As can be seen in Table 1-11, there were 575 of these awards in the broad field of mathematics (degree code 843), while the balance were in Engineering (1,381) and Business (445). These data are consistent with the hypothesis that the “missing” SDR doctorate operations researchers are being captured in Other Engineering (code 741).

Life and Related Sciences (631-642, 680-682, 781-791)

The NSCG estimate is 270,695 versus only 139,398 in the SDR. This is the largest discrepancy found between these two surveys. As can be seen in Table 1-3, virtually all of the difference results from the Health Professions and Related Sciences degree fields (codes 781-791). This is examined in detail.

Health Professions and Related Sciences (781-791)

The NSCG estimate is 139,276 versus only 15,026 in the SDR. (Table 1-3.) Most of the people checking these codes in the NSCG are expected to be health practitioners such as nurses, physicians, dentists, optometrists, etc. and assistants to these practitioners. NSF's definition of science degrees would exclude the professional degrees earned by nearly all of these health practitioners. However, in many of these fields a small portion of all the degrees awarded are research doctorates, and these generally fit within NSF's definition of science fields. Clearly, something went wrong as the NSCG estimate of 103,302 doctorates in "medicine" not only conflicts with the SDR, but also with what is generally known about degree awards in this area.

There is strong evidence to suggest that the NSCG misclassified the vast majority of the doctorates checking Medicine (786) as well as many of those checking Pharmacy (788) and Other Health/Medical (791). Apart from the implausibility of the NSCG numbers there are two kinds of evidence to support this conclusion:

1.) An examination was made of detailed responses written on the actual NSCG survey forms for doctorates coded 786 (Medicine), including short written descriptors of respondents degree field, university, and job description. Many specifically indicated that their degree was an MD degree. Most wrote in a simple word like Medicine, Dentistry, etc. to describe their degree fields. A very small proportion, substantially fewer than 10 percent, wrote in something that seemed more descriptive of a research specialty, e.g., professor of medicine or biochemist.

When examining the degree granting institutions of those coded 786 (Medicine) it was found that about half (49.4 percent) of a sample of 250 were clearly identified as professional schools, in that they had the word medical or a related professional term such as chiropractic in the title. The other half were names of universities that include medical or dental schools as part of a larger university.

An examination of occupational information was also made. Most of the persons with 786 (Medicine) degrees indicated that their occupation was 111, "Diagnosing/Treating Practitioners (e.g., dentists, optometrists, physicians, psychiatrists, podiatrists, surgeons, veterinarians)." All of the cases examined wrote in descriptors that were fully consistent with the interpretation that these respondents were practitioners whose primary job was to see patients. A relatively small number of the NSCG respondents indicating 786 (Medicine) degrees used words often associated with the work of PhDs to describe their work (e.g., research, professor, postdoctoral fellow, medical school) in their short job descriptions. However, these respondents are not coded in the 111 category, but either in scientific occupational categories (e.g. 023, Biological scientists, 027, Other biological scientists) or as professors (e.g., 287, Medical science).

The above observations based on an examination of individual detailed responses at the Census Bureau indicate we can be confident that the most of the NSCG respondents coded 786 (Medicine) are indeed people whose job it is to see patients. In all 50 states they are required to be licensed to perform this work. The licensing authorities virtually always require a professional degree, not a research doctorate. It seems that many doctors (of medicine, optometry, etc., and chiropractic) checked the "doctorate" category in response to a question about university degrees instead of the "Other professional degree" category that the survey authors expected them to check.

To a lesser extent the same comments that apply to the degree fields 788, Pharmacy and 791, Other Health/Medical. That is, many of them reported practitioner occupations (111, 112) and wrote in responses suggesting that they were licensed health practitioners.

2.) An examination of the data file was also conducted in an effort to understand the true educational backgrounds of the NSCG respondents who reported 786, (Medicine) doctorates. This tended to corroborate the conclusions noted above.

First, of the total 103,302 NSCG respondents indicating a doctorate in category 786, (Medicine), fully 78,881 or 76.3 percent indicated that their occupation was either 111 or 112, two occupational codes that cover a wide range of health practitioner occupations. (Table 1-13.)

Second, we examined the response of these 78,881 health practitioners to a question about their education. Question A19 of the NSCG asked, "Thinking about the relationship between your work and your education, to what extent was your work on your principal job held during the week of April 15 related to your HIGHEST degree?" Over 98 percent indicated that their work was "Closely related" to their highest degree. One can imagine MDs working as physicians saying this, but such a high response does not occur among research doctorates even when they report working as scientists.

Of course, some of the persons with 786 (Medicine) degrees who work in the health practitioner occupations, 111 and 112, could possess both a professional degree of the kind required for licensure and a separate doctorate degree. The data in Table 1-15 show this. Only about 6,766, or 8.6 percent, of these health practitioners reported a doctorate and a professional degree of any kind.

Psychology (704, 891-897)

The NSCG estimate is 118,633 versus only 77,005 for the SDR. Nearly all of this difference is accounted for by differences in the sub-fields: 891 (Clinical), 892 (Counseling), and 704 (Educational). Much of the explanation seems to be linked to restrictions placed on the SDR. The population surveyed in the SDR is limited in three ways: they must have a doctorate; their university must be accredited; their university must report that the doctorate is a research doctorate. Most research doctorates are PhDs but other doctorates in the sciences and engineering are included if the university asserts it is a research doctorate.

The SDR staff have indicated that they know they overlook a substantial number of psychology degrees because some are not classified as research doctorates. These are usually classified as Doctor of Psychology (PsyD) degrees rather than Doctor of Philosophy (PhD) degrees. The Doctor of Psychology degree is practice oriented and has become increasingly popular because the growth area for psychologists in recent years has been among psychologists who see patients or clients. The American Psychological Association (APA) reports that the PsyD degrees have been growing rapidly and now number more than 600 per year. The APA provided estimates of the total number of PsyD degrees awarded. Table 1-12 shows a total of 3,258 PsyD degrees awarded between 1979 and 1993. While the number awarded before 1979 appears to have been small, the total number could be quite a bit higher than 3,258 because the APA does not have responses from all degree granting departments. This incomplete coverage is especially problematic in the APA data among those schools of psychology that are not accredited.

The SDR excludes non-accredited universities. A check of schools reported on the NSCG indicated that very few doctorates are reported from universities not surveyed by the SDR. Psychology, however, is an exception to this generalization. A check of Psychology degrees reported on the NSCG since 1986 indicated that in three fields combined (Clinical, Counseling, and General) the NSCG respondents indicated universities not surveyed by SDR about 12 percent of the time. Respondents in other fields of psychology reported schools not surveyed by the SDR only about 1 percent of the time. This explanation probably overlaps somewhat with the PsyD explanation. That is, some PsyD degrees are awarded by schools that are not surveyed by the SDR.

There appears to be a third explanation for degree field 704, Educational Psychology. Degrees in Educational Psychology are awarded by psychology departments and also by schools of Education, often within the same university. The NSCG would include such persons regardless of where they received their degree. The SDR, however, has a screen. It is the Survey of Earned Doctorates which is administered to virtually all new doctorates at the time their degree is awarded and provides the sampling frame for the SDR. The Survey of Doctorate Recipients permits respondents to report an education or school psychology degree in two different places: under the heading of Psychology (along with other psychology fields such a clinical, experimental, etc.) or under the heading of Education (along with College of Education fields such as Curriculum & Instruction, Social and Philosophical Foundations of Education, etc.) However, if the respondent's degree is an EdD the editing procedures for the coders on the SED instruct them to force the response into the education category. The SDR then excludes from its sampling frame all persons whose degree field falls under the heading of Education. Thus, there is only one way for a person with a doctorate in education or school psychology from a College of Education

to be included in the SDR: he/she must have a PhD (not an EdD) and must also report the degree field under a heading other than Education, e.g., under Psychology.

Physical Sciences (871-879)

Earth Science/Geology/Oceanography (872-877)

The NSCG estimate for Earth science/Geology/Oceanography is 18,462 compared with 14,234 for the SDR. However, it should be noted that the Survey of Earned Doctorates (which provides the sampling frame for the SDR) does not have an explicit category for Earth Science—persons in the SDR were forced to choose another category. Thus, this comparison is not entirely valid. It still is true, however, that the categories of Geology (875) and Other Geological science (876) when combined are larger in the NSCG than in the SDR by a factor of more than 20 percent. This is likely partly due to the way certain detailed fields in the Survey of Earned Doctorates are mapped to the less detailed taxonomy that is used by NSF for reporting data from both the SDR and the NSCG in 1993. For example, "Hydrology and Water Resources" has a separate education code on the Survey of Earned Doctorates specialties list and this code was mapped to Other Physical Sciences in the SDR taxonomy. Some of these doctorates may choose Geology or Other Geological science on the NSCG survey taxonomy because there is no specific listing for Hydrology on that survey.

Social Sciences (601, 620, 771, 902, 921-930)

The NSCG estimate is 86,819 versus only 73,700 for the SDR. (Table 1-7.) As the NSCG estimate exceeds the SDR estimate by only 17.8 percent, the general factors which would lead one to expect higher estimates from the NSCG may be relied upon to explain much of this difference. An examination of university names written in by NSCG respondents was conducted at the Census Bureau with the following result: only 2 to 3 percent of recent graduates wrote in university names not on the list of doctorate granting schools surveyed by the SDR (via the Survey of Earned Doctorates). There are other explanations besides this and the reporting of non-existent credentials that we can turn to understand the difference in social science estimates, however. Both "Area/Ethnic Studies" (620) and Philosophy of Science (861) seem to be much higher on the NSCG because of differences in coverage of the two surveys.

Area/Ethnic Studies (620)

The NSCG estimate is 3,080 versus 506 for the SDR. (Table 1-7). The Department of Education data on degree awards is instructive both for the size of their estimates and because they show detailed sub-fields within this category. For example, Department of Education data for 1989 showed 110 doctorates awarded, of which 95 were in Area Studies. Of these 95, most were in "American Studies" (60), followed by "Asian Studies" (17) and "Middle Eastern Studies" (10). (U.S. Department of Education, p. 239) This suggests that the total number of degree awards made to persons now under age 75 may be much larger than 500. However, the field which accounts for more than half of all these degrees, American Studies, is usually a program that contains more humanities (e.g., literature, history, and philosophy) than social science. This can obviously be true of some of the other Area Studies programs as well.

The issue of humanities versus social science emphasis in Area/Ethnic Studies is important because the SDR is designed to survey only Area/Ethnic Studies doctorates with a social science emphasis. This can be seen by examining the degree field specialties list for the Survey of Earned Doctorates (Appendix A) which is used to define the population for the SDR. The Survey of Earned Doctorates specialties list contains only two specific references to Area/Ethnic Studies. One is under the heading of Social Sciences and is named simply "Area Studies." The other choice facing a new doctorate responding to the Survey of Earned Doctorates is under the heading of Humanities and is named "American Studies." Those who select "American Studies" are presumed to be recipients of Humanities doctorates and are not included in the population selected for follow-up survey via the SDR. Only those who chose "Area Studies" under the Social Science heading are included in the SDR survey.

Another difference between the classifications used in the Survey of Earned Doctorates and the NSCG is that the Survey of Earned Doctorates provides 11 specific languages for a person receiving a doctorate in foreign language

and literature. The NSCG offers only one category, and it is titled "OTHER Foreign Languages and Literature." Thus, a person combining Area Studies with a heavy concentration of language and literature in the same area might pick one of the languages listed in the Survey of Earned Doctorates, e.g., Arabic, because it describes their degree fairly well. The same person confronted with the NSCG taxonomy of degree fields might choose Area/Ethnic Studies rather than to pick the general category of "OTHER Foreign Languages and Literature." This would cause that person to be excluded from the SDR (because languages are humanities), but not from the NSCG.

We examined the undergraduate degrees reported by Area/Ethnic Studies doctorates in the two surveys. (Table 1-8.) Relatively few from either survey reported a social science undergraduate degree. The number in the SDR reporting social science undergraduate degrees is slightly larger than the number in the NSCG—this fits our interpretation of the reason for differences. However, the high number of humanities undergraduate degrees in Table 1-8 may indicate that both surveys are including doctorates with a strong humanities component.

Philosophy of Science (861)

The NSCG estimate is 3,903 versus none for the SDR. (Table 1-7.) The NSCG estimate seems high given that total philosophy doctorates awarded were 255 in 1989 and that Philosophy of Science is a very minor sub-field of philosophy. (Department of Education, p. 244) However, the bigger issue is, why does the SDR show no degree recipients in Philosophy of Science? In general, NSF practice is to include four fields that are claimed by the humanities community in their definitions of science and engineering: archeology, linguistics, history of science, and philosophy of science. The first three of these have SDR estimates in Table 1-7 that are remarkably close to the NSCG estimates. Given that these are small fields and each survey has sampling error, we might have expected larger differences.

The SDR estimate for Philosophy of Science in Table 1-7 is zero. This seems to be because the specialties list used for the Survey of Earned Doctorates does not include Philosophy of Science as a distinct choice. (Appendix A) The few persons who do earn doctorates with a specialty in the philosophy of science probably choose the category "Philosophy." Since this is a Humanities field, they are not included in the population sampled for the SDR. This appears to be a glitch that should be corrected if possible. We have not conducted a complete history of changes in the specialties list for the Survey of Earned Doctorates but note that it included a category "History & Philosophy of Science" in 1982. In 1983 the specialties list was changed to look much like the present list, i.e. History of Science was given a separate category and Philosophy of Science was dropped.

Conclusions

This preliminary review has identified plausible explanations for differences in the areas with the largest absolute differences: life sciences, psychology, social sciences. We have not been able to find a convincing explanation for computer science.

Table 1-1. NSCG and SDR Estimates of 1993 Doctorate Population

Field	Estimates of 1993 Doctorate Population		Ratio of NSCG/SDR
	NSCG	SDR	
Math/Computer Science	40,723	29,485	1.4
Mathematics	28,766	24,322	1.2
Computer Science	11,957	5,163	2.3
Life Science	270,695	139,398	1.9
Agricultural Sciences	15,136	17,327	0.9
Biology	113,965	102,735	1.1
Environmental Sciences	2,318	4,310	0.5
Health Professions	139,276	15,026	9.3
Psychology	118,633	77,005	1.5
Engineering	90,519	81,258	1.1
Physical Sciences	125,013	112,427	1.1
Chemistry	64,216	59,977	1.1
Physics/Astronomy	39,302	37,073	1.1
Earth/Geology	18,462	14,234	1.3
Other Physical Sciences	3,033	1,143	2.7
Social Science	86,819	73,700	1.2
Total, all fields	732,402	513,273	1.4

Source: Estimated by ORAU.

Table 1-2. NSCG and SDR Estimates of 1993 Doctorate Population
Mathematics and Computer Science

	Degree Code	Estimates of 1993 Doctorate Population		Ratio of
		NSCG	SDR	NSCG/SDR
COMPUTER SCIENCE	D67		5,163	
Computer and Information Science	671	841		
Computer Science	673	9,678		
Computer Systems Analysis	674	403		
Information Services and Systems	676	408		
Other Computer and Information Science	677	627		
Total, Computer Science		11,957	5,163	2.3
MATHEMATICS				
Applied Mathematics	841	4,097	3,197	1.3
Mathematics, General	842	13,638	2,261	6.0
Mathematics, Other	845	1,518	14,143	0.1
Operations Research	843	2,728	500	5.5
Statistics	844	6,785	4,221	1.6
Total, Mathematics		28,766	24,322	1.2
Total, Math/Computer Science		40,723	29,485	1.4

Source: Estimated by ORAU.

Table 1-3. NSCG and SDR Estimates of 1993 Doctorate Population: Life Sciences

	Degree Code	Estimates of 1993 Doctorate Population		Ratio of NSCG/SDR
		NSCG	SDR	
AGRICULTURAL SCIENCES				
Animal Sciences	605	3,439	4,153	0.8
Food Science and Technology	606	2,758	1,774	1.6
Plant Science	607	5,652	8,613	0.7
Other Agricultural Science	608	3,287	2,787	1.2
Total Agricultural Sciences		15,136	17,327	0.9
BIOLOGICAL SCIENCES				
Biochemistry and Biophysics	631	26,558	21,534	1.2
Biology, General	632	8,599	4,281	2.0
Botany	633	5,557	6,944	0.8
Cell and Molecular Biology	634	11,387	7,075	1.6
Ecology	635	3,666	3,758	1.0
Genetics	636	5,212	3,999	1.3
Microbiology	637	13,237	10,243	1.3
Nutritional Sciences	638	1,996	1,663	1.2
Pharmacology	639	7,830	5,570	1.4
Physiology	640	9,774	8,257	1.2
Zoology	641	9,376	14,988	0.6
Other Biological Sciences	642	10,773	14,423	0.7
Total Biological Sciences		113,965	102,735	1.1
ENVIRONMENTAL SCIENCE				
Environmental Science Studies	680	434	1,916	0.2
Forestry Sciences	681	1,884	2,394	0.8
Total Environmental Science		2,318	4,310	0.5
HEALTH PROFESSIONS				
Audiology and Speech Pathology	781	3,762	2,634	1.4
Health Services Administration	782	2,228		
Health/Medical Assistants	783	200		
Health/Medical Technologies	784	278		
Medical Preparatory Programs	785	2,414		
Medicine	786	103,302	965	107.0
Nursing	787	2,592	2,740	0.9
Pharmacy (see also 639)	788	8,405	2,195	3.8
Physical Therapy and Other Rehabilitation	789	1,474	45	32.8
Public Health	790	5,914	3,718	1.6
Other Health/Medical	791	8,341	2,729	3.1
Other	991	366		
Total Health Professions		139,276	15,026	9.3
Total Life Science		270,695	139,398	1.9

Source: Estimated by ORAU.

Table 1-4. NSCG and SDR Estimates of 1993 Doctorate Population Psychology

	Degree Code	Estimates of 1993 Doctorate Population		Ratio of NSCG/SDR
		NSCG	SDR	
PSYCHOLOGY				
Clinical	891	39,235	27,417	1.4
Counseling	892	16,755	7,990	2.1
Educational	704	18,014	2,579	7.0
Experimental	893	8,913	7,591	1.2
General	894	14,149	6,573	2.2
Industrial/Organizational	895	3,181	2,287	1.4
Social	896	5,160	5,114	1.0
Other	897	13,226	17,454	0.8
Total Psychology		118,633	77,005	1.5

Source: Estimated by ORAU.

Table 1-5. NSCG and SDR Estimates of 1993 Doctorate Population Engineering (Revised SDR Estimates)

	Degree Code	Estimates of 1993 Doctorate Population		Ratio of NSCG/SDR
		NSCG	SDR	
ENGINEERING				
Aerospace	721	3,768	3,377	1.1
Agricultural	722	951	1,221	0.8
Architectural	723	354		
Biomedical	724	1,988	1,943	1.0
Chemical	725	12,227	12,294	1.0
Civil	726	10,147	7,269	1.4
Computer	727	2,494	1,930	1.3
Electrical, Electronics	728	23,702	19,082	1.2
Engineering Science	729	3,669	4,880	0.8
Environmental	730	2464	1505	1.6
Geophysical	732	179		
Industrial	733	3345	2041	1.6
Materials	734	4,994	4,350	1.1
Mechanical	735	12,601	10,086	1.2
Metallurgical	736	3,233	3,436	0.9
Naval/Marine	738	177	32	5.5
Nuclear	739	2,407	2,054	1.2
Petroleum	740	674	290	2.3
Other Engineering	741	1,145	5,783	0.2
Total Engineering		90,519	81,573	1.1

Source: NSCG data estimated by ORAU. SDR data from unpublished data from the National Research Council. Totals for NRC SDR engineering (81,573) differ from ORAU SDR engineering (81,258) because the NRC statistics are from a revised data set.

Table 1-6. NSCG and SDR Estimates of 1993 Doctorate Population Physical Science

	Degree Code	Estimates of 1993 Doctorate Population		Ratio of NSCG/SDR
		NSCG	SDR	
PHYSICAL SCIENCES				
Astronomy	871	2,528	2,788	0.9
Atmospheric/meteorology	872	1,804	1,837	1.0
Chemistry	873	64,216	59,977	1.1
Earth Sciences	874	1,973		
Geology	875	9,824	5,197	1.9
Other Geological Sciences	876	3,232	5,247	0.6
Oceanography	877	1,629	1,953	0.8
Physics	878	36,774	34,285	1.1
Other Physical Sciences	879	3,033		
Physical Sciences	D87		1,143	
Total Physical Sciences		125,013	112,427	1.1

Source: Estimated by ORAU.

Table 1-7. NSCG and SDR Estimates of 1993 Doctorate Population Social Science

	Degree Code	Estimates of 1993 Doctorate Population		Ratio of NSCG/SDR
		NSCG	SDR	
SOCIAL STUDIES				
Anthropology/archeology	921	6,686	7,907	0.8
Criminology	922	199	565	0.4
Area/Ethnics Studies	620	3,080	506	6.1
Economics	923	21,905	19,620	1.1
Agricultural Economics	601	3,526	2,246	1.6
Geography	924	3,438	3,421	1.0
History of Science	925	330	397	0.8
International Relations	927	1,559	2,097	0.7
Political Science	928	17,001	13,180	1.3
Public Policy	902	923	814	1.1
Linguistics	771	3,976	3,349	1.2
Philosophy of Science	861	3,903		
Sociology	929	17,939	13,801	1.3
Other Social Sciences	930	2,354	5,797	0.4
Total Social Sciences		86,819	73,700	1.2

Source: Estimated by ORAU.

Table 1-8. Bachelor's Degree Field of Area Studies Doctorates

Bachelor's Degree Field	Estimates of 1993 Doctorate Population		Percent Distribution	
	NSCG	SDR	NSCG	SDR
Area/Ethnic Studies	766	75	24.9%	14.9%
Education	238	9	7.7%	1.8%
Humanities	1,667	256	54.1%	50.7%
Social Science	54	69	1.8%	13.7%
All Other or Missing	354	96	11.5%	19.0%
Total, All Bachelor's Fields	3,079	505	100.0%	100.0%

Source: NSCG data calculated by ORAU, SDR data from the National Research Council

Table 1-9. Bachelor's Degree Field of Operations Research Doctorates

Bachelor's Degree Field	Estimates of 1993 Doctorate Population		Percent Distribution	
	NSCG	SDR	NSCG	SDR
Life Science		16		3.2%
Business	232	35	9.3%	7.0%
Engineering	778	102	31.1%	20.3%
Mathematics	970	285	38.8%	56.8%
Physical Science	345	48	13.8%	9.6%
Economics	177	16	7.1%	3.2%
Total, All Bachelor's Fields	2,502	502	100.0%	100.0%

Source: NSCG data calculated by ORAU, SDR data from the National Research Council

Table 1-10. Bachelor's Degree Field of Computer Science Doctorates

Bachelor's Degree Field	Estimates of 1993 Doctorate Population		Percent Distribution	
	NSCG	SDR	NSCG	SDR
Life Sciences	0	88	0.0%	1.7%
Business	0	113	0.0%	2.2%
Computer Science	2,190	1,229	18.3%	23.7%
Education	177	43	1.5%	0.8%
Engineering	3,302	1,214	27.6%	23.4%
Humanities	438	150	3.7%	2.9%
Mathematics	3,738	1,535	31.3%	29.6%
Physical Sciences	697	299	5.8%	5.8%
Social Sciences and Psychology	271	60	2.3%	1.2%
All Other or Missing	1,144	458	9.6%	8.8%
Total, All Bachelor's Fields	11,957	5,189	100.0%	100.0%

Source: NSCG data calculated by ORAU, SDR data from the National Research Council

Table 1-11. Doctorate Awards in Operations Research, 1970- 1991

Year	Operations Research PhDs by Broad Field			
	Mathematics	Engineering	Business	Total
1970-79	246	693		939
1980-89	284	566	341	1,191
1990-91	45	122	104	271
Total	575	1,381	445	2,401

Note: Data are all doctorates awarded, including foreign nationals.

Source: National Research Council, "Summary Report Doctorate Recipients from United States Universities" (Washington DC: National Research Council, various years).

Table 1-12. Doctorate of Psychology Degree Awards , 1978-1993

Year	Doctorate of Psychology Degree Awards		
	Clinical	School and Other	Total
1978-79	48	14	62
1979-80	71	16	87
1980-81	118	26	144
1981-82	171	19	190
1982-83	199	34	233
1984-85	257	30	287
1986-87	327	57	384
1988-89	504	125	629
1990-91	474	136	610
1992-93	544	88	632
Total	2,713	545	3,258

Source: "Graduate Study in Psychology", selected years, American Psychological Association. Compiled by Research Office, APA.

Table 1-13. Job Categories for Medicine Doctorates in the NSCG, 1993

Job Category	Job Code	Number	Percent
Diagnosing/Treating Practitioners	111, 112	78,881	76.4%
Top and Mid Level Managers	141	3,341	3.2%
Medical Scientists	025	2,502	2.4%
Professors	271-299	1,539	1.5%
All Other Job Categories		17,039	16.5%
Total, All Job Categories		103,302	100.0%

Source: Calculated by ORAU.

Table 1-14. How Close Was Job Related to Highest Degree, Medical Doctorates in 1993 NSCG

Job Category	Non Response	Closely Related	Somewhat Related	Not Related	Total
Diagnosing/Treating Practitioners					
Number	0	77,575	406	900	78,881
Percent	0.0%	98.3%	0.5%	1.1%	100.0%
All Other Job Categories					
Number	15,394	6,523	1,746	758	24,421
Percent	63.0%	26.7%	7.1%	3.1%	100.0%

Source: Calculated by ORAU.

Table 1-15. Second Most Recent or Highest Degree Type, Medical Doctorates in 1993 NSCG

Job Category	Non Response	Bachelor	Master	Doctorate	Profess-ional	Total
Diagnosing/Treating Practitioners						
Number	10817	52,836	7,373	1,089	6,766	78,881
Percent	13.7%	67.0%	9.3%	1.4%	8.6%	100.0%
All Other Job Categories						
Number	5735	11,459	4,246	1,245	1,736	24,421
Percent	23.5%	46.9%	17.4%	5.1%	7.1%	100.0%

Source: Calculated by ORAU.

Chapter 2

Introduction

After the completion of Chapter 1 and before widespread access to the NSCG data was granted, the NSF decided to make a recode to correct at least some of the misclassification of MDs and other health professionals who were incorrectly classified as having received doctorate degrees. In this Chapter we describe that recode. We also compare the NSCG estimates of doctorates before and after this coding change, and compare these with the SDR estimates. Finally, we review the various reasons why differences between the two surveys still exist, and we provide some estimates of the quantitative significance of each of these.

Recode to Adjust Misclassification of MDs and Other Health Professionals Classified as Life Scientists

Because the evidence of misclassification is very strong, a change in coding to correct misclassification seemed appropriate. After seeing our initial results shown above, a recode was suggested by staff at the National Science Foundation. While no recode that we can devise will completely cure the misclassification problem, this one is expected to correct most of it. It consists of the following:

If the respondent met the following conditions:

1. Highest reported degree is a doctorate in one of the "Health Professions and Related Sciences" fields (781-791), and
2. No professional degree is reported (e.g., no MD or DDS), and
3. Reported occupation is 111 Diagnosing/Treating Practitioners (e.g., dentists, optometrists, physicians, psychiatrists, podiatrists, surgeons, veterinarians),

then the respondent's highest degree code was changed from a Doctorate to a Professional Degree.

One of the reasons this change makes sense is that about 99 percent of the survey respondents who met the above three conditions indicated their work was closely related to their degree. That is consistent with a professional degreed person working as a practitioner in the health sciences, but would be hard to explain if these persons had doctorate degrees such as the PhD degree.

Table 2.1 compares the SDR and NSCG estimates of doctorates in science and engineering by degree field made before and after this change in coding.

This change does not completely eliminate misclassification that might have occurred by MDs and other professionals incorrectly listing their degree field as a doctorate instead of a professional degree. While most such persons did check one of the occupations listed above (coded 111 or 112), some checked Other Occupations. One of these other occupations is Postsecondary Teacher/Professor of Medical Science (code 287). We probably still have some professors of medicine listed as having doctorate degrees when their only advanced degree is an MD degree. However, we can not recommend making the same recode in this case because some professors of medical sciences hold PhD degrees. The same would be true if they were in a management or science occupation. As noted earlier, because of state licensing requirements it is very unlikely that persons with only a PhD degree would be working in one of the "diagnosing/treating practitioner" occupations noted above. We are comfortable about excluding them but cannot easily identify others by occupation who can be assumed to be misclassified to be doctorates instead of professional degree holders.

Table 2.1 shows the count of NSCG doctorates before and after the change noted above. As a result of this change the total estimated number of doctorates with degrees in health profession fields declines from 134,571 to 48,550. Table 2.3 shows more detail on the degree fields affected. Most of the reduction is in degree field 786 "Medicine" where the NSCG count is reduced from 100,889 to 20,283. Other substantial

reductions occur in 785, “Medical Preparatory Programs” and in 791, “Other Health and Medical.” All of these health profession sub-fields are categories that might be selected by MDs.

Table 2.3 also shows that there is a large discrepancy between the NSCG and the SDR in Pharmacy. This discrepancy was affected little by the coding change described above. The problem is that the coding change applied only to those who indicated their occupation was category 111. The occupation of pharmacist was included in occupation 112, and thus, most practicing pharmacists were not affected by the coding change.

Reconciliation Summary

Table 2.1 showed that even after the NSCG coding of doctorates was revised, the NSCG still estimates 619,762 S/E doctorates versus only 512,273 estimated from the SDR. There are a variety of reasons why the NSCG still differs from the SDR. We cannot estimate the impact of most of these with anything approaching precision. Nevertheless, we have attempted to list these reasons and provide an estimate of the contribution each makes to the total discrepancy between these two surveys' estimates of the S/E doctorate population. Figure 2.1 lists several reasons why the SDR might be expected to give smaller estimates of this population than the NSCG and our judgment of percentage that the NSCG might exceed the SDR as a result of these reasons. Figure 2.1 shows a high and low estimate as well as a midrange. None of these are precise estimates, but are intended to give relative and absolute magnitudes that can plausibly explain most of the difference between these survey estimates.

We have placed a fairly wide band on the estimates in Figure 2.1 to emphasize that they are judgments based on limited data. One might be tempted to take the mid-point of the range to come up with a mid-case estimate. However, because of the judgmental basis for the estimates in Table Figure 2.1, we do not wish to make a single estimate out of this exercise.

We note, however, that the NSCG estimate of total S/E doctorates is 619,762. This is 20.7 percent higher than the SDR estimate of the same population. (Table 2.1.) This is very near to the mid-point of the range shown in Figure 2.1.

The first three explanations for the NSCG/SDR difference in Figure 2.1 describe differences in survey coverage. If each survey were executed with perfection these differences would still exist.

The last three explanations for the NSCG/SDR difference in Figure 2.1 are largely things that have to be viewed as survey deficiencies. No survey is without some such deficiencies. Our estimates suggest they are quantitatively a larger problem with the NSCG than with the SDR. In a way that is reassuring. The National Science Foundation would be wasting a great deal of money and volunteer time conducting a survey of the nation's science and engineering doctorates if the Census-based survey could perform as well as the SDR. The screening that goes on at universities prior to defining the SDR population assures not only that the SDR respondents have research doctorates from U.S. universities, but also more generally, that they have doctorates in first place.

The last two sources of difference in Figure 2.1 describe overcounts that are difficult to avoid given the screening process that the Census Bureau is forced to follow. The Census Bureau samples from those who self-report a college education or science or related occupation in the 1990 Census, then it asks NSCG respondents to self-report whether they have a doctorate degree. Virtually any adult in the United States could have been included in the NSCG doctorate population if they checked the right boxes. What we have called “Claiming Doctorates they Do Not Have” in Figure 2.1 will occur when Census and NSCG respondents overstate their educational credentials. A certain amount of this seems unavoidable given the documented tendency for some people to overstate their educational credentials. This also happens if persons check the wrong box by mistake—because most respondents do not have doctorates.

The last reason given in Figure 2.1, misclassification of doctorate degrees in the NSCG, is something that can probably be improved in the future. The NSCG question could be modified to discourage persons with professional degrees or other degrees that are not research doctorate degrees from choosing it. The most obvious change to try is to use the wording of a similar question on the 1990 Census. As Figure 2.2

indicates, the Census question gave examples for each degree and highlighted the PhD in the example for the Doctorate degree. The NSCG questions failed to give examples for the Doctorate category. Also, the NSCG category following the doctorate category contains the words "Other Professional." This might have caused respondents to conclude that the previous category was also a category which included professional degrees.

Figure 2.1
Sources of Differences between NSCG and SDR

Doctorate not Counted by SED **2 to 6 Percent**

Many people report doctorates that are not classified as research doctorates by the Survey of Earned Doctorates, and thus are not part of the population sampled in the SDR. Most numerous seem to be EdD and PsyD degrees.

Doctorate from Non-Accredited School **2 to 5 Percent**

This seems to have occurred relatively infrequently except for psychology. There were numerous institutions cited by respondents to NSCG which are not on the SED's list of accredited universities.

Emigrated, then Returned **1 to 3 Percent**

The SDR does not survey foreign students who receive U.S. doctorates and report plans to go abroad after graduation. Some of these doctorates come back within a few years and some never leave. The mid-point of this estimate would be correct if about 1 in 5 of the approximately 44,000 doctorates who have been left out of the SDR for this reason were in the United States in 1993.

SED Undercount **0 to 2 Percent**

The SED staff review graduation programs and lists of graduates in an effort to gather information on doctoral recipients who do not fill out the SED questionnaire. However, if the graduate does not appear on the program, or if the university does not cooperate fully to provide the lists and programs, or if the staff effort is less than perfect, then some doctorates do not get counted in the population surveyed by the SDR. It appears that all philosophy of science doctorates are missing from the SDR because of such an oversight.

NSCG Respondents Claim Doctorates They Do Not Have **2 to 9 Percent**

We have no hard data on this. However, studies show that people falsify credentials. Some of these people may have nearly completed a doctorate, but unless it is actually recorded as completed by a university it is not a doctorate to the SDR. Also included here are simple errors of checking the wrong box on the questionnaire, and mischievous behavior on the part of a tiny fraction of the population. If, for any one of these reasons, one out of every thousand persons in the NSCG indicated a doctorate degree they do not have, this would overstate the number of doctorates by an amount that is equal to more than 4 percent of the SDR total of 512,000.

Misclassification of Doctorate Degree in NSCG **4 to 6 Percent**

Much of the remaining difference between NSCG and SDR in the Medical Science degree field is likely due to persons reporting doctorate degrees when they should have reported professional degrees. If, for example, all those reporting doctorates in medical sciences in the NSCG were recoded to having professional degrees if they reported a professional degree in the 1990 Census, this alone would amount to about 4 percent of the SDR count.

Total, All of the Above **11 to 31 Percent**

Figure 2.2

Wording of Questions Used to Identify Types of College and University Degrees at the Bachelor's and Higher Level, 1990 Census and 1993 National Survey of College Graduates

1990 Census	1993 NSCG
Bachelor's degree (e.g., BA, AB, BS)	Bachelor's degree
Master's degree (e.g., MA, MS, MEng, MSW, MBA)	Master's degree (includes MBA)
Professional school degree (e.g., MD, DDS, DVM, LLB, JD)	Doctorate degree
Doctorate degree (e.g., PhD, EdD)	Other professional degree (e.g., JD, LLB, ThD, MD, DDS, etc.)

Using the 1990 Census wording would probably reduce the observed tendency in the NSCG for persons with only professional medical degrees to report doctorates. However, the 1990 Census question gives PhD and EdD as the only two examples of doctorate degrees. Since NSF has chosen to exclude all EdD degree holders from the research doctorate population described by the SDR the wording of the 1990 Census question does not seem to be ideal for the NSCG. However, dropping the EdD example in favor of another such as DSc, DChem, or DEng does not really solve the problem. Persons with EdD and PsyD degrees will probably still be classified as doctorates. It probably is not feasible for the NSCG to make the distinction between research doctorates and other doctorates that has been made for many years in the SDR.

Table 2-1. NSCG and SDR Estimates of 1993 Doctorate Population
Summary of All Fields

Field	Original NSCG	Revised NSCG	SDR
Math/Computer Science	38,818	38,818	29,485
Mathematics	27,653	27,653	24,322
Computer Science	11,165	11,165	5,163
Life Science	***259,618***	***173,773***	139,398
Agricultural Sciences	14,944	14,944	17,327
Biology	***107,989***	***108,165***	102,735
Environmental Sciences	2,114	2,114	4,310
Health Professions	***134,571***	***48,550***	15,026
Psychology	114,734	114,734	77,005
Engineering	86,290	86,290	81,573
Physical Sciences	121,696	121,696	112,427
Chemistry	62,875	62,875	59,977
Physics/Astronomy	38,204	38,204	37,073
Earth/Geology	17,785	17,785	14,234
Other Physical Sciences	2,832	2,832	1,143
Social Science	84,451	84,451	73,700
Total, all fields	705,607	619,762	513,588

Source: Estimated by ORAU.

The 1993 SDR survey only includes doctorates awarded up to mid-1992, the 1993 NSCG includes doctorates awarded through mid-1993. The column "Original NSCG" includes NSCG awards through mid-1992 and is therefore comparable to the SDR time span. Chapter 1 NSCG data do not include this adjustment and differ from these Chapter 2 tables.

The column labeled “Revised NSCG” differs from the “Original NSCG” column because of the degree coding change described in Chapter 2.

Table 2-2. NSCG and SDR Estimates of 1993 Doctorate Population
Mathematics and Computer Science

	Degree Code	Original NSCG	Revised NSCG	SDR
COMPUTER SCIENCE	D67			5,163
Computer and Information Science	671	841	841	
Computer Science	673	9,096	9,096	
Computer Systems Analysis	674	312	312	
Information Services and Systems	676	408	408	
Other Computer and Information Science	677	508	508	
Total, Computer Science		11,165	11,165	5,163
MATHEMATICS				
Applied Mathematics	841	3,942	3,942	3,197
Mathematics, General	842	13,162	13,162	2,261
Mathematics, Other	845	1,518	1,518	14,143
Operations Research	843	2,579	2,579	500
Statistics	844	6,452	6,452	4,221
Total, Mathematics		27,653	27,653	24,322
Total, Math/Computer Science		38,818	38,818	29,485

Source: Estimated by ORAU.

The 1993 SDR survey only includes doctorates awarded up to mid-1992, the 1993 NSCG includes doctorates awarded through mid-1993. The column "Original NSCG" includes NSCG awards through mid-1992 and is therefor comparable to the SDR time span. Chapter 1 NSCG data do not include this adjustment and differ from these Chapter 2 tables.

The column labeled “Revised NSCG” differs from the “Original NSCG” column because of the degree coding change described in Chapter 2.

Table 2-3. NSCG and SDR Estimates of 1993 Doctorate Population Life Sciences

	Degree Code	Original NSCG	Revised NSCG	SDR
AGRICULTURAL SCIENCES				
Animal Sciences	605	3,439	3,439	4,153
Food Science and Technology	606	2,758	2,758	1,774
Plant Science	607	5,460	5,460	8,613
Other Agricultural Science	608	3,287	3,287	2,787
Total Agricultural Sciences		14,944	14,944	17,327
BIOLOGICAL SCIENCES				
Biochemistry and Biophysics	631	25,264	25,264	21,534
Biology, General	632	8,301	8,301	4,281
Botany	633	5,379	5,379	6,944
Cell and Molecular Biology	634	10,045	10,045	7,075
Ecology	635	3,471	3,471	3,758
Genetics	636	5,060	5,060	3,999
Microbiology	637	12,287	12,287	10,243
Nutritional Sciences	638	1,878	1,878	1,663
Pharmacology	639	7,391	7,391	5,570
Physiology	640	9,380	9,380	8,257
Zoology	641	9,308	9,308	14,988
Other Biological Sciences	642	***10,225***	***10,401***	14,423
Total Biological Sciences		***107,989***	***108,165***	102,735
ENVIRONMENTAL SCIENCE				
Environmental Science Studies	680	230	230	1,916
Forestry Sciences	681	1,884	1,884	2,394
Total Environmental Science		2,114	2,114	4,310
HEALTH PROFESSIONS				
Audiology and Speech Pathology	781	3,667	3,667	2,634
Health Services Administration	782	***2,000***	***1,831***	
Health/Medical Assistants	783	***200***	***0***	
Health/Medical Technologies	784	152	152	
Medical Preparatory Programs	785	***2,386***	***317***	
Medicine	786	***100,889***	***20,283***	965
Nursing	787	2,241	2,241	2,740
Pharmacy (see also 639)	788	***7,795***	***7,612***	2,195
Physical Therapy and Other Rehabilitation	789	1,378	1,378	45
Public Health	790	***5,462***	***5,400***	3,718
Other Health/Medical	791	***8,062***	***5,330***	2,729
Other	991	339	339	
Total Health Professions		***134,571***	***48,550***	15,026
Total Life Science		259,618	173,773	139,398

Source: Estimated by ORAU.

The 1993 SDR survey only includes doctorates awarded up to mid-1992, the 1993 NSCG includes doctorates awarded through mid-1993. The column "Original NSCG" includes NSCG awards through mid-1992 and is therefor comparable to the SDR time span. Chapter 1 NSCG data do not include this adjustment and differ from these Chapter 2 tables.

The column labeled “Revised NSCG” differs from the “Original NSCG” column because of the degree coding change described in Chapter 2.

Table 2-4. NSCG and SDR Estimates of 1993 Doctorate Population
Psychology

	Degree Code	Original NSCG	Revised NSCG	SDR
PSYCHOLOGY				
Clinical	891	37,988	37,988	27,417
Counseling	892	16,092	16,092	7,990
Educational	704	17,275	17,275	2,579
Experimental	893	8,496	8,496	7,591
General	894	14,003	14,003	6,573
Industrial/Organizational	895	3,145	3,145	2,287
Social	896	5,093	5,093	5,114
Other	897	12,642	12,642	17,454
Total Psychology		114,734	114,734	77,005

Source: Estimated by ORAU.

The 1993 SDR survey only includes doctorates awarded up to mid-1992, the 1993 NSCG includes doctorates awarded through mid-1993. The column "Original NSCG" includes NSCG awards through mid-1992 and is therefor comparable to the SDR time span. Chapter 1 NSCG data do not include this adjustment and differ from these Chapter 2 tables.

The column labeled “Revised NSCG” differs from the “Original NSCG” column because of the degree coding change described in Chapter 2.

Table 2-5. NSCG and SDR Estimates of 1993 Doctorate Population Engineering (Revised SDR Estimates)

	Degree Code	Original NSCG	Revised NSCG	SDR
ENGINEERING				
Aerospace	721	3,734	3,734	3,377
Agricultural	722	917	917	1,221
Architectural	723	354	354	
Biomedical	724	1,892	1,892	1,943
Chemical	725	11,857	11,857	12,294
Civil	726	9,362	9,362	7,269
Computer	727	1,938	1,938	1,930
Electrical, Electronics	728	22,979	22,979	19,082
Engineering Science	729	3,636	3,636	4,880
Environmental	730	2,222	2,222	1,505
Geophysical	732	90	90	
Industrial	733	3,191	3,191	2,041
Materials	734	4,797	4,797	4,350
Mechanical	735	11,904	11,904	10,086
Metallurgical	736	3,199	3,199	3,436
Naval/Marine	738	177	177	32
Nuclear	739	2,378	2,378	2,054
Petroleum	740	674	674	290
Other Engineering	741	989	989	5,783
Total Engineering		86,290	86,290	81,573

Source: NSCG data from ORAU. SDR data from unpublished tables from the National Research Council (NRC). Totals for NRC SDR engineering (81,573) differ from ORAU SDR engineering (81,258) because NRC data are from a revised data set.

The 1993 SDR survey only includes doctorates awarded up to mid-1992, the 1993 NSCG includes doctorates awarded through mid-1993. The column "Original NSCG" includes NSCG awards through mid-1992 and is therefor comparable to the SDR time span. Chapter 1 NSCG data do not include this adjustment and differ from these Chapter 2 tables.

The column labeled “Revised NSCG” differs from the “Original NSCG” column because of the degree coding change described in Chapter 2.

Table 2-6. NSCG and SDR Estimates of 1993 Doctorate Population
Physical Science

	Degree Code	Original NSCG	Revised NSCG	SDR
PHYSICAL SCIENCES				
Astronomy	871	2,466	2,466	2,788
Atmospheric/meteorology	872	1,804	1,804	1,837
Chemistry	873	62,875	62,875	59,977
Earth Sciences	874	1,888	1,888	
Geology	875	9,338	9,338	5,197
Other Geological Sciences	876	3,126	3,126	5,247
Oceanography	877	1,629	1,629	1,953
Physics	878	35,738	35,738	34,285
Other Physical Sciences	879	2,832	2,832	
Physical Sciences	D87			1,143
Total Physical Sciences		121,696	121,696	112,427

Source: Estimated by ORAU.

The 1993 SDR survey only includes doctorates awarded up to mid-1992, the 1993 NSCG includes doctorates awarded through mid-1993. The column "Original NSCG" includes NSCG awards through mid-1992 and is therefor comparable to the SDR time span. Chapter 1 NSCG data do not include this adjustment and differ from these Chapter 2 tables.

The column labeled “Revised NSCG” differs from the “Original NSCG” column because of the degree coding change described in Chapter 2.

Table 2-7. NSCG and SDR Estimates of 1993 Doctorate Population
Social Science

	Degree Code	Original NSCG	Revised NSCG	SDR
SOCIAL STUDIES				
Anthropology/archeology	921	6,544	6,544	7,907
Criminology	922	199	199	565
Area/Ethnics Studies	620	3,080	3,080	506
Economics	923	21,407	21,407	19,620
Agricultural Economics	601	3,495	3,495	2,246
Geography	924	3,404	3,404	3,421
History of Science	925	330	330	397
International Relations	927	1,559	1,559	2,097
Political Science	928	16,642	16,642	13,180
Public Policy	902	855	855	814
Linguistics	771	3,873	3,873	3,349
Philosophy of Science	861	3,702	3,702	
Sociology	929	17,143	17,143	13,801
Other Social Sciences	930	2,218	2,218	5,797
Total Social Sciences		84,451	84,451	73,700

Source: Estimated by ORAU.

The 1993 SDR survey only includes doctorates awarded up to mid-1992, the 1993 NSCG includes doctorates awarded through mid-1993. The column "Original NSCG" includes NSCG awards through mid-1992 and is therefor comparable to the SDR time span. Chapter 1 NSCG data do not include this adjustment and differ from these Chapter 2 tables.

The column labeled “Revised NSCG” differs from the “Original NSCG” column because of the degree coding change described in Chapter 2.

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