A RAND NOTE

ADAMHA and NIH Research Grants to Psychologists

John Uebersax, Linda Ferguson

November 1989

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PREFACE

This Note reports the results of a study sponsored by the Science Directorate of the American Psychological Association (APA), the purpose of which is to describe trends in basic investigator-initiated research awards (R01 grants) to psychologist researchers by the Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA) and the National Institutes of Health (NIH) from 1968 to 1985.

As has been well documented, federal support for research in the social sciences has fluctuated markedly over the last 25 years. However, few previous studies have focused specifically on psychology as distinct from other social sciences, and little attention has been paid to funding with respect to individual subfields of psychology. The present study should therefore be of value in providing more detailed information on ADAMHA and NIH support for psychology research, in identifying problems, and in suggesting possible solutions.

It is also hoped that this study will help generate greater interest in the subject of federal funding for psychological research and stimulate critical inquiry by the federal government and psychological research community alike concerning psychology research policy.

SUMMARY

This study examines trends in research grants to psychologists awarded by the Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA) and the National Institutes of Health (NIH) from 1968 to 1985. Specifically considered are the numbers of R01 grant applications[1] submitted by psychologists to each institute, the numbers of applications resulting in awards, the dollar amounts awarded, and the priority scores assigned to applications by institute review groups.

FINDINGS

The major findings of this study are as follows:

- At ADAMHA, R01 funding for psychologists and other investigator groups fluctuated markedly from 1968 to 1985. Little net change occurred, however, and inflation-adjusted funding levels in 1985 only slightly exceeded those of 1968.
- At NIH, R01 funding for psychologists, as well as R01 funding overall, increased substantially. Between 1968 and 1985, the number of R01 grants awarded to psychologists by NIH increased fivefold.
- As a result of the two above trends, a shift occurred in the proportion of R01 support to psychologists accounted for by NIH.
- There has been a striking decrease in the proportion of ADAMHA and NIH R01 awards to young researchers.
- A consistent decrease has occurred in the proportion of R01 grant applications that are funded.
- The proportion of R01 awards accounted for by psychologists varies considerably across NIH institutes.

[1]R01 is the designation for a basic Public Health Service research grant.

- There are differences among ADAMHA institutes in the distribution of R01 awards and applications across psychology subfields.

We discuss implications of these findings below:

Volatile funding levels at ADAMHA. R01 support for psychologist researchers at ADAMHA increased steadily from 1968 to 1976, then decreased for two years. It increased again in 1979 and 1980, then decreased sharply for the next three years. Awards began again to increase in 1984. The first period of decreasing funding may be associated with a "rebound" from the comparatively high levels of social research funding of the 1960s and early 1970s. The second period of decreasing funding corresponds to the Reagan administration's cutbacks on social science research support. It is unlikely that such fluctuations create a favorable climate for the development of psychology. Their existence underscores the need for a consistent national policy toward psychology research, based on an objective appraisal of needs and priorities and the potential contribution of the field.

Increasing funding levels at NIH, and a shift in the proportion of NIH-funded psychological research. The increase in R01 funding for psychologists at NIH paralleled increases in total NIH R01 funding. While this trend toward an increasing "medicalization" of psychological research has positive aspects, a shift from predominantly ADAMHA-funded research support to predominantly NIH-funded research support may have important implications for the field that should be carefully considered.

Reduction in the proportion of awards to young researchers. At ADAMHA the proportion of R01 awards made to psychologists age 35 or younger decreased from 38 percent in 1968 to 14 percent in 1985; at NIH this percentage dropped from 37 percent in 1968 to 21 percent in 1985. This trend is closely paralleled by a decrease in the proportion of R01 applications from young investigators. Why young researchers are

submitting fewer applications is unclear. Possible explanations include demographic changes affecting the composition of the psychology research workforce, changing employment patterns, and changes in the mechanisms young researchers seek to support research. This is an important issue for the future of psychology--a shortage of young researchers receiving support now could lead to a shortage of capable, senior-level scientists in 20 years.

Decrease in the proportion of funded applications. The proportion of R01 applications resulting in awards (*award rate*) for psychologists at ADAMHA dropped from 42 percent in 1968 to 29 percent in 1985, and at NIH from 37 percent in 1968 to 26 percent in 1985. Other researcher groups were affected similarly. The preparation and submission of unfunded grant applications requires investigator time and resources that must be diverted from direct research. The processing and review of large numbers of unfunded applications also creates additional administrative burden for ADAMHA and NIH.

Differences between NIH institutes in the proportion of awards made to psychologists. Considerable variability was found among NIH institutes in the amount of support for psychology research. Five of the six institutes making the largest number of R01 awards overall--NIAID, NIADDK, NCI, NIGMS, and NHLBI[2]--were among those making the fewest to psychologists.

Variability among ADAMHA institutes in the distribution of awards across psychology subfields. The proportion of R01 awards to psychologists in the experimental, comparative, and physiological psychology subfield was greater at NIDA than at NIAAA and NIMH.[3] Correspondingly, the proportion of awards to psychologists in the clinical subfield was lower at NIDA than at NIAAA and NIMH. NIDA and NIAAA also made few R01 awards to psychologists in the developmental

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[2]National Institute of Allergy and Infectious Diseases, National Institute of Arthritis, Diabetes, and Digestive and Kidney Diseases, National Cancer Institute, National Institute of General Medical Sciences, and National Heart, Lung, and Blood Institute, respectively.

[3]National Institute on Drug Abuse, National Institute on Alcohol Abuse and Alcoholism, and National Institute of Mental Health.

subfield. Differences in the distribution of applications among subfields paralleled those in awards. These differences may partly be the result of differences in the missions of the various institutes. However, they may also reflect differences in the scientific cultures of the institutes that have spontaneously arisen and potentially reduce their effectiveness.

RECOMMENDATIONS

Based on these results, several recommendations are made. These fall into three categories: (1) structural changes in the procedures for soliciting and reviewing grant applications and for formulating and implementing policy; (2) changes in the nature and availability of information on grant applications and awards; and (3) additional research needs.

Specific recommendations are as follows:

- *Structural changes.* Changes in the procedures for soliciting and reviewing grant applications and for formulating and implementing policy on psychology research should be considered as follows:
    - -- The implementation of innovative procedures for soliciting and reviewing grant applications may help minimize problems associated with the large proportion of unfunded applications. Possible improvements include *two-stage application procedures*, by which investigators provide short synopses of proposed research that are formally screened for potential fundability before a full application. Electronic communication media (e.g., electronic mail) could also be used more extensively for the submission of grant applications and their distribution to review panel members. Although such procedures may not directly increase the proportion of applications that are funded, they may help reduce the amount of work

required by researchers and agencies to prepare and process them. The introduction of such procedures, however, may also have unanticipated negative effects, which should be considered thoroughly.

-- Vigorous efforts may be required to more fully involve young researchers in the grant process. Possible strategies for accomplishing this include the preparation and dissemination of specialized information apprising young researchers of funding opportunities, the strengthening of funding mechanisms better suited to the needs of young researchers, such as the First Independent Research and Transition (FIRST) award and Small Grant programs, and changes in the application and review process to minimize structural impediments that may affect young researchers.

-- ADAMHA and NIH should cooperate to develop a coherent and consistent policy toward psychology research, including explicit long-term agendas. It would be difficult to imagine an effective policy emerging without the existence of a formal organizational structure to oversee its formulation and insure continuity. Similarly, for such policy to be effective it would almost certainly need to be coordinated with other federal agencies supporting psychology research, most notably, the National Science Foundation (NSF).

-- The psychology research community must recognize its pivotal role in insuring suitable funding levels. Ultimately, the primary determinant of the relative priority of psychology research in the federal budget is the extent to which elected officials and the public are aware of its importance. One strategy for increasing funding levels is by placing a higher priority within the research community on high-leverage

studies that assess and demonstrate the value of psychology research.

- *Applications and awards data*. Suggestions concerning the increased availability of data on grant applications and awards are as follows:

  -- ADAMHA and NIH should consider the value and feasibility of increasing the accessibility of data on grant applications and awards. For example, yearly listings of applications and awards, broken down by institute and IRG, could be published. Such data might be especially useful if made available in machine-readable form. Two advantages may be seen as stemming from this. First, it would facilitate research in this area and promote greater participation of the research community in policy formulation and evaluation. Second, it may help alert researchers to areas with high or low application rates relative to available funds, promoting a more even distribution of applications across mission areas.

- *Additional research*. Recommendations for additional research include the following:

  -- Although the results here indicate a substantial reduction in the proportion of R01 applications and awards accounted for by young researchers, they leave it unclear as to its causes. More extensive analyses are necessary to determine whether there is an actual lack of funding for young researchers. Among other things, such research must consider (1) ADAMHA/NIH award mechanisms other than the R01 which younger researchers may be relying on for support, (2) other

sources of support, such as the NSF, private foundations, and university endowment funds, (3) research participation by young researchers in which they are not the principal investigator, and (4) the proportion of the research workforce accounted for by young researchers and how this may be changing. Survey research may also be useful in determining the current funding requirements of young researchers and how adequately these are being met. We also urge the NSF and National Academy of Sciences to consider this issue.

-- Novel procedures for grant application and review and for increasing information availability may carry with them risks as well as benefits. The structure of the ADAMHA/NIH grant application and review process is such that it would readily lend itself to the controlled experimental introduction and evaluation of such procedures.

ACKNOWLEDGMENTS

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Several RAND colleagues are also to be thanked for their contributions. This Note benefited from careful and insightful reviews by Sandra Berry and Tora Bikson. Grace Carter's guidance concerning the analysis of the CGAF data is greatly appreciated, and Peter Morrison provided useful suggestions concerning the interpretation of age trends.

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I. INTRODUCTION

We describe here a study of basic research grants to psychologists by the Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA) and the National Institutes of Health (NIH) from 1968 to 1985. Federal support for research in psychology has been highly variable and the source of debate for several decades. Recently, the psychological community has attempted to take a more active role in the formulation of federal policy toward psychology research. There is, related to this, a need to better understand funding trends and their effects on the field.

ADAMHA and NIH provide the large majority of nondefense-related federal support for psychology research. Although previous reports (e.g., Knezo, 1986; Gerstein et al., 1988) have provided overall data concerning funding levels by these agencies, they have not included details about levels of support by specific institutes, for subfields of psychology, and with respect to numbers of applications and awards, as opposed to simple yearly dollar totals. We perceived an important need to document and analyze this more finely graded information.

In conjunction with previous RAND research projects (Carter et al., 1987; Biddle et al., 1988) we became familiar with the Consolidated Grant Application File (CGAF), a large longitudinal database containing information on NIH and ADAMHA grant applications and awards. In using this file, it appeared possible to extract from the CGAF the more detailed information on trends in psychology research applications and awards required.

While this study was being planned, a report on age trends of research grant recipients was released by ADAMHA (ADAMHA, 1988a). The report noted what appeared to be a steady rise in the average age of NIH and ADAMHA principal investigators over the last 10 years. We saw that the CGAF data could illumine the questions raised by the ADAMHA report in two ways. First, it would be possible to determine if this trend has occurred for psychology researchers. Second, it would be possible to determine whether the trend has occurred with respect to grant

applications as well as awards. The latter was seen as particularly important, since it could rule out one possible explanation for the trend in awards: If the proportion of applications submitted by young researchers is remaining constant, the drop in their proportion of awards could indicate that they are losing out to more experienced investigators in grant competition; however, if applications by young researchers are decreasing correspondingly with awards, it would suggest that other factors, such as demographic or employment changes, are responsible.

We restrict attention to basic investigator-initiated research awards, or, as they are termed, R01 grants, as opposed to other support categories, such as small grants, project grants, and training grants. The R01 grant is the mainstay of the ADAMHA/NIH research program and accounts for the large majority of extramural research expenditures by these agencies. By considering only R01 grants, it was felt that major trends in applications and awards relevant for policy purposes could be identified, without introducing unnecessary complexity by considering other support mechanisms.

RESEARCH QUESTIONS

The major questions the present investigation set out to study were as follows:

- How many R01 applications are submitted by psychologists to each ADAMHA/NIH institute? How does this compare with other investigator groups, and how has this changed over time?
- What is the total level of R01 support, both in terms of the number of awards and total inflation-adjusted and unadjusted dollar amounts, to psychologists at various institutes? How does this compare with total R01 support, and how has this changed over time?
- What is the proportion of R01 applications by and awards to psychologists and comparison investigators accounted for by researchers under the age of 36, and how has this changed over time?

- What are the mean priority scores and proportions of applications resulting in awards for psychologists and comparison investigators, and how have these changed over time?
- Which review groups are responsible for the most awards to psychologists, and how has this changed over time?
- How many applications and awards are accounted for by researchers in various psychology subfields, and how does this differ among ADAMHA and NIH institutes?

METHODOLOGICAL APPROACH

This study is largely descriptive and exploratory. Our effort proceeded in several stages, consisting of (1) simple data reduction and description, (2) examination of results for evidence of trends over time or across investigator groups or agencies, and (3) interpretation of trends observed. We used the graphical representation of results to detect trends, but did not consider evidence of trends to be compelling unless verified by appropriate statistical tests. In interpreting trends, we attempted to consider as many alternative explanations as possible. In presenting these interpretations it is our goal to sensitize readers to the full range of issues these data raise. Where data appeared to suggest discernible problems, we attempted to identify steps that may be taken to alleviate them. We also noted where there appeared to be insufficient information to determine the causes of a trend, and where additional research is needed.

ORGANIZATION OF THIS NOTE

Section II provides background information on the grant application and review process and discusses the CGAF database, the variables considered, and the statistical analyses performed. Section III considers overall R01 application and award trends for psychologists and comparison investigators. Section IV presents results concerning investigator age trends. Section V considers trends in award rates and priority scores by psychologists and comparison investigators. In Sec. VI, differences in award frequencies, award rates, and priority scores

among psychology subfields are presented. Finally, Sec. VII describes results concerning the distribution of awards to psychologists across specific ADAMHA and NIH institutes and review groups.

Sections III through VII are primarily concerned with the presentation of research results. In Sec. VIII, possible explanations and policy implications are discussed, and recommendations made.

II. DATA AND METHODS

In this section, we describe the data, the measures of grant activity considered, and the analyses performed. We also define several key terms. This section should be most helpful to readers who are not already familiar with ADAMHA and NIH grant application and review procedures.

GRANT APPLICATIONS TO ADAMHA AND NIH

ADAMHA and NIH are agencies subsumed under the Public Health Service (PHS) of the U.S. Department of Health and Human Services (DHHS). Both are composed of various institutes, each focusing on a particular health or mental health area. For example, ADAMHA consists of three institutes, the National Institute on Alcohol Abuse and Alcoholism (NIAAA), the National Institute on Drug Abuse (NIDA), and the National Institute of Mental Health (NIMH). NIH currently includes 13 institutes.

Taken together, ADAMHA and NIH constitute the primary source of federal funds for psychology research. In 1985, for example, they accounted for 80 percent of all nondefense-related research support for the behavioral sciences (Knezo, 1986); the National Science Foundation (NSF), by comparison, accounted for only approximately 8.5 percent. ADAMHA and NIH support a wide range of research activity, which includes intramural and extramural research. Intramural research is conducted by staff scientists at agency-run facilities; extramural research support takes the form of funding to outside researchers, for example, university or medical school faculty, usually awarded on a competitive basis.

ADAMHA and NIH provide several categories of extramural research awards, including multi-investigator project grants, training grants, career development grants, small grants, and individual investigator research grants. A particular category, termed the R01, is made to an individual principal investigator and usually lasts two to five years.

The R01 grant is the mainstay of the extramural research program. Its primary role may be seen in Table 2.1, which lists the number and percentage of competing (defined below) grant applications by category received by NIH in 1985. As shown, over 70 percent of applications were for R01 grants. In this year, a total of approximately 17,000 competing and noncompeting R01 grants were awarded by NIH and ADAMHA, amounting to approximately $2.3 billion, with an average yearly award amount, including direct and indirect costs, of roughly $130,000.

THE GRANT APPLICATION AND REVIEW PROCESS

The process by which R01 grants are applied for, reviewed, awarded, and administered is highly structured. It begins with an application by a primary researcher, designated the principal investigator or PI. The application consists of a technical section, up to 20 pages in length, which describes the proposed research, a budget, and several special forms. Applications are usually submitted to coincide with one of several review cycles that occur throughout the year.

Several measures ensure consistency in procedures and standards for reviewing grant applications. Although ADAMHA and NIH are distinct, NIH's Division of Research Grants (DRG) performs many of the

Table 2.1

COMPETING APPLICATIONS RECEIVED BY NIH (1985)

Activity	Number of Applications	Percent
Traditional research projects (R01)	17,016	72.0
Other research projects	2,740	11.6
Research centers	46	0.2
Career development awards	348	1.5
Other research	909	3.8
Training	30	0.1
Fellowships	2,536	10.7
Total	23,625	100.0

SOURCE: NIH (1987), p. 5.

administrative functions concerning the receipt, processing, and review of R01 applications for both. The DRG receives applications, and usually directs them to an appropriate Initial Review Group (IRG) for review. IRGs provide expertise in specific health and mental health areas. At present, approximately 70 serve NIH and another 30 serve ADAMHA. The large number of IRGs assures a high degree of specialization. They usually consist of from 10 to 20 "experts" who come from the extramural research community. Thus, this system provides a peer review of grant applications.

IRGs evaluate grant applications based on their relevance to the mission of funding agencies, the quality of the research plan, and the qualifications of investigators to perform the work. Some applications are deemed by these criteria to be unsuitable for funding and disapproved. The remainder are assigned a *priority score*, a numerical value from 100 to 500 that reflects the judged priority of the application relative to other approved applications. Lower priority scores correspond to higher priority. Thus, a score of 100 indicates the highest priority for funding, and a score of 500 the lowest priority.

The IRG does not make the final decision concerning which grants are awarded. That determination is made by the individual institutes and their advisory committees, which begin with the grants having the lowest priority scores and work up the list, awarding grant monies to approved applications with progressively higher priority scores, until available funds are exhausted. The highest priority score of a grant that receives funding is referred to as the *payline* for an institute.

COMPETING AND NONCOMPETING GRANTS

At the time of submitting an R01 application, the investigator may request support for up to five years. If the grant is approved by the IRG and assigned a sufficiently low priority score that it receives its first year of funding, renewal on successive years is usually routine. That is, during these years the grant does not directly compete with other grants for funding, and continuing R01 grants in their second

through fifth years are de facto given a higher priority for funding than new applications. New R01 grant applications are thus referred to as *competing new grant* applications as opposed to applications for renewal of ongoing grants in their second through fifth years, which are termed *noncompeting continuation* applications. Funded R01 grants, once they have gone beyond five years, may be extended, but must again go through the competitive review process as would a new application. Such applications are termed *competing renewals*.

THE CGAF DATABASE

The DRG is extensively involved in the collection of data concerning grant applications and awards. The primary database maintained by the DRG for monitoring extramural grant activity is the IMPAC (Information for Monitoring of Projects and Accounting) system. This is mainly oriented to the accounting needs of NIH and ADAMHA. A second database, the CGAF, is more closely suited to the needs of policymakers and planners.[1] It represents an attempt to consolidate information on grant applications and awards for NIH and ADAMHA institutes in a consistent format. Importantly, grant application records in the CGAF are linked to individual investigators. Thus, it is a longitudinal database, in which records of all grant applications by an investigator can be retrieved. The CGAF also contains information on several variables, such as year of graduation, not available in the IMPAC or other administrative databases.

CONSTRUCTION OF WORKING FILES

In the analyses reported here, the CGAF data for fiscal years 1968 to 1985 were used. We selected fiscal year 1968 as the lower limit to ensure consistency of the coding conventions for the variables considered, which varied over time. The upper limit was imposed by the version of the CGAF available to us, which contained information only through fiscal year 1985.

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[1]An additional research-oriented database, the CRISP (Computer Retrieval of Information on Scientific Projects) contains more detailed information on the scientific content of grants and grant applications.

As noted, only data on R01 grants were considered. Once receiving a grant, investigators occasionally apply for small supplements to cover expenses not originally anticipated. Since these are infrequent, and, when awarded, of a relatively small amount, they were not considered. Investigators also sometimes submit amendments to original grant applications. For example, a revised budget may be submitted. Amendments to original applications are included in the CGAF. When this occurred, we considered only the last amended version of a grant application filed within a given fiscal year.

All three ADAMHA institutes and 12 NIH institutes were included in analyses.[2] These institutes, their acronyms, and CGAF abbreviations are listed in Table 2.2.

PSYCHOLOGIST RESEARCHER AND COMPARISON GROUPS

The CGAF documentation lists approximately 400 doctorate specialty codes. We used these to identify investigators with Ph.D.s in psychology and comparison groups of Ph.D. investigators in (1) the biological and health sciences and (2) other social sciences. The former comparison group consisted primarily of investigators with degrees in biochemistry, microbiology, organic chemistry, and pharmacology; the latter consisted mainly of investigators with degrees in sociology, anthropology, economics, political science, and public administration.[3] A third comparison group, M.D. researchers, was also

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[2]Before 1986, two current institutes, the National Institute of Diabetes and Digestive and Kidney Diseases and the National Institute of Arthritis and Musculoskeletal and Skin Diseases, jointly constituted the Institute of Arthritis, Diabetes, and Digestive and Kidney Diseases. The National Institute on Aging is included in the analyses, though it came into existence during the middle of the study period, making R01 awards beginning with fiscal year 1974. Awards by the recently created National Institute of Deafness and Communicative Disorders are not considered. The National Library of Medicine is treated here as an NIH institute.

[3]Principal investigator degree (e.g., M.D., Ph.D., M.D./Ph.D) is coded in the CGAF for all records. Information on Ph.D. field, however, is present for only approximately 85 to 90 percent of Ph.D. investigators. Thus, the number of investigators in each Ph.D. field is slightly higher than indicated by the CGAF. Records from investigators shown as having Ph.D.s, but whose field of specialization could not be

Table 2.2

ADAMHA AND NIH INSTITUTES CONSIDERED

Acronymn	CGAF Code	Institute Name
		ADAMHA
NIAAA	AA	National Institute on Alcohol Abuse and Alcoholism
NIDA	DA	National Institute on Drug Abuse
NIMH	MH	National Institute of Mental Health
		NIH
NIA	AG	National Institute on Aging
NIAID	AI	National Institute of Allergy and Infectious Diseases
NIADDK	AM	National Institute of Arthritis, Diabetes, and Digestive and Kidney Diseases
NCI	CA	National Cancer Institute
NIDR	DE	National Institute of Dental Research
NIEHS	ES	National Institute of Environmental Health Sciences
NEI	EY	National Eye Institute
NIGMS	GM	National Institute of General Medical Sciences
NICHD	HD	National Institute of Child Health and Human Development
NHLBI	HL	National Heart, Lung, and Blood Institute
NLM	LM	National Library of Medicine
NINCDS	NS	National Institute of Neurological and Communicative Disorders and Stroke

identified using variables in the CGAF that indicate highest academic degree. The M.D. researcher category excluded M.D./Ph.D. researchers, who were considered separately.

PSYCHOLOGY SUBFIELDS

We also used the doctorate specialty codes to identify five psychology subfields: (1) clinical, (2) developmental, (3) experimental, comparative, and physiological, (4) personality and social, and (5) other subfields. The codes defining these subfields are shown in

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determined, were used in analyses pertaining to differences among researchers of various degree types, but not for comparisons of investigators in specific Ph.D. fields and psychology subfields.

App. A.[4] It may be noted that these subfields indicate area of specialization based on doctorate field. This does not take into account that investigators may change their field of emphasis. Neither does it acknowledge that, in practice, there is no reason to believe that these disciplinary lines are strictly adhered to; for example, a researcher with a doctorate in clinical psychology may do physiologically oriented research. Nevertheless, we take doctorate specialization to be an adequate indicator of research area for purposes of aggregate comparisons.

STATISTICAL ANALYSES

For each R01 application, we considered its application category (e.g., competing or noncompeting), the priority score assigned (if any), and whether it was funded. For each investigator group, we calculated as the *award rate* the proportion of applications that resulted in funding. We calculated award amounts both in noninflation-adjusted dollars (current dollars), and in inflation-adjusted dollars (constant dollars), equated to 1987 dollars, using the Consumer Price Index. Results primarily take the form of group means, totals, and frequency counts. Trends over time were statistically assessed by bivariate linear regression and evaluated with two-tailed significance tests. In most cases, unweighted regression analysis was used. However, for trends involving means or proportions based on fewer than 20 observations, we used weighted least-squares regression (Weisberg, 1985), the weight of each value being determined by the number of observations going into its calculation. Wherever possible, we present results in the form of figures and tables. In addition, several statistical files summarizing data in aggregate form were generated, to permit analyses subsequent to this study. A list of these files appears in App. B.

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[4]The "other subfields" category consisted primarily of researchers whose subfield specialization was simply listed as "Psychology, other" in the CGAF, so that the precise composition of this group cannot be determined.

III. OVERALL TRENDS IN GRANT APPLICATIONS AND AWARDS

In this section, we describe trends at the agency level in the amount of R01 support to psychologists and comparison investigators at ADAMHA and NIH from 1968 to 1985.

R01 AWARDS AT ADAMHA

Trends in R01 awards at ADAMHA from 1968 to 1985 are shown in Figs. 3.1 through 3.4. Figures 3.1 and 3.2 indicate the total amount of R01 support by ADAMHA in current and constant 1987 dollars, respectively. Overall, R01 support increased in terms of current dollar amounts. Positive linear trends significant at the 0.01 level are obtained for each of the four degree groups shown. However, this increase largely reflects inflation. When inflation is taken into account (Fig. 3.2), yearly award totals are seen to fluctuate markedly: amounts generally increased from 1968 to 1976, but decreased first beginning in 1977 and then again beginning in 1981; in 1984 they again began to increase. The net result is that 1985 adjusted dollar totals only slightly exceeded those of 1968. The downward trends beginning in 1977 and 1981 are presumably linked to policy changes that occurred during these years. The drop in 1977 may represent a "rebound" effect, reflecting growing disillusionment with social science research and dissatisfaction with a lack of perceived results brought about by the increase in funding of the 1960s and early 1970s (Knezo, 1986). The drop in 1981 reflects the Reagan administration's budgetary agenda, which entailed explicit cuts in the social and behavioral sciences.

Ph.D. investigators received the largest amount of R01 support at ADAMHA--more than twice as much as M.D. investigators. The funding reductions beginning in 1977 and 1981 affected investigators of all degree types more or less equally. For constant dollar award totals, trend analysis reveals no significant linear trends, except for the M.D. researcher group, where a negative trend significant at the 0.05 level is present.

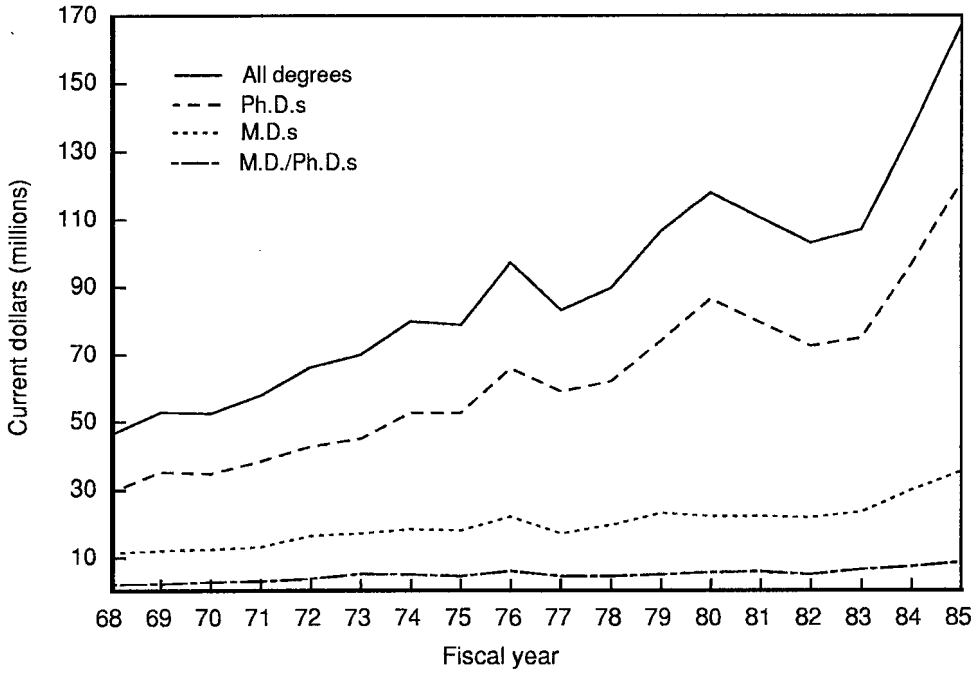

Fig. 3.1--ADAMHA R01 award totals by degree category and year in current dollars

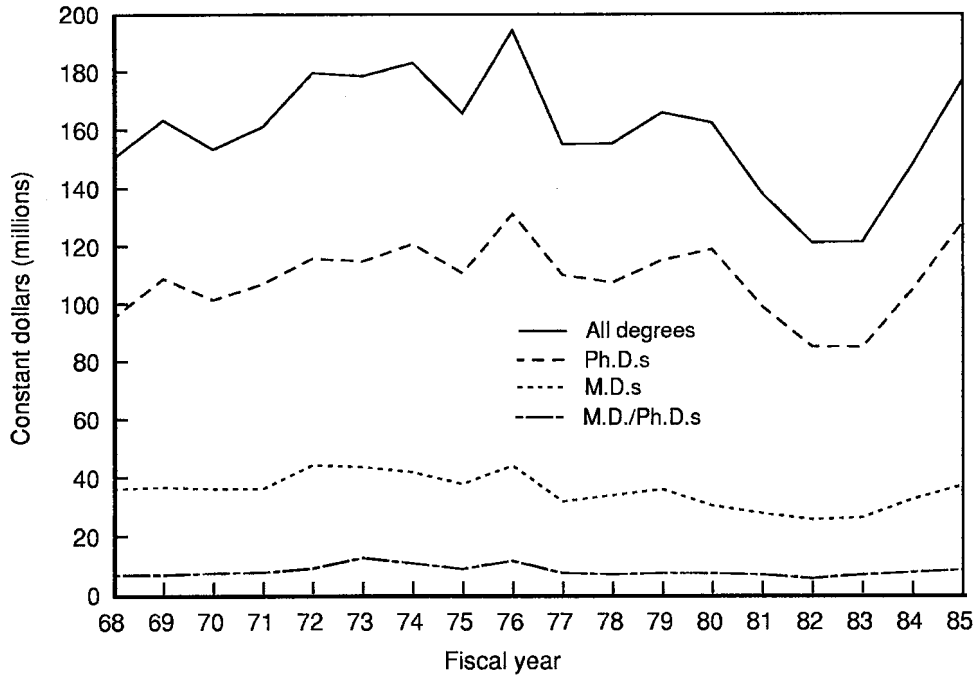

Fig. 3.2--ADAMHA R01 award totals by degree category and year in constant (1987) dollars

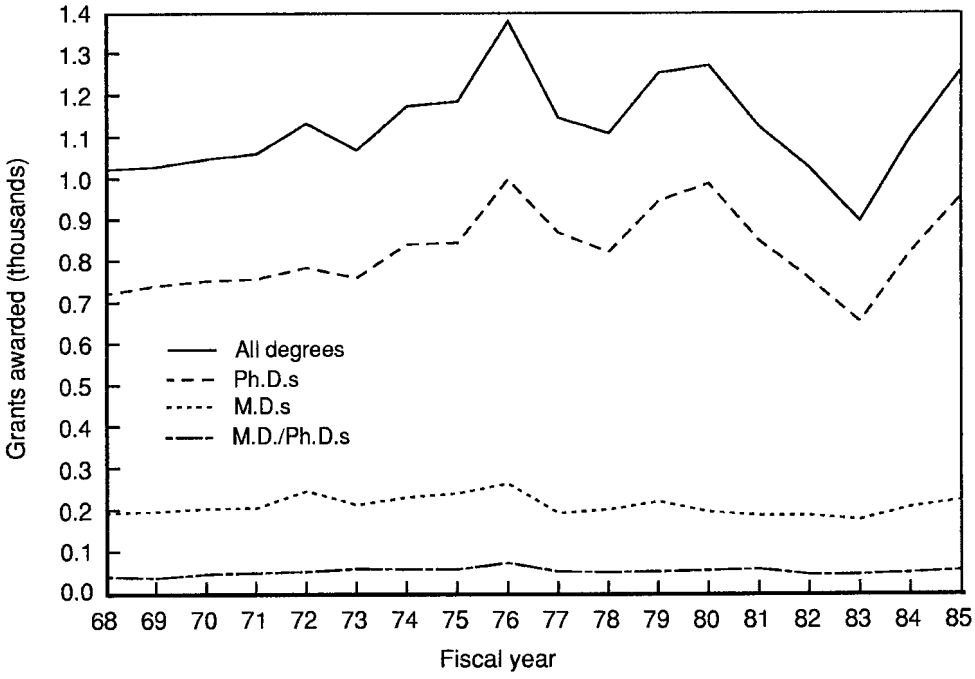

Fig. 3.3--ADAMHA R01 grants by degree category and year

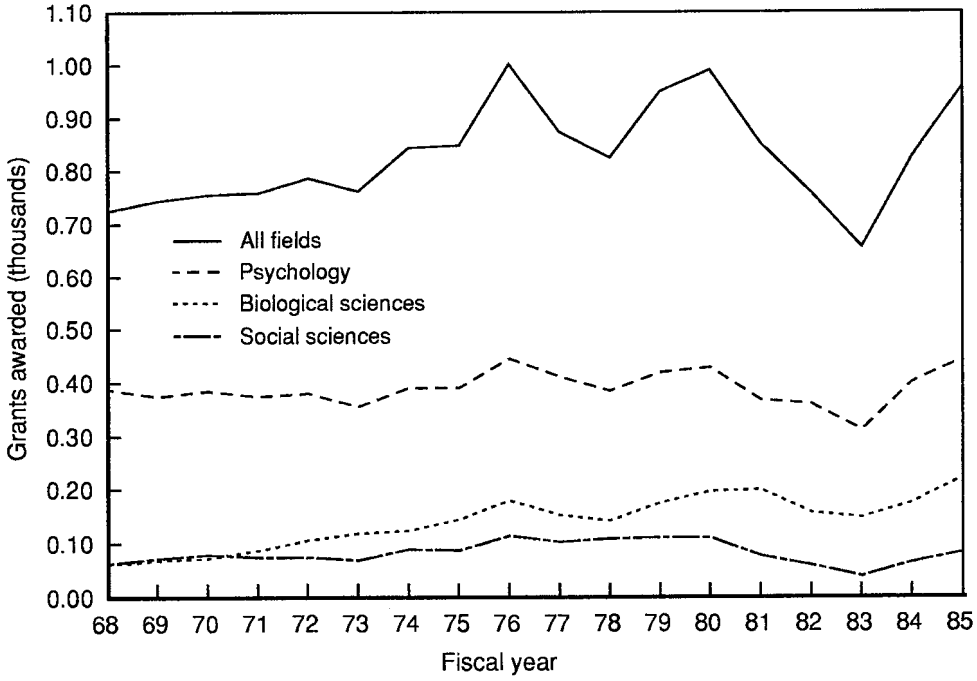

Fig. 3.4--ADAMHA R01 grants by Ph.D. field and year

Essentially the same trends are present in Figs. 3.3 and 3.4, which show total R01 award activity in terms of the number of awards made. Figure 3.3 shows number of awards as a function of investigator degree category (all linear trends statistically nonsignificant). Figure 3.4 shows the number of awards to Ph.D. investigators in various fields. It is seen that psychologists received a much larger number of awards than either biological and health science or other social science researchers. The number of awards to Ph.D. investigators in the biological and health sciences increased consistently between 1968 and 1985, however. This trend is statistically significant at the 0.05 level--all others shown are nonsignificant. Associated with this, the proportion of R01 awards at ADAMHA going to Ph.D. psychologists decreased from approximately 40 percent in 1968 to approximately 32 percent in 1985.

R01 AWARDS AT NIH

Figures 3.5 and 3.6 show changes in the total dollar amount of R01 awards by NIH from 1968 to 1985. The most noticeable feature of these figures is the substantially larger award totals in comparison with ADAMHA--in 1985 the current dollar total of all R01 awards made by NIH was more than $2.1 billion, in comparison with $170 million by ADAMHA. Also clearly seen is the large increase in R01 funding by NIH. All trends shown in Figs. 3.5 and 3.6 are statistically significant at the 0.01 level.

The total number of R01 awards at NIH also grew substantially--from approximately 7,300 in 1968, to more than 16,000 in 1985 (Figs. 3.7 and 3.8). Positive trends are evident for all degree categories considered (all trends in both figures statistically significant at the 0.01 level). Most of this increase was accounted for by an increase in the number of awards to Ph.D. researchers.

Researchers in the biological and health sciences received the majority of grants awarded to Ph.D. researchers by NIH. The proportion accounted for by Ph.D. psychologists was small in comparison with that at ADAMHA. However, there was also a much larger number of R01 awards

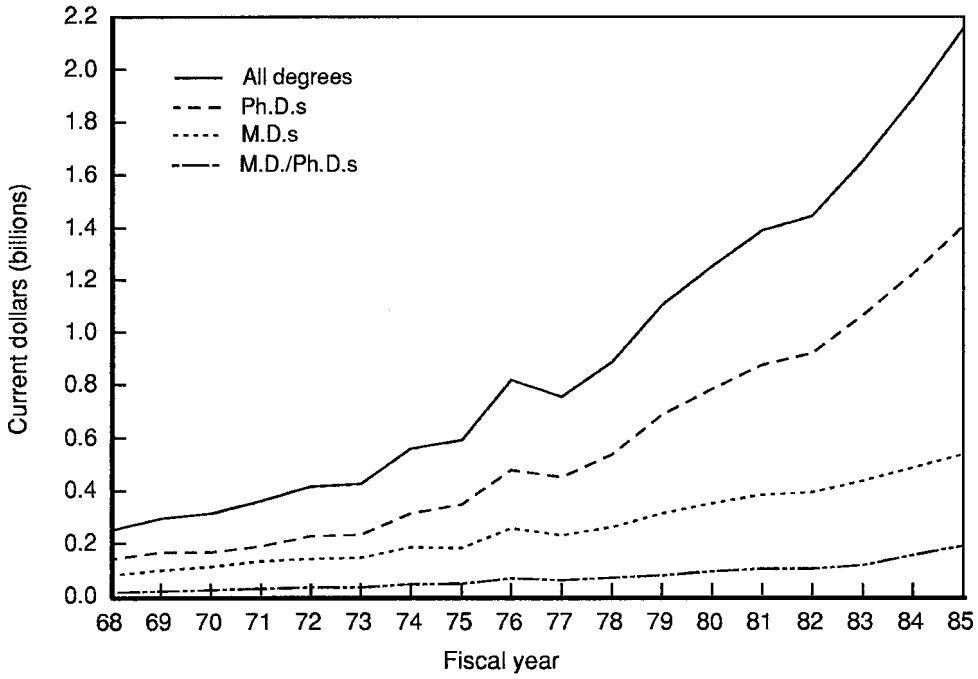

Fig. 3.5--NIH R01 award total by degree category and year in current dollars

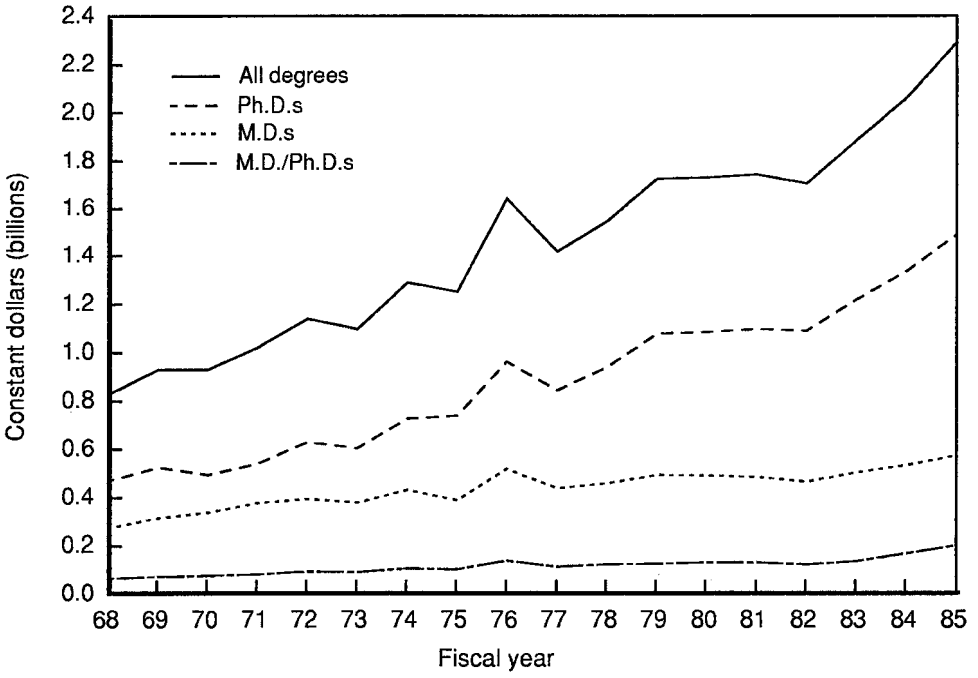

Fig. 3.6--NIH R01 award total by degree category and year in constant (1987) dollars

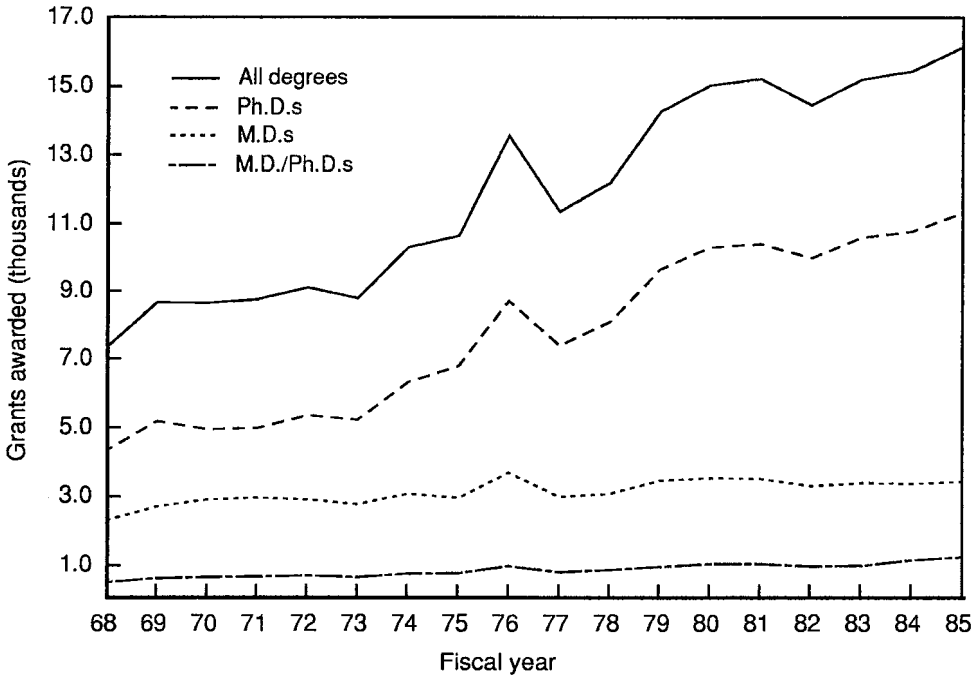

Fig. 3.7--NIH R01 grants by degree category and year

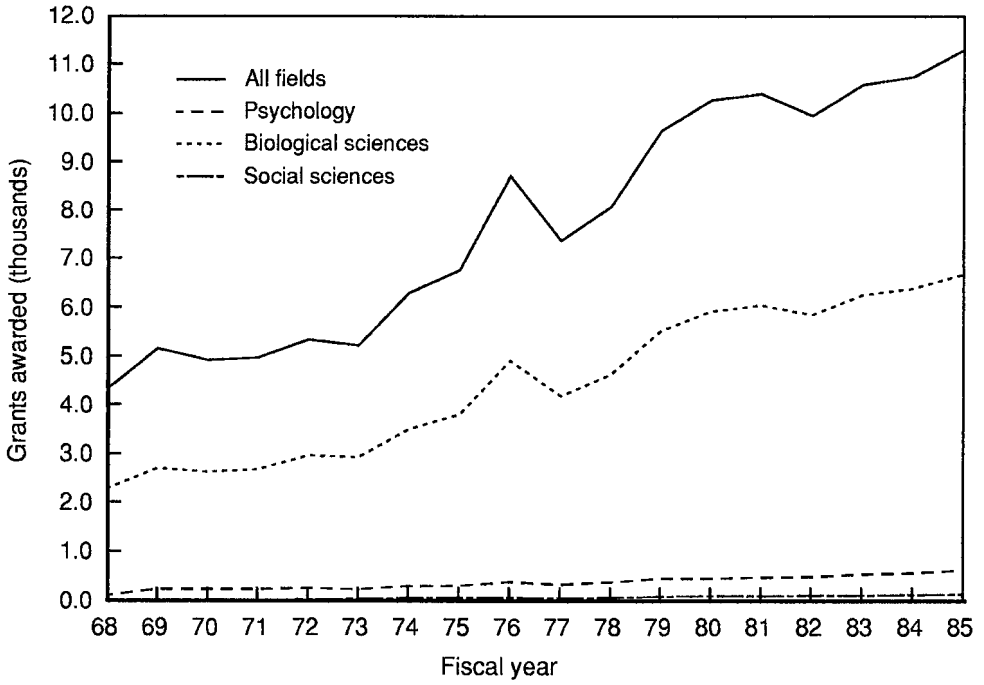

Fig. 3.8--NIH R01 grants by Ph.D. field and year

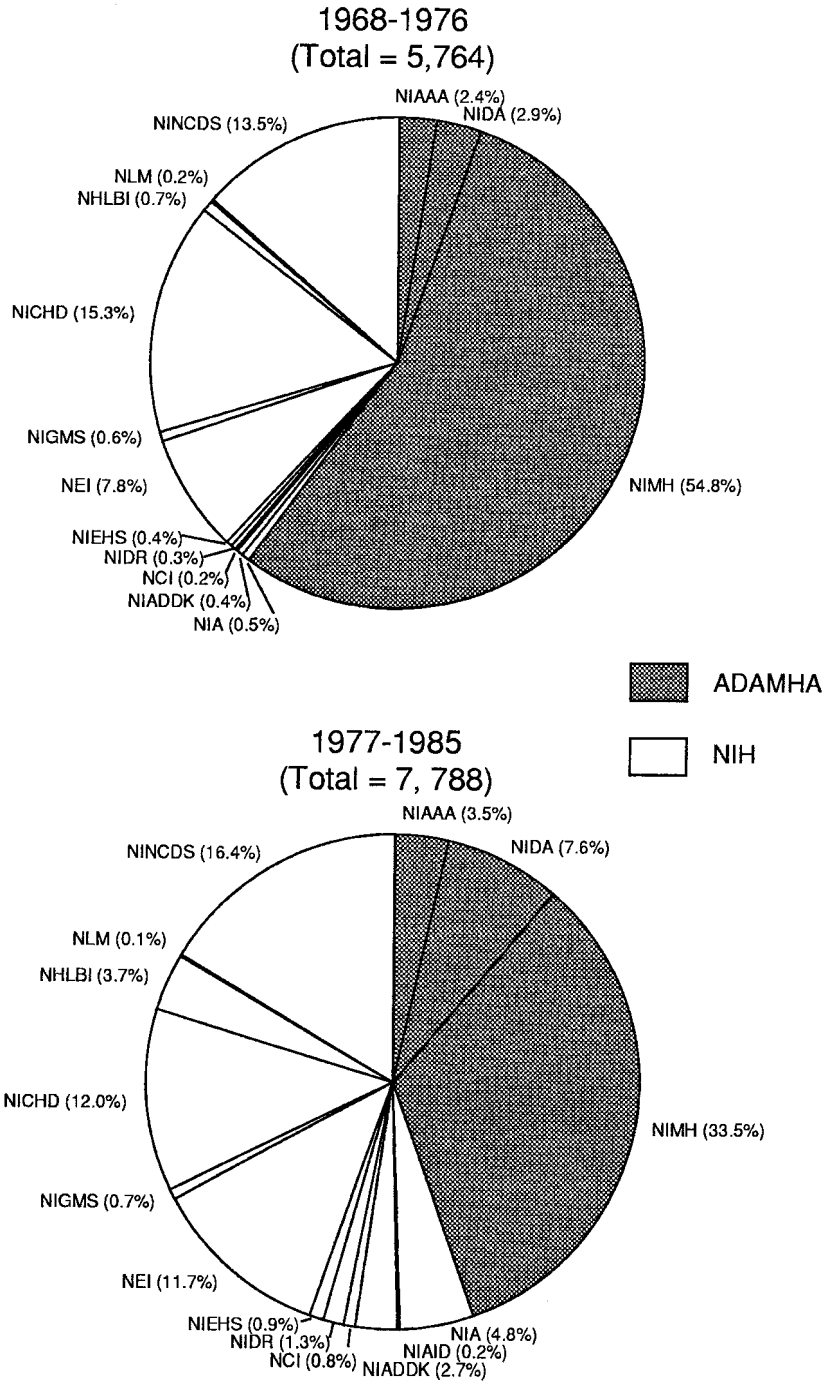

Fig. 3.9--Proportion of awards to psychologists coming from ADAMHA and NIH: 1968-1976 and 1977-1985

made by NIH overall. In addition, the number of awards to psychologists at NIH has, along with R01 awards overall, increased. As a result, a shift occurred in the proportion of R01 awards to psychologists coming from NIH (Fig. 3.9). From 1968 to 1976, only 40 percent of all awards to psychologists made by either agency came from NIH. However, from 1977 to 1985, 55 percent of awards to psychologists came from NIH (this difference is statistically significant at the 0.001 level[1]). The results shown here thus point to a "medicalization" of psychological research occurring during the time period considered.

We consider possible implications of these trends in Sec. VIII.

SUMMARY

The results of this section may be summarized as follows:

- At ADAMHA, R01 support, both in terms of the number of awards and total dollar amount, was very volatile. Levels increased from 1968 to 1976, but decreased first beginning in 1977 and again beginning in 1981.
- Psychologists received more R01 support at ADAMHA than other researcher groups. At ADAMHA, a significant increase occurred in awards to researchers in the biological and health sciences, but not in other fields.
- R01 support increased dramatically at NIH from 1968 to 1985.
- A shift occurred in the proportion of psychological research funded by NIH as opposed to ADAMHA. From 1968 to 1976, the majority of R01 support to psychologists came from ADAMHA. From 1977 to 1985, the majority came from NIH.

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[1] $\chi^2 = 318.5$, 1 df.

IV. INVESTIGATOR AGE TRENDS

In this section, we describe age trends in R01 applications and awards at ADAMHA and NIH for Ph.D. psychologist and comparison investigators. In particular, we focus on the proportion of applicants and recipients accounted for by young (i.e., 35 years of age or younger) researchers. These analyses were performed at the request of the American Psychological Association (APA), in response to a recent ADAMHA report (ADAMHA, 1988a) noting what appeared to be a decrease in the proportion of young recipients. The analyses reported here were conducted, first, to corroborate the results of the ADAMHA report, and, second, to determine whether the trend has occurred with respect to grant applications as well as awards. The second question is important because the implications of a decreasing trend in the proportion of awards to young investigators would be different depending upon whether young applicants were submitting fewer applications or applying at levels comparable with previous years. If the former were true, it might indicate changes in the demographics of the psychology research workforce or types of positions occupied by young researchers. However, if the latter were true, it might indicate that young researchers are submitting applications of poorer quality or that review panels are weighing investigator experience too heavily in evaluating applications; the second possibility, in particular, would not be implausible, since previous research has suggested that it is at least a common perception among both applicants and reviewers that the peer review process favors established investigators (Hensler, 1976).

INVESTIGATOR AGE

Although the CGAF contains a variable for researchers' date of birth, this information is, in fact, not given, except for certain years. In most cases, therefore, age had to be estimated on the basis of other information. For approximately 85-90 percent of Ph.D. researchers, the CGAF contains information on date of graduation. Using

this information in conjunction with the data on date of birth, when the latter was indicated, estimates were derived for the average age at graduation for Ph.D. psychologists, biological and health science Ph.D. researchers, and other social science Ph.D. researchers, at ADAMHA and NIH separately. These estimates were 29 for psychologists and biological and health science researchers and 31 for other social science researchers, for both agencies. These mean ages at graduation were then used to estimate the age of researchers at the time of applying for R01 grants. For example, if a psychologist submitted an application in 1970, and received a Ph.D. in 1965, estimated age at the time of the application was taken to be the mean graduation age of Ph.D. psychologists, 29, plus the five years between the receipt of the degree and the grant application, or 34.

For these analyses, only competing R01 awards were considered.

AGE TRENDS IN AWARDS

Figs. 4.1 and 4.2 show the proportion of R01 awards at ADAMHA and NIH accounted for by investigators age 35 or younger. A clear trend is evident, indicating a marked and consistent decrease in this proportion from 1968 to 1985. The effect is evident at both agencies, and for psychologists as well as comparison Ph.D. groups (trends for all three groups and both agencies are statistically significant at the 0.01 level). It is most striking at ADAMHA, where the proportion of young psychologist investigators dropped from 38 percent in 1968 to only 14 percent in 1985. This trend was more pronounced during the second half of the time period considered (a decrease of 18 percent, compared with a decrease of 6 percent during the first half), which coincides with the period of funding reductions at ADAMHA.

AGE TRENDS IN APPLICATIONS

Thus, these results confirm those of the ADAMHA report concerning the reduction in the proportion of awards to young investigators. However, they leave it unclear as to whether this decrease is due to a poorer showing by young researchers at the level of grant review, or to

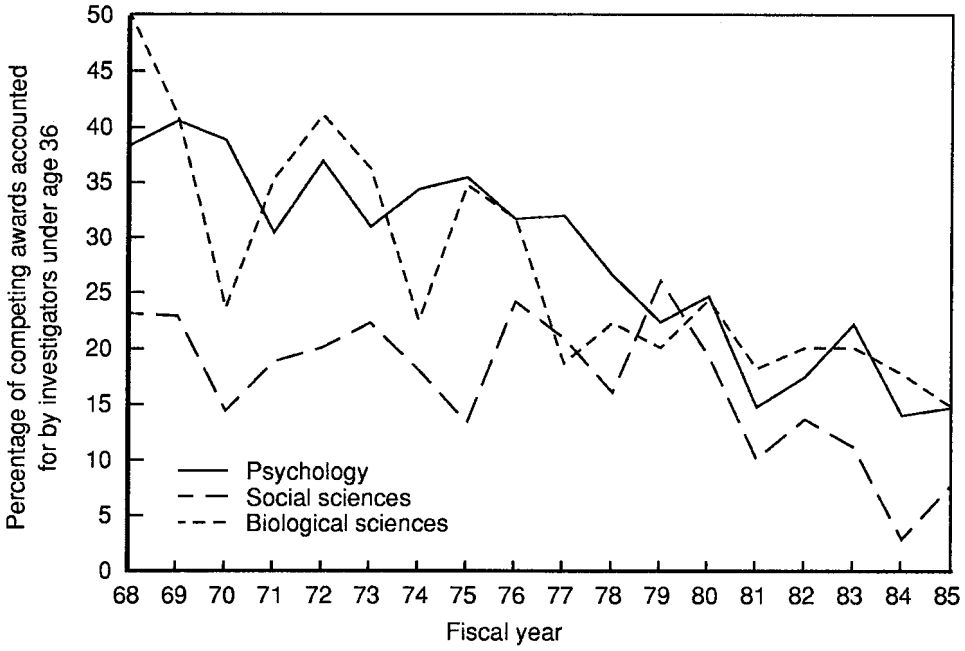

Fig. 4.1--Age trends in R01 awards at ADAMHA

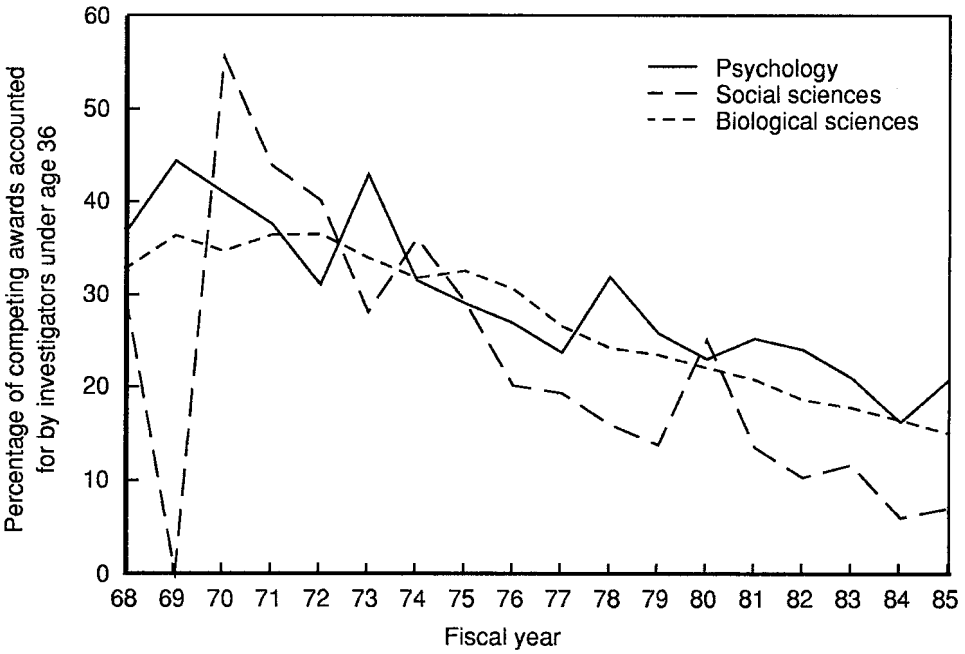

Fig. 4.2--Age trends in R01 awards at NIH

the fact that they are not applying for as many grants. Other studies (NIH, 1987) suggest that young researchers tend to receive lower (better) priority scores, arguing against the former explanation. To investigate this issue, similar analyses to those described above were performed with respect to R01 applications. These results, shown in Figs. 4.3 and 4.4, indicate that the trend concerning a reduced proportion of R01 awards made to young researchers is closely paralleled by a reduction in the proportion of applications accounted for by this group. Again, all trends are significant at the 0.01 level. Thus, the most proximal cause for the decrease in awards to young researchers is that they are submitting fewer applications.

We believe that these results are compatible with several hypotheses, and that additional research is required to determine their precise cause. We believe, moreover, that this is an important subject to pursue, since a shortage of funding for young researchers now could

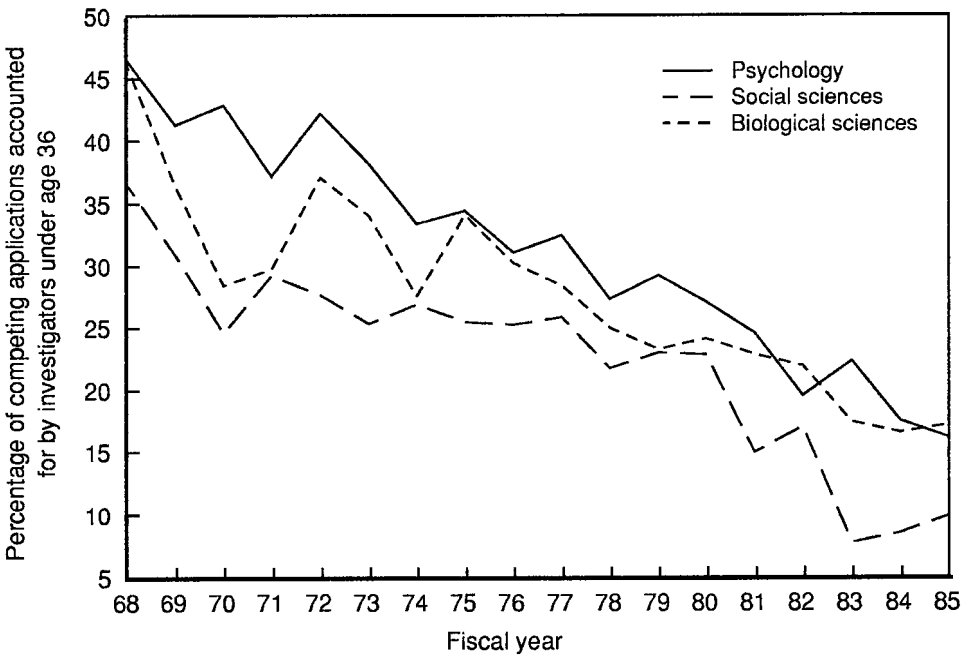

Fig. 4.3--Age trends in R01 applications at ADAMHA

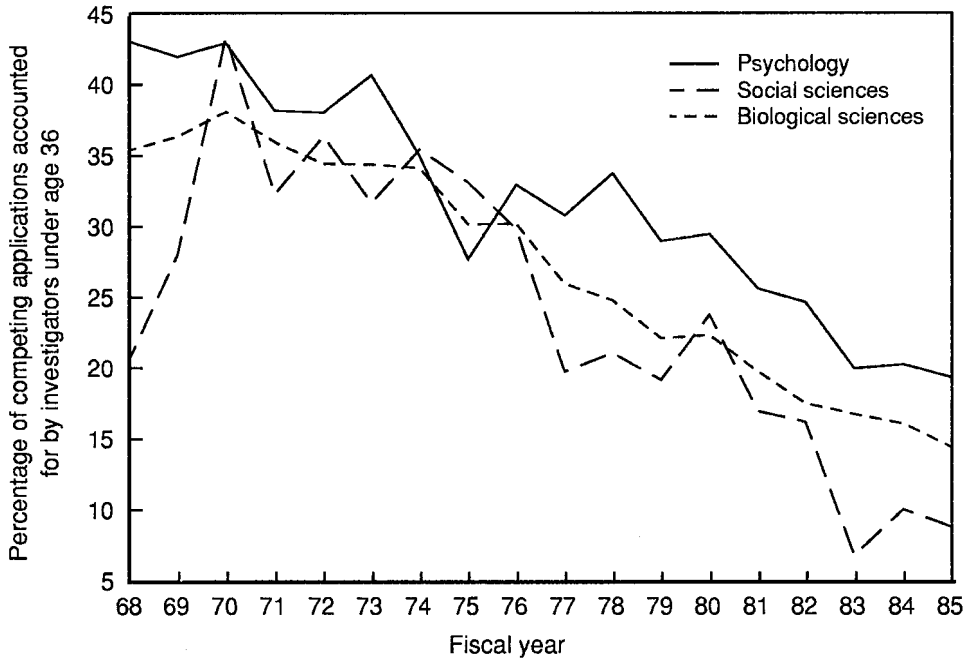

Fig. 4.4--Age trends in R01 applications at NIH

result in a shortage of experienced, senior researchers in 10 to 20 years.

We describe possible explanations for these results in Sec. VIII, and suggest additional research that may be useful in identifying the causes of these trends.

SUMMARY

With respect to age trends among ADAMHA/NIH R01 investigators, the results observed were as follows:

- The proportion of Ph.D. psychologist R01 recipients under the age of 36 has decreased markedly since 1968 at both ADAMHA and NIH.
- Trends in grant awards to young researchers were closely paralleled by trends in grant applications.
- These trends are compatible with several explanations. More research is required to determine their exact cause.

V. SUCCESS AND QUALITY OF GRANT APPLICATIONS

Previous studies (e.g., NIH, 1987, 1988) have presented aggregate statistics concerning overall trends in the relative quality and success of R01 grant applications over time. However, little is known specifically about how psychologists as a group are faring in the grant application and review process. The analyses reported in this section were conducted to shed needed light on this question.

Two measures of grant application quality are considered. The first is the proportion of applications submitted by psychologists and comparison investigators that result in awards (i.e., the proportion of funded applications), or what we term the *award rate*. The second is the mean priority score of psychologists and comparison researcher groups over time. Priority scores are easily retrievable data and appealing as a basis for comparing the judged quality of grant applications. However, as has been noted elsewhere (Carter et al., 1987; Sherman and Morgan, 1979), they are subject to a number of interpretative difficulties; for example, priority scores across different IRGs may not be strictly comparable, because of the tendencies of some to assign higher or lower scores, and because the method by which final priority scores are calculated has varied at NIH over time. Consequently, we present data on both award rates and priority scores, but consider the former to provide the more meaningful information concerning the success of psychologists and comparison groups in the grant review process.

AWARD RATES

Figures 5.1 and 5.2 show award rates for psychologists and comparison groups at ADAMHA and NIH. Only data for competing grant applications (new applications and renewals) are shown.[1] With regards to ADAMHA, an overall decrease in the award rate among all groups is evident (the trends for psychologist, biological and health science, and

[1] Award rates for noncompeting renewals are considerably higher.

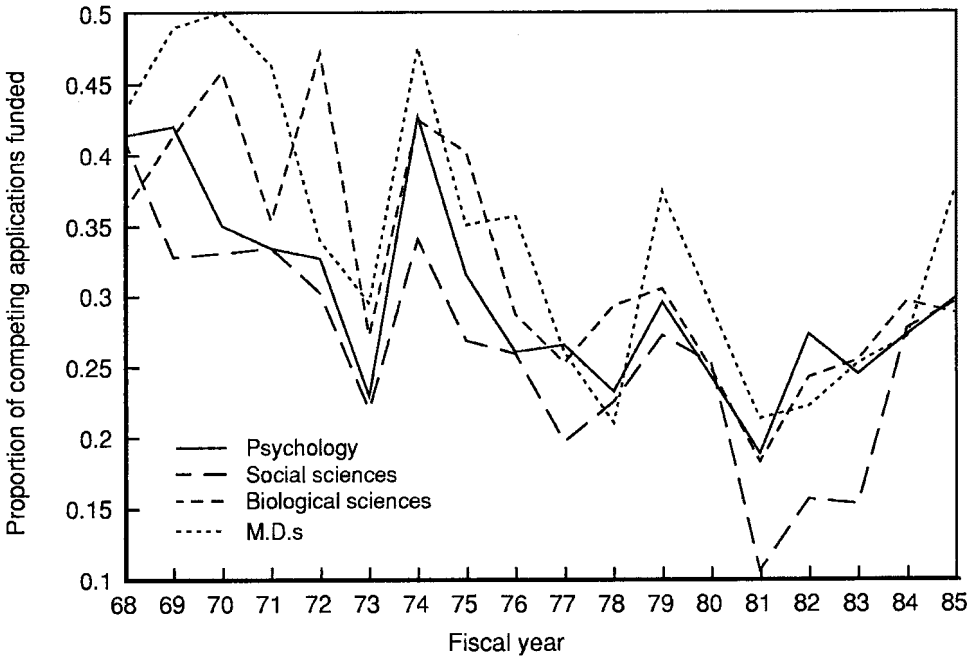

Fig. 5.1--Award rates for psychologists and comparison groups by year at ADAMHA

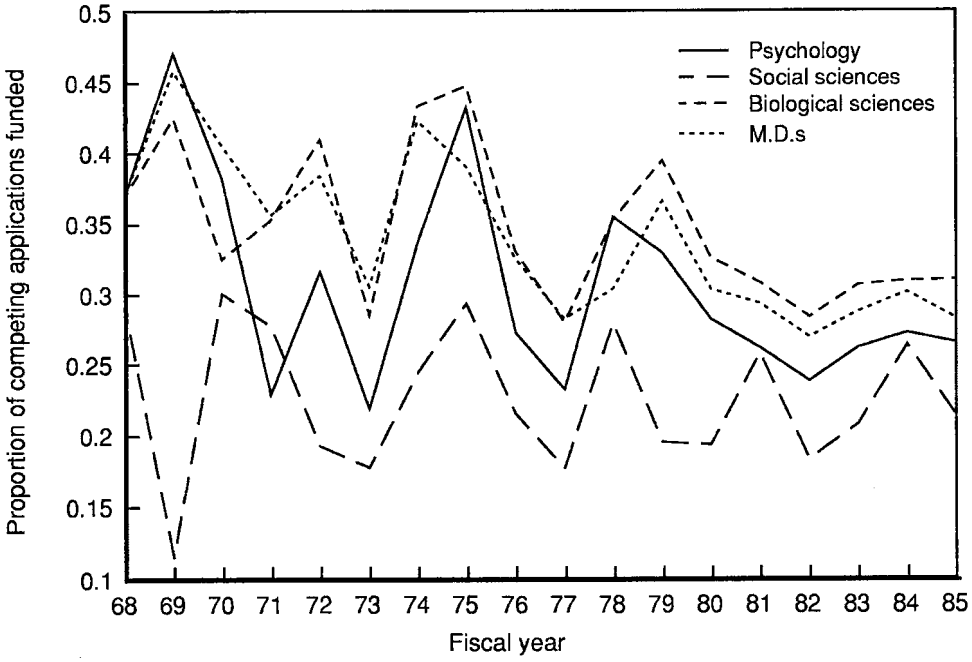

Fig. 5.2--Award rates for psychologists and comparison groups by year at NIH

M.D. researchers are statistically significant at the 0.01 level; for other social science researchers, the trend is significant at the 0.05 level). For example, in 1968, approximately 42 percent of all competing R01 applications by psychologists resulted in awards; by 1985 this decreased to approximately 29 percent. The latter value, however, does represent an increase over the 1981 award rate for psychologists, which was less than 20 percent.

At NIH, an overall decrease in the proportion of funded applications is again evident--the award rate for psychologist researchers decreased from approximately 37 percent in 1968 to approximately 26 percent in 1985 (for psychologist and biological and health science researchers, this trend is statistically significant at the 0.05 level and for M.D. researchers it is significant at the 0.01 level; the trend for other social science researchers is not statistically significant). Recent DRG data (NIH, 1988) indicate that this general reduction in award rate has continued since 1985. Award rates for psychologists have tended to be lower than those of M.D. researchers and biological and health science researchers at NIH. Since 1979, this difference has been particularly consistent. Researchers in the other social science category had lower award rates than other investigators in all but one year.

PRIORITY SCORES

Priority scores for psychologists tended to decrease (improve) at ADAMHA from 1968 to 1985 (Fig. 5.3). This trend is statistically significant at the 0.01 level. Trends for other investigator groups are nonsignificant. There also appears to have been a decrease in priority scores at ADAMHA between 1980 and 1985 affecting all researcher groups to a comparable degree.

At NIH (Fig. 5.4), no simple trend was observed for any investigator group (all linear trends statistically nonsignificant). Mean priority scores for psychologist, biological and health science, and M.D. researchers, however, increased consistently from 1971 to

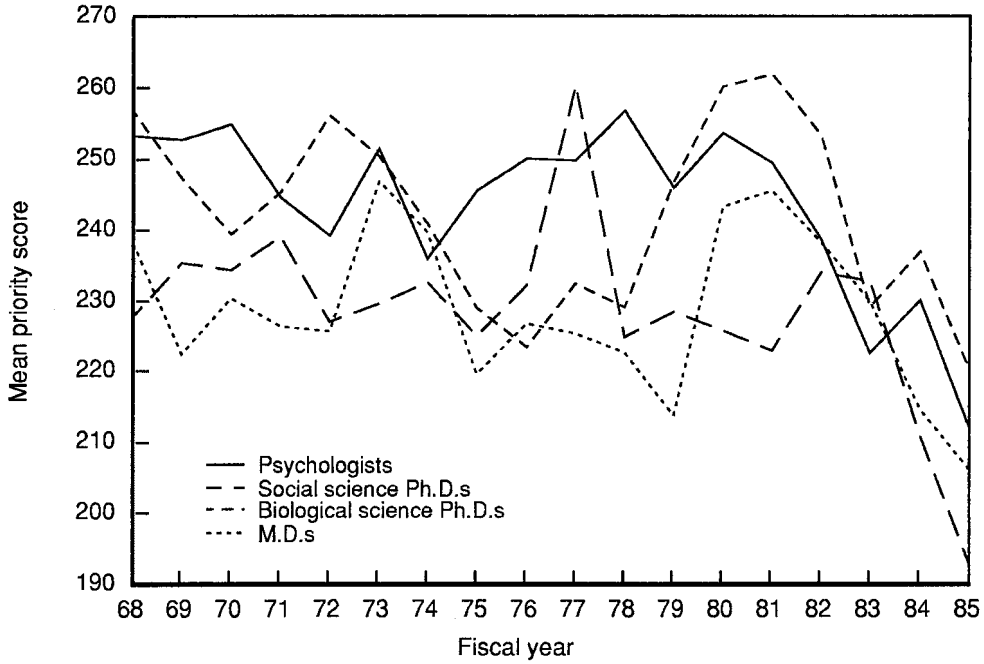

Fig. 5.3--Mean priority scores of psychologists and comparison groups by year at ADAMHA

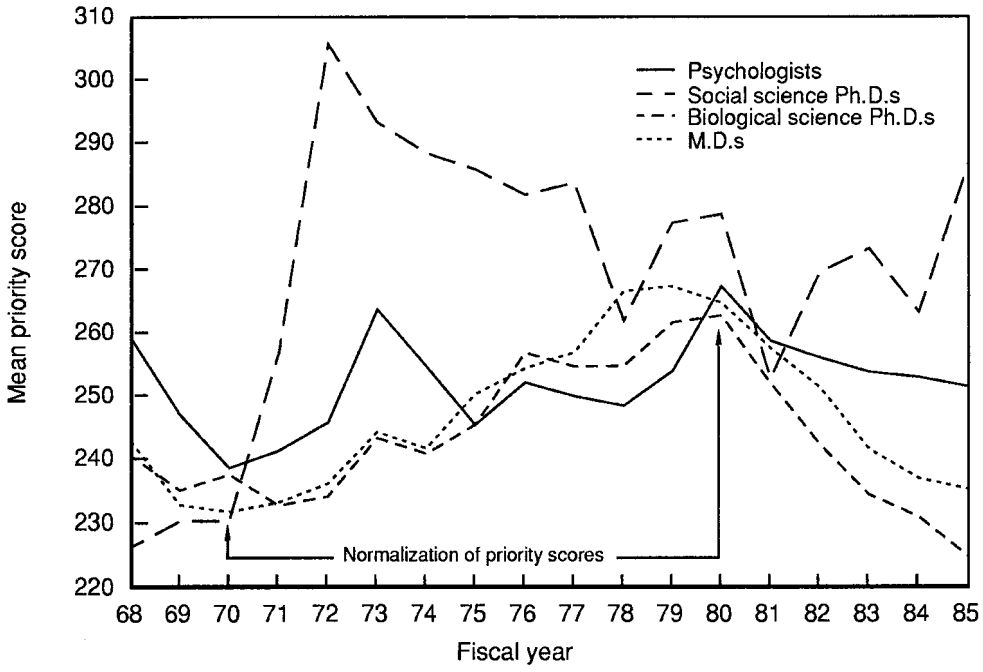

Fig. 5.4--Mean priority scores of psychologists and comparison groups by year at NIH

1980.[2] This is a well known phenomenon (NIH, 1987) associated with the fact that during this period NIH experimented with a system of normalizing priority scores across IRGs. Before this, IRGs had an incentive to assign low priority scores--IRGs with lower mean priority scores would tend to get more of their approved research projects funded than IRGs with higher priority scores. The normalization procedure, by which the priority of an application was measured in terms of its value *relative* to other priority scores assigned by the same IRG, eliminated this incentive, and, as a result, priority scores climbed steadily. After 1980, when the standardization procedure was abandoned, priority scores again began to decrease. A divergence in priority scores between psychologists and M.D. and biological and health science researchers at NIH since 1980 may be noted.

SUMMARY

The major results in this section may be summarized as follows:

- The award rate for psychologists, as well as other Ph.D. and M.D. researchers, decreased at ADAMHA and NIH. For psychologists, it decreased at ADAMHA from approximately 42 percent in 1968 to 29 percent in 1985. At NIH, the decrease for psychologists was from approximately 37 percent in 1968 to 26 percent in 1985. At least for NIH, more recent data indicate that this decrease has continued since 1985.
- Award rates for psychologists at NIH were generally lower than those of biological and health science and M.D. researchers, and higher than those of other social science researchers.
- Priority scores for psychologists and comparison investigators increased at NIH throughout the 1970s and decreased after 1980. These trends are related to changes in methods for calculating priority scores.

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[2]The mean priority score for the other social science group is based on a small sample size and cannot be reliably interpreted.

VI. ANALYSES BY PSYCHOLOGY SUBFIELDS

In this section, we consider differences in award and application trends for researchers in specific psychology subfields. As described in Sec. II, five psychology subfields were derived using information in the CGAF: (1) clinical, (2) developmental, (3) experimental, comparative, and physiological, (4) personality and social, and (5) other subfields.[1]

R01 AWARDS AT ADAMHA AND NIH

Figures 6.1 and 6.2 show the number of R01 awards at ADAMHA and NIH to investigators in each subfield. At ADAMHA (Fig. 6.1), the ECP subfield accounted for the largest number of awards to psychologists. The subfield receiving the second largest number was CL, followed by OTH, PS, and DEV, respectively. From 1968 to 1985, the number of awards in the ECP subfield decreased, and the number in the CL, PS, and DEV subfields increased--by 1985 these latter three accounted for the majority of R01 awards made to psychologists by ADAMHA, which was not true in earlier years. These trends are statistically significant at the 0.01 level; a less pronounced decreasing trend for awards in the OTH subfield is also significant at the 0.05 level.

The exact interpretation of the decrease in the proportion of awards in the ECP subfield at ADAMHA is not clear. The suggestion that ADAMHA has become less interested in more "hard science" experimental and biological psychological research, as opposed to more "soft science" areas such as clinical, developmental, personality, and social psychology, is not supported by the earlier-noted results concerning trends in ADAMHA awards by field (Fig. 3.4), where it was seen that research support in the biological and health sciences has increased since 1968.[2]

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[1]For convenience, we abbreviate these as follows: clinical, CL; developmental, DEV; experimental, comparative, and physiological, ECP; personality and social, PS; and other subfields, OTH.

[2]Of course, these two trends are not necessarily contradictory.

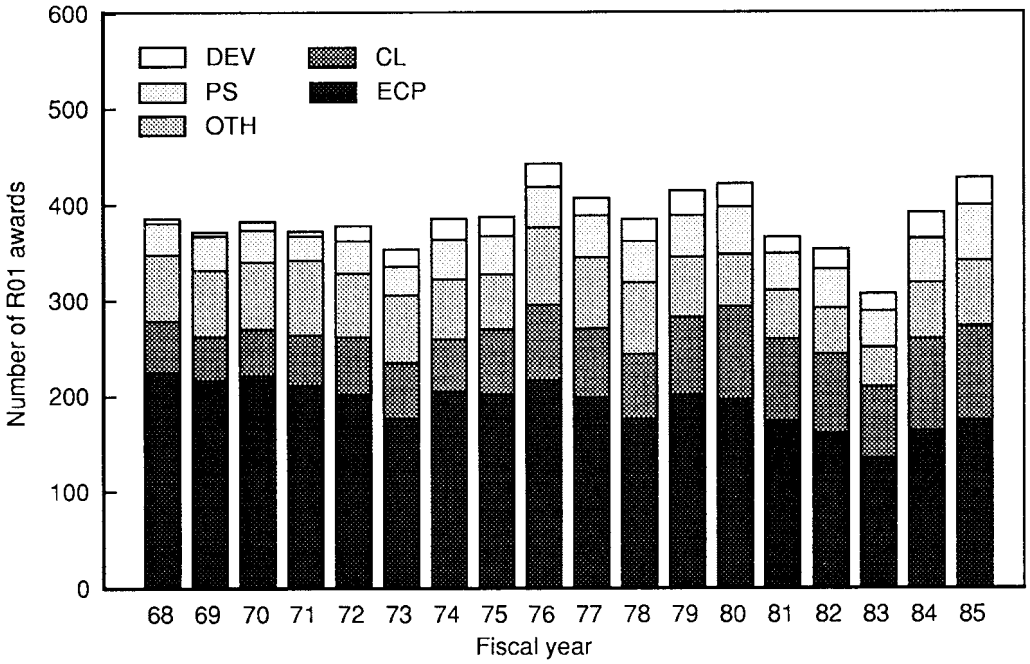

Fig. 6.1--ADAMHA R01 awards by psychology subfield and year

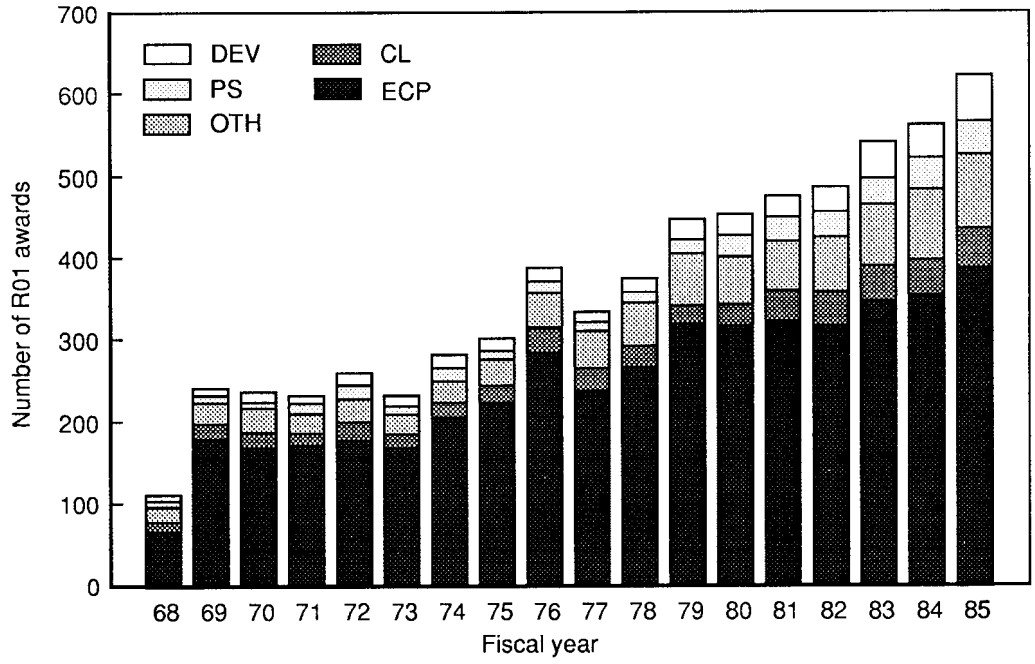

Fig. 6.2--NIH R01 awards by psychology subfield and year

Table 6.1

ADAMHA AWARD RATES BY PSYCHOLOGY SUBFIELD AND YEAR

Fiscal Year	Psychology Subfield					All Subfields
	CL	DEV	ECP	PS	OTH	
68	0.35	0.29	0.43	0.39	0.46	0.41
69	0.32	0.33	0.43	0.40	0.51	0.42
70	0.28	0.44	0.39	0.34	0.28	0.35
71	0.33	0.17	0.37	0.16	0.38	0.33
72	0.41	0.89	0.27	0.28	0.38	0.33
73	0.21	0.32	0.23	0.18	0.30	0.23
74	0.34	0.48	0.46	0.38	0.45	0.43
75	0.38	0.14	0.32	0.23	0.37	0.32
76	0.25	0.29	0.27	0.20	0.29	0.26
77	0.25	0.24	0.28	0.23	0.29	0.27
78	0.23	0.27	0.21	0.23	0.29	0.23
79	0.29	0.37	0.33	0.19	0.28	0.30
80	0.25	0.17	0.25	0.25	0.24	0.24
81	0.17	0.22	0.22	0.09	0.23	0.19
82	0.29	0.31	0.27	0.30	0.23	0.27
83	0.29	0.23	0.25	0.19	0.20	0.24
84	0.29	0.25	0.25	0.22	0.36	0.27
85	0.24	0.24	0.34	0.27	0.33	0.30
All Years	0.28	0.28	0.30	0.24	0.32	0.29

At NIH, R01 support increased consistently in all subfields (Fig. 6.2). Increasing trends for all five are statistically significant at the 0.01 level. The ECP subfield accounted for approximately 70 percent of awards to psychologists made by NIH. The second most highly represented category was the OTH subfield. The preponderance of awards in the ECP area at NIH is of interest. It does not correspond well with the apparent distribution of psychologists belonging to various subfields in the research workforce--data presented by Howard et al. (1986) suggest a distribution of researchers across subfields more

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The existence of both may suggest, not implausibly, that attempts to characterize changes in the priorities of ADAMHA in terms of variation on a single dimension of "hard science" and "soft science" research is overly simplistic.

Table 6.2

NIH AWARD RATES BY PSYCHOLOGY SUBFIELD AND YEAR

Fiscal Year	Psychology Subfield					All Subfields
	CL	DEV	ECP	PS	OTH	
68	0.38	0.50	0.37	0.33	0.40	0.38
69	0.32	0.10	0.56	0.25	0.39	0.47
70	0.33	0.46	0.41	0.22	0.33	0.38
71	0.10	0.17	0.27	0.27	0.11	0.23
72	0.37	0.40	0.31	0.32	0.29	0.32
73	0.12	0.33	0.24	0.05	0.24	0.22
74	0.17	0.33	0.38	0.30	0.20	0.34
75	0.38	0.43	0.46	0.20	0.41	0.43
76	0.26	0.21	0.29	0.23	0.23	0.27
77	0.20	0.13	0.24	0.18	0.27	0.23
78	0.19	0.36	0.39	0.23	0.35	0.35
79	0.21	0.23	0.39	0.22	0.30	0.33
80	0.14	0.15	0.34	0.29	0.25	0.28
81	0.22	0.21	0.29	0.21	0.24	0.26
82	0.21	0.18	0.25	0.21	0.27	0.24
83	0.24	0.25	0.29	0.21	0.23	0.27
84	0.21	0.13	0.31	0.27	0.30	0.27
85	0.28	0.24	0.27	0.19	0.29	0.27
All Years	0.23	0.23	0.32	0.23	0.28	0.30

consistent with the award distribution at ADAMHA. It may be useful to consider other data sources, such as the CRISP database maintained by the DRG, to better characterize NIH-funded research in the area we have broadly defined as the ECP subfield.

AWARD RATES

As in Sec. V, we calculated the award rate as the proportion of competing R01 applications (new applications or renewals) that received funding. These rates, by psychology subfield and year, are shown in Tables 6.1 and 6.2. Statistically significant decreasing trends occurred at ADAMHA with respect to award rates for the CL, ECP, PS, and OTH subfields, but not for the DEV subfield (trends for the ECP and OTH

Table 6.3

ADAMHA MEAN R01 PRIORITY SCORES BY PSYCHOLOGY SUBFIELD

Fiscal Year	Psychology Subfield					All Subfields
	CL	DEV	ECP	PS	OTH	
68	244.2	175.0	260.0	236.3	248.0	252.1
69	233.4	136.0	262.5	239.4	241.7	251.6
70	262.0	220.9	255.1	230.3	268.9	253.8
71	239.6	258.0	249.5	241.2	229.4	243.5
72	226.2	206.0	247.0	237.6	231.2	238.1
73	266.0	225.2	257.2	230.6	217.0	250.4
74	236.5	198.1	239.8	239.7	220.3	234.8
75	244.9	260.3	245.2	255.6	229.8	244.4
76	234.2	206.8	257.3	250.0	252.9	249.0
77	230.5	240.6	256.7	254.6	241.8	248.8
78	222.1	271.5	263.5	251.8	259.4	255.7
79	224.2	250.1	246.1	270.3	242.7	244.8
80	252.8	254.9	247.2	254.8	268.8	252.6
81	251.2	264.9	242.6	278.6	233.8	248.4
82	235.3	240.8	241.3	227.7	233.0	237.6
83	191.9	273.1	217.7	244.3	249.7	221.5
84	211.4	244.2	237.4	236.3	212.4	229.2
85	210.5	183.2	208.4	221.8	216.5	211.0
Mean	234.3	228.3	246.4	244.5	238.7	242.6

categories significant at the 0.01 level; trends for the CL and PS categories significant at the 0.05 level). When considered across all years, there was a tendency for award rates in the PS subfield to be lower compared to each of the other subfields (differences statistically significant at the 0.01 level or below).

For NIH (Table 6.2) trends in award rate for all subfields were statistically nonsignificant. Considered across all years, award rates for the CL, DEV, and PS subfields were lower than those of the ECP and OTH subfields; these differences are statistically significant at the 0.01 level or below.

Table 6.4

NIH MEAN R01 PRIORITY SCORES BY PSYCHOLOGY SUBFIELD

Fiscal Year	Psychology Subfield					All Subfields
	CL	DEV	ECP	PS	OTH	
68	263.5	236.8	258.4	273.0	252.0	258.1
69	256.0	235.0	246.6	282.8	212.1	246.0
70	227.1	220.8	241.3	233.5	237.5	237.6
71	280.3	267.6	236.3	194.5	240.7	240.8
72	229.5	228.2	245.3	233.1	261.3	243.9
73	273.3	247.3	261.0	308.7	259.3	263.0
74	259.2	213.2	248.4	286.6	291.5	253.6
75	237.0	250.0	248.7	208.7	226.5	244.4
76	291.1	259.6	245.0	263.7	249.3	251.1
77	261.6	281.1	248.9	244.7	231.6	248.5
78	278.3	221.8	247.7	251.6	236.0	247.5
79	256.2	263.1	250.5	271.5	245.1	252.9
80	262.1	289.5	266.7	246.4	263.7	265.9
81	275.2	261.1	252.6	270.5	259.7	257.2
82	259.8	289.8	248.2	269.6	250.3	254.7
83	279.3	278.7	244.2	244.4	249.6	251.7
84	278.5	295.4	235.4	257.6	262.9	251.7
85	262.8	264.9	242.3	290.1	245.0	250.2
Mean	262.8	255.8	248.2	257.3	248.6	251.0

PRIORITY SCORES

Mean priority scores for each subfield are shown in Tables 6.3 and 6.4. At ADAMHA (Table 6.3), for the CL and ECP subfields, decreasing (improving) trends significant at the 0.05 and 0.01 levels are present; all other trends are nonsignificant. The unusually low mean priority score for 1969 in the DEV subfield appears to be the effect of a small sample size--that year only three competing awards were submitted to ADAMHA by investigators defined by our criteria as belonging to this subfield. At NIH (Table 6.4), all trends are nonsignificant, except for the DEV subfield, where a positive trend, significant at the 0.01 level, occurred.

SUMMARY

The major findings in this section are as follows:

- At ADAMHA, the ECP subfield accounted for approximately half of all awards to psychologists. Awards to investigators in this subfield decreased over time, however, whereas awards in the CL, DEV, and PS subfields increased.
- At NIH, awards to investigators in all psychology subfields increased substantially. Overall, the ECP subfield accounted for approximately 70 percent of all awards to psychologists.
- At ADAMHA, award rates in the PS subfield were significantly lower than those of other subfields. At NIH, award rates in the CL, DEV, and PS subfields were significantly lower than those of the ECP and OTH subfields.

VII. ANALYSES BY SPECIFIC INSTITUTES AND IRGs

In earlier sections, we described R01 support for psychology research at the agency level, that is, ADAMHA- and NIH-wide levels of support. Because of the relative autonomy of various institutes within these larger agencies, we believe that this level of analysis alone is insufficient to fully characterize allocations of funds to psychology research. In this section, we present analyses focusing on R01 applications and awards at the level of specific institutes and IRGs.

SPECIFIC INSTITUTES

Figure 7.1 shows the total number of R01 awards and awards to psychologists for each of the 15 ADAMHA/NIH institutes considered.[1] NIMH accounted for, by far, the largest number of awards to psychologists. NINCDS, NICHD, and NEI ranked second, third, and fourth, respectively. Variability among institutes in the proportion of awards accounted for by awards to psychologists is evident. It is interesting to note that several of the institutes making the largest number of R01 grants overall--NIADDK, NIGMS, NCI, NHLBI, and NIAID--were among those making the fewest to psychologists.

Figure 7.2 shows changes in the number of awards to psychologists by each institute over time. The number of awards to psychologists decreased at NIMH in 1980-1985. Support for psychological research tended to increase at most NIH institutes. In App. C, we present more detailed data on the number of awards to psychologists and comparison investigators by each ADAMHA and NIH institute over time.

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[1]Institute titles, acronyms, and abbreviations are shown in Table 2.2.

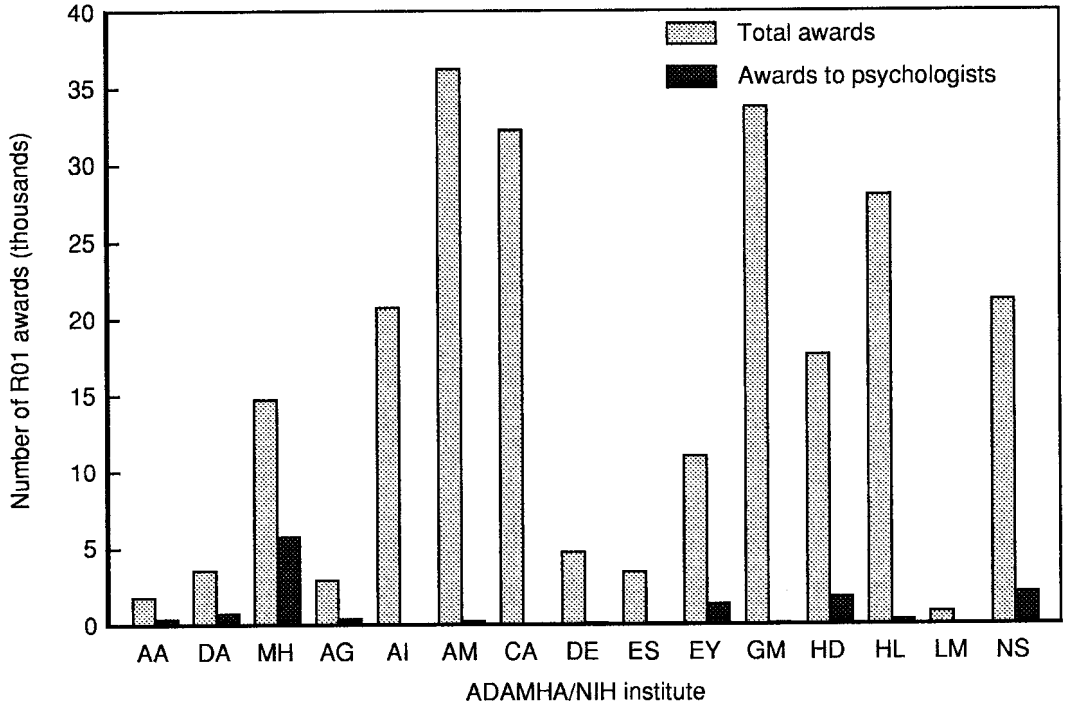

Fig. 7.1--Total awards and number of awards to psychologists by institute

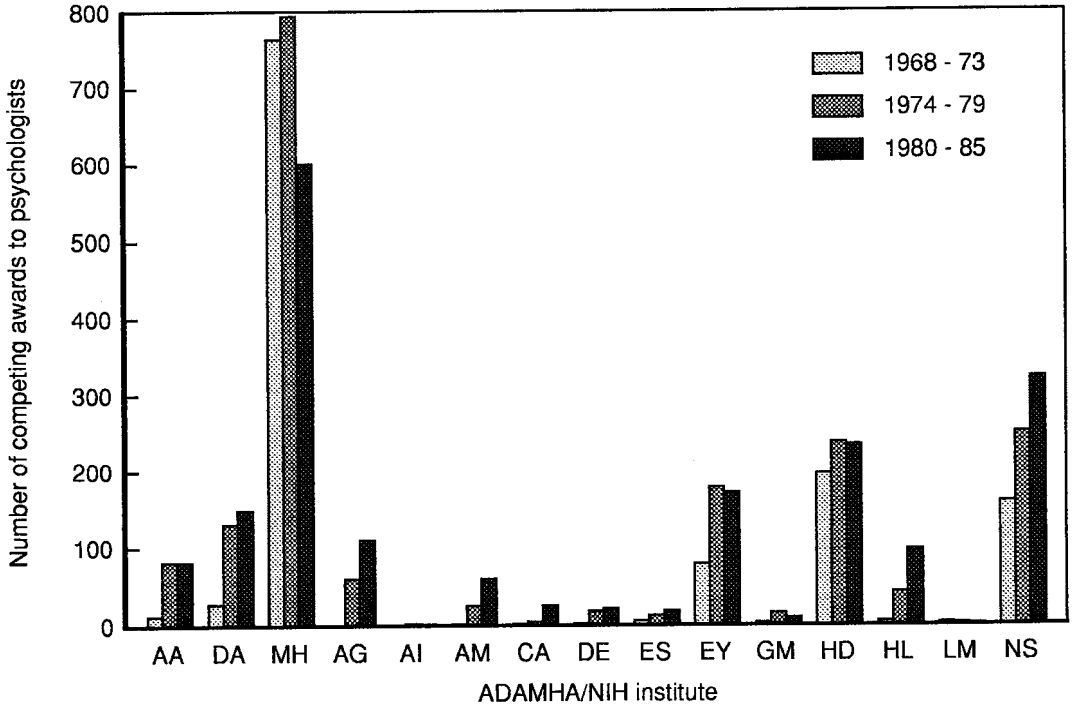

Fig. 7.2--Awards to psychologists by institute over time

NIAAA, NIDA, AND NIMH

Because of ADAMHA's traditional importance in the funding of psychological research, an analysis was made of the relative number of R01 awards made by each ADAMHA institute to the different psychology subfields. These data are shown in Fig. 7.3. Several results are noteworthy. First, the proportion of awards in the ECP subfield was higher at NIDA (64.2 percent of all awards to psychologists) than at NIAAA and NIMH (53.0 percent and 47.8 percent, respectively).[2] This is consistent with an expressed commitment at NIDA (Booth, 1988; Schuster, 1988) to determine the physiological mechanisms of drug addiction. The proportion of awards in the CL subfield was correspondingly smaller at NIDA (11.8 percent) than at NIAAA and NIMH (23.2 percent and 18.8 percent, respectively).[3]

Also noticeable is the lower proportion of awards in the DEV subfield at NIAAA (0.0 percent) and NIDA (1.0 percent) compared with NIMH (5.5 percent). The differences between NIMH and each of the other agencies are statistically significant at the 0.001 level.[4] Similar differences are present in the distribution of R01 applications by subfield across institutes.

We consider the implications of these differences in Sec. VIII.

IRGs

The data presented in Table 7.1 address the question of which IRGs are most likely to review R01 applications that result in awards to psychologists. Shown are the IRGs responsible for the largest numbers of R01 awards to psychologists from 1968 to 1976 and from 1977 to 1985.

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[2]The differences between NIDA and NIAAA and between NIDA and NIMH are both statistically significant at the 0.001 level (χ^2 = 13.9, 1 df and χ^2 = 72.5, 1 df, respectively).

[3]Difference between NIDA and NIAAA significant at the 0.001 level (χ^2 = 26.2, 1 df); difference between NIDA and NIMH significant at the 0.01 level (χ^2 = 10.7, 1 df).

[4]For NIMH-NIAAA comparison, χ^2 = 23.0, 1 df; for NIMH-NIDA comparison, χ^2 = 27.5, 1 df.

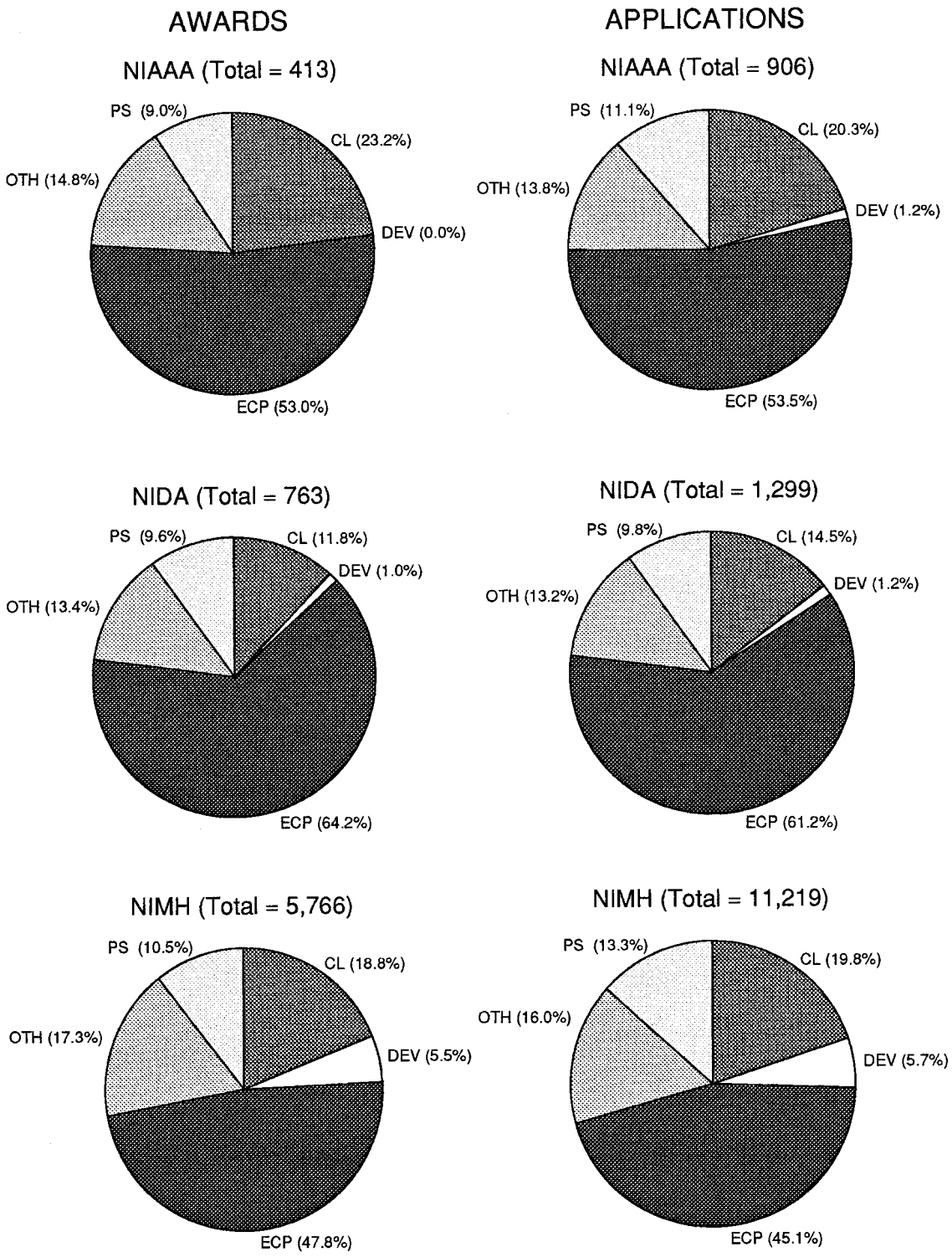

Fig. 7.3--Distribution of awards and applications across psychology subfields by ADAMHA institute: 1968-1985

Table 7.1

IRGs AWARDING MOST FREQUENTLY TO PSYCHOLOGISTS

Number of Awards to Psychologists	IRG	Abbrev-iation
	1968-1976	
164	Experimental Psychology Study Section (NIMH)	EPR
150	Experimental Psychology Study Section (DRG)	EP
130	Personality and Cognition Research Committee	PCR
102	Neuropsychology Research Review Committee	NP
75	Developmental Behavioral Sciences Study Section	DBR
73	Clinical Projects Research Review Committee	CPR
58	Sensory Disorders and Language Study Section	CMS
49	Visual Sciences Study Section	VIS
46	Social Sciences Research Review Committee	SSR
44	Drug Abuse Review Committee	NAD
	1977-1985	
176	Human Development and Aging	HUD
151	Bio-Psychology Study Section	BPO
136	Visual Sciences B Study Section	VISB
117	Behavioral Medicine Study Section	BEM
104	Sensory Disorders and Language Study Section	CES
83	Basic Behavioral Processes Research Review Committee	BBP
80	Drug Abuse Clinical, Behavioral, and Psychosocial Research Review Committee--Clinical and Behavioral Subcommittee	DACB
61	Alcohol Psychosocial Research Review Committee	ALCP
60	Basic Psychopharmacology and Neuropsychology Research Review Committee--Neuropsychology Subcommittee	BPNB
59	Psychopathology and Clinical Biology Research Review Committee--Clinical Psychopathology Subcommittee	PCBA

From 1968 to 1976, four of the five IRGs making the largest numbers of awards to psychologists appear to have been oriented towards more "traditional" types of psychological research, that is, in such areas as experimental, personality, cognitive, and developmental psychology. A more health and physiologically oriented emphasis of the IRGs making the largest numbers of awards to psychologists from 1977 to 1985 is

suggested. This is consistent with recent trends at ADAMHA, which in 1982 redefined its mission to de-emphasize social science research not explicitly concerned with mental illness and mental health (Knezo, 1986). It is also consistent with the trend toward more medically related psychological research noted in Sec. III. However, conclusions drawn from a categorization of research content based on the reviewing IRG are necessarily limited.

SUMMARY

The main findings of this section may be summarized as follows:

- NIMH accounted for the largest number of R01 awards to psychologists of any ADAMHA or NIH institute. However, the number of awards to psychologists by NIMH decreased over time.
- NIH institutes varied with respect to the proportion of R01 awards made to psychologists. Several NIH institutes making the largest number of R01 awards overall made comparatively few to psychologists.
- Differences were found among ADAMHA institutes in the distribution of awards across psychology subfields. Specifically, the proportion of awards in the ECP subfield was higher at NIDA than at NIAAA and NIMH, the CL subfield was better represented at NIAAA and NIMH than NIDA, and the proportion of awards in the DEV subfield was lower at NIAAA and NIDA than at NIMH.

VIII. DISCUSSION

In this section, we summarize the major results of this study, consider explanations for and implications of the trends observed, and suggest strategies for further research. The results in each section are considered in succession.

OVERALL TRENDS IN APPLICATIONS AND AWARDS

Perhaps the most striking aspect of the data in Sec. III is the volatility of funding levels at ADAMHA from 1968 to 1985. Much of this may be attributable to broader political changes that have occurred over the last several decades (Knezo, 1986). In the 1960s there was an upsurge in funding for social research and interest in the potential of the social sciences for solving social problems. By the mid-1970s, a slower economy, combined with concerns that the investment of funds in social research had not produced results, prompted a more conservative federal attitude. This coincided with the decrease in ADAMHA funding beginning in 1977. The second major decrease in ADAMHA funding, beginning in 1981, coincided with the Reagan administration, which, as a matter of policy, placed a lower priority on social science research.

The increases in psychology research funding at NIH have undoubtedly helped to take up slack for variable funding at ADAMHA. However, the shift from predominantly ADAMHA-funded to predominantly NIH-funded psychological research may carry with it important consequences for the field. For example, basic personality and social psychology research may not be considered as relevant for medical research as it is for mental health research. Thus, the shift toward more medically related psychological research may affect the proportion of research opportunities in various psychology subfields. This, in turn, may have implications for academic institutions, affecting curricula and the need for faculty in various subfields. There is also a danger that in emphasizing medical applications of psychology, sight will be lost of areas that are uniquely psychological, such as the nature of interpersonal relations and emotional well being.

The lack of an adequate base of support for psychological research may have a vicious circle quality--if adequate funding is not available, the quality of research may suffer, and the field may appear less capable of addressing relevant social concerns. This, in turn, may lower public confidence in the discipline, making it more difficult to obtain societal resources for research. Of course, one might also argue that an overabundance of funds results in trivial or mediocre research, which also reduces the credibility of the discipline. It need not follow, therefore, that because funding levels are reduced research is of poorer quality--when funding is scarce, it may be that only the best research projects are funded.

However, it is unlikely that *fluctuating* levels of support create a favorable climate for psychological research. There appears to be a great need for an explicit and longitudinally consistent federal policy with regards to psychology research, which encompasses both ADAMHA and NIH, and probably NSF as well.

The role of the research community in initiating and affecting research policy should be emphasized. As evidenced by recent hearings of the House Committee on Science and Technology (1986), and a history of similar hearings going back several decades, Congress has been receptive to efforts to demonstrate the value of psychological and social science research. The best strategy for obtaining more stable funding for psychology research may be through demonstrations or assessments of the value of such research. It may be advantageous, therefore, for the research community to place a greater emphasis on high-leverage research, which increases the perceived value of the discipline and thereby promotes higher levels of appropriations.

AGE TRENDS

There can be no doubt that a substantial decrease in the proportion of R01 awards made to young investigators has occurred. However, this trend is compatible with several explanations. Possible explanations, listed in an order corresponding roughly to increasing levels of concern, are:

- Young investigators are increasingly using other ADAMHA/NIH funding mechanisms, such as small grants.
- Young researchers are increasingly beginning their careers as co-investigators or research staff on grants on which they are not principal investigators.
- The proportion of young investigators in the research workforce is decreasing.
- For social and economic reasons, young investigators are finding it more difficult to launch and maintain research careers.
- Young investigators are at an increasing disadvantage relative to more established investigators in the grant application and review process.
- Young researchers are becoming less competitive in the quality of their research.

The last four of these are probably the major sources of concern, although there may be problems with the second as well in terms of cultivating research leadership skills and fostering innovation. The major concern is that a shortage of adequately funded young researchers now may result in a shortage of experienced, senior-level scientists in 10 or 20 years. A second concern is that if there are not adequate opportunities to launch research careers, there will be less incentive for young people to seek training in these areas.

The impact of basic demographic changes must be considered as a contributing factor for these trends. The baby "boom" after the second world war was followed by the baby "bust," a period of lower birth rates (Butz et al., 1982). In anticipation of lower college admissions and needs for faculty, the rate of production for academic research Ph.D.s, including those in psychology, began to decrease in the mid-1970s and has continued to decrease since (Howard et al., 1986). Thus, young researchers may be entering the research workforce at a decreasing rate. However, even if this is the primary cause of the age trends in R01 awards, it may still pose problems from the standpoint of whether there

will be an adequate number of experienced scientists in coming years to maintain research institutions that are currently primed with the number of senior researchers now available.

In any case, it is clear that this is an issue of sufficient importance to warrant careful attention and further study. At least some of the possibilities above may be ruled out by analyses that consider such factors as the production of newly graduating Ph.D. psychologist researchers, the percentage of recent graduates employed in research positions, and the rate at which older researchers retire from the research workforce. Although it may be possible to address many of these issues with archival data, formal survey methods may also be required to determine such things as the extent of nonfederal sources of support and the extent of involvement in research at other than a principal investigator level.

It is likely that this trend is not confined to ADAMHA and NIH. Rather, it may characterize a more general lack of research opportunities for a generation of young investigators. We therefore recommend that other agencies, notably NSF and the National Academy of Sciences, also undertake research to determine the full scope of this trend.

Steps to remedy the possible adverse consequences associated with this trend must, of course, await the outcome of such research. If the numbers of researchers entering the workforce are found to be decreasing, it may be necessary to create additional incentives, for example, graduate fellowships, for recruiting researchers. On the other hand, if it is a matter of there being sufficient numbers of potential young researchers, but increasing difficulty in their being assimilated into the grant process, a solution may involve more decisive efforts to involve young researchers. Strategies for accomplishing this might include the preparation and dissemination of written material targeted to young researchers, the strengthening of award mechanisms specifically suited to their needs, and modifications in the grant application and review process to remove possible structural barriers that particularly affect young researchers. Again, the immediate need is for additional

research to determine the precise origin of this trend. The urgency of such research is to be emphasized, however--it may be much easier to reverse this trend now than deal with its consequences in 20 years.

AWARD RATES

Clearly a situation in which as many as 70 percent of all grant applications do not result in awards is problematic. At the least, it points to a large amount of wasted effort expended by researchers in writing and submitting proposals, and by ADAMHA and NIH in processing and reviewing them. For researchers, this represents time and effort that must be diverted from direct research activities. It would make sense, therefore, for ADAMHA and NIH to exercise initiative and imagination in considering possible modifications of and alternatives to the present application and review process. For example, a *two-stage application procedure* could be considered, by which researchers would submit brief synopses of proposed research, and some form of formal feedback (e.g., an estimated priority score) provided. Researchers could then decide whether to submit a full application. We present this as but one of a range of options available. The greater use of electronic communication, including electronic mail, may also increase the speed and efficiency of grant solicitation, application, and review.

Forms of these procedures are already in use or being experimented with at federal agencies. For example, several NIH and ADAMHA institutes make use of a "letter of solicitation," by which investigators initially express an interest in a research project, but apply only if encouraged to do so. NSF is also experimenting with and planning the eventual introduction of an electronic system for grant application submission and review, Project EXPRES (Thaler, 1988).

The greater availability of data on grant applications and awards for specific ADAMHA/NIH institutes, programs, and IRGs may help to keep investigators better apprised of funding trends. This may allow researchers to orient their research toward areas where more money is available relative to the number of applicants, and promote a more even distribution of applications across areas. Increased availability of

such data might also promote greater involvement by the research community in policy formulation and evaluation. Some yearly summaries of grant award data are currently published. ADAMHA, for example (ADAMHA, 1988b), each year lists the recipients, amounts, and titles of all R01 awards. The value of such information might be increased by (1) providing the information in machine-readable form, (2) identifying the reviewing IRG and sponsoring program within an institute, and (3) including data on unfunded as well as funded applications.

It is important to consider, however, possible adverse consequences that may be associated with such innovations. For example, although a two-stage application procedure may reduce the work associated with processing any one application, it may result in a greater number of applications, and a possible reduction in the average quality of applications. Similarly, the introduction of electronic mail-based systems for grant application submission and review may contribute to the formation of cliques, and place researchers who have greater access to computer networks at an unfair advantage compared to other researchers--that is, it may benefit the technology "haves" more than the technology "have nots." The introduction of such innovations may involve a variety of sociotechnical issues (Bikson et al., 1984; Talbert et al., 1984; Tornatzky & Johnson, 1982), which require an interdisciplinary perspective to fully understand and study.

Importantly, the structure of the extramural grant process at ADAMHA and NIH is well suited to the controlled, experimental introduction and evaluation of innovative grant application and review procedures. For example, a new procedure could be introduced for one institute, IRG, or funding mechanism, and be fully evaluated before implementing it more broadly. Moreover, institutional structures exist, in the form of policy and evaluation sections within ADAMHA, NIH, and the DRG, that are capable of conducting such research.

SUBFIELD SUPPORT

Some determination must be made concerning the appropriate distribution of research resources across psychology subfields. The differences among ADAMHA institutes observed with regards to the distribution of support across subfields may warrant specific attention. There has recently been controversy about what some have perceived as an overemphasis at NIDA on physiologically related research, and an underemphasis on treatment and prevention (Booth, 1988; Schuster, 1988). Although the data here suggest that a greater emphasis on physiological research has occurred at NIDA, it is also evident that this research has produced tangible results. Much of what we know about endorphins, for example, is a result of NIDA-sponsored research. However, several questions of a general nature regarding the structure of scientific progress (Kuhn, 1972) should be considered. It is not clear, for example, that if a successful research paradigm reaches a point of diminishing marginal returns relative to alternative paradigms or research investment options, it will automatically give way to newer theories, methods, and approaches. Rather, it may be that as a research paradigm develops, a knowledge elite (see, e.g., Cole, 1983) is created, which exerts impact on the course of research--by, for example, constituting review committees--that persists even after the general research community begins to view other areas as more important. This is not to suggest that this has occurred in the present case, but it is an example of a class of issues that the scientific community must address. The questions that need to be answered are: What factors govern the progression of psychology, what decisions are involved, and who, if anyone, makes them?

SETTING AGENDAS FOR PSYCHOLOGY RESEARCH

Effective science is guided by agendas. Agendas are common in other scientific disciplines--particle accelerators are planned for years in advance, and the long-term project of sequencing the human genome has already begun. There is no reason to think that such agendas are not equally applicable to or necessary for psychology. Both the

public and psychologists have a vested interest in developing such agendas, though their interests and priorities may differ. Federal agencies, charged with the responsibility of meeting public needs, but also understanding the capabilities and requirements of the research community, are the logical candidates for balancing both, and should play a major role in this process. One approach might be for federal agencies to help subsidize efforts by the research community to set relevant agendas. For example, a special category of grant could be created to fund policy-related research or symposia. Strategies ADAMHA and NIH might adopt for accomplishing this are limited only by the resources and effort they are willing to allocate to it, and the degree to which they recognize its importance.

Appendix A

DOCTORATE SPECIALTY FIELDS USED TO DEFINE PSYCHOLOGY SUBFIELDS

Subfield	CGAF Doctorate Specialty Field (DSF)
Clinical	Clinical
Developmental	Developmental
Experimental, comparative, and physiological	Comparative Experimental Experimental, comparative, and physiological Physiological
Personality and social	Personality Social
Other subfields	Cognitive Counseling Educational Human engineering Industrial and organizational Psychology, general Psychology, other Psychometrics Quantitative School

Appendix B

DETAILED STATISTICAL TABLES

Statistical Table	Description
1	Numbers of R01 applications by psychologists and comparison investigators, summarized by institute/year combination and IRG/year combination
2	Numbers of R01 applications by psychologists and comparison investigators under the age of 36, summarized by institute/year combination and IRG/year combination
3	Total amount of R01 grants, in current and constant (1987) dollars, awarded to psychologists and comparison investigators, summarized by institute/year combination and IRG/year combination
4	Mean priority scores for competing R01 grant applications by psychologists and comparison investigators, calculated by institute/year combination and IRG/year combination
5	Numbers of R01 applications by psychologists and comparison investigators reviewed, summarized by institute/year combination and IRG/year combination
6	Numbers of R01 applications by psychologists submitted, approved, and awarded, summarized by institute/year combination and IRG/year combination
7	Numbers of R01 applications by psychologists under the age of 36 submitted, approved, and awarded, summarized by institute/year combination and IRG/year combination

NOTE: The statistical tables listed above were constructed during the course of this study. They are available to researchers on request.

Appendix C

R01 AWARD TRENDS BY SPECIFIC INSTITUTES

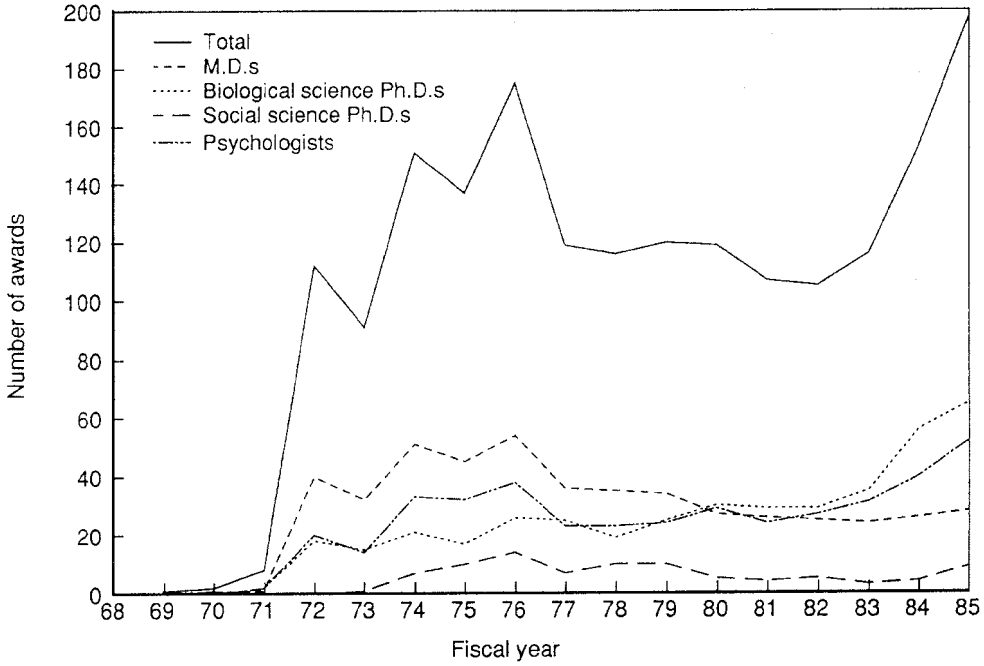

Fig. C.1--R01 awards by NIAAA by fiscal year

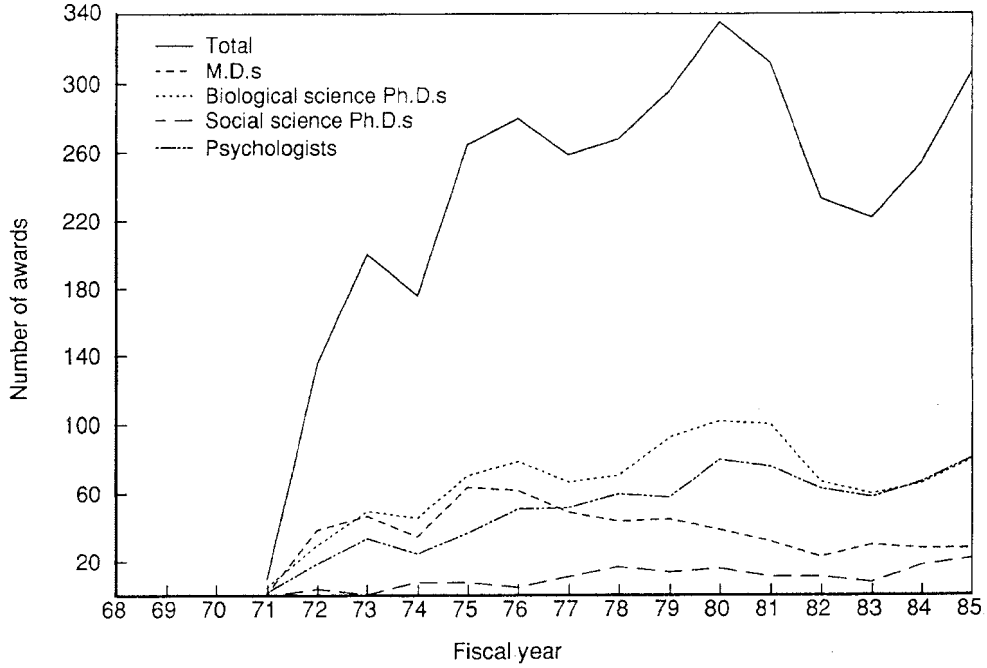

Fig. C.2--R01 awards by NIDA by fiscal year

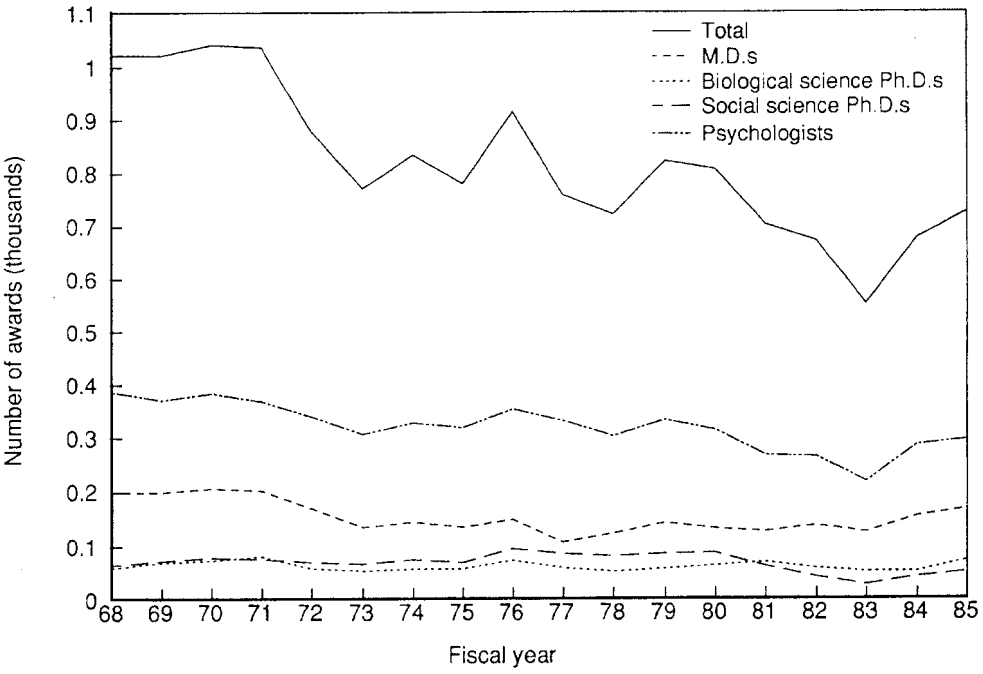

Fig. C.3--R01 awards by NIMH by fiscal year

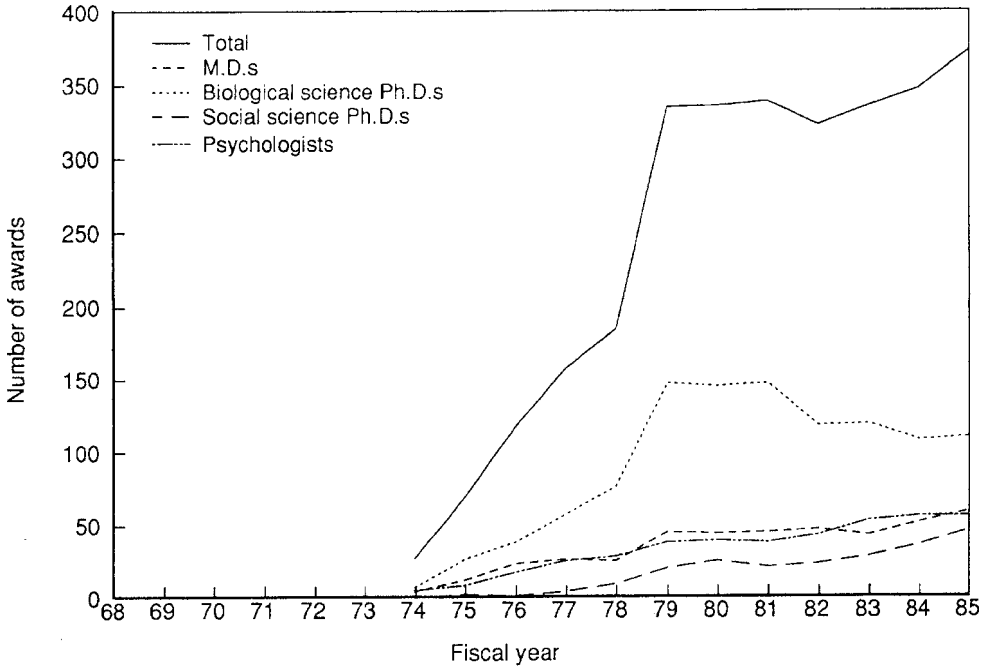

Fig. C.4--R01 awards by NIA by fiscal year

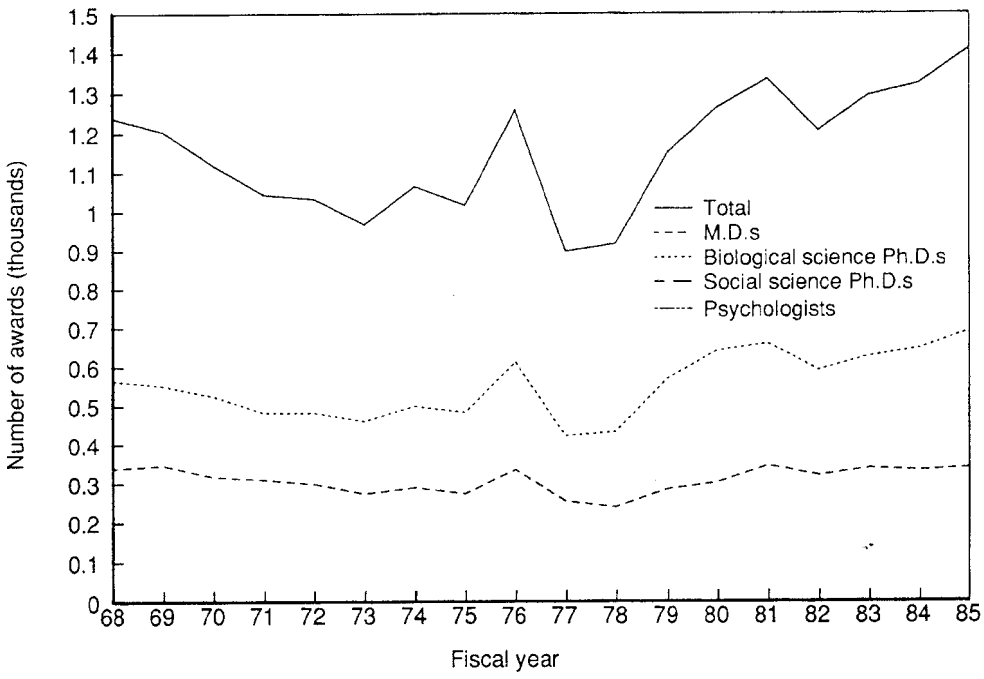

Fig. C.5--R01 awards by NIAID by fiscal year

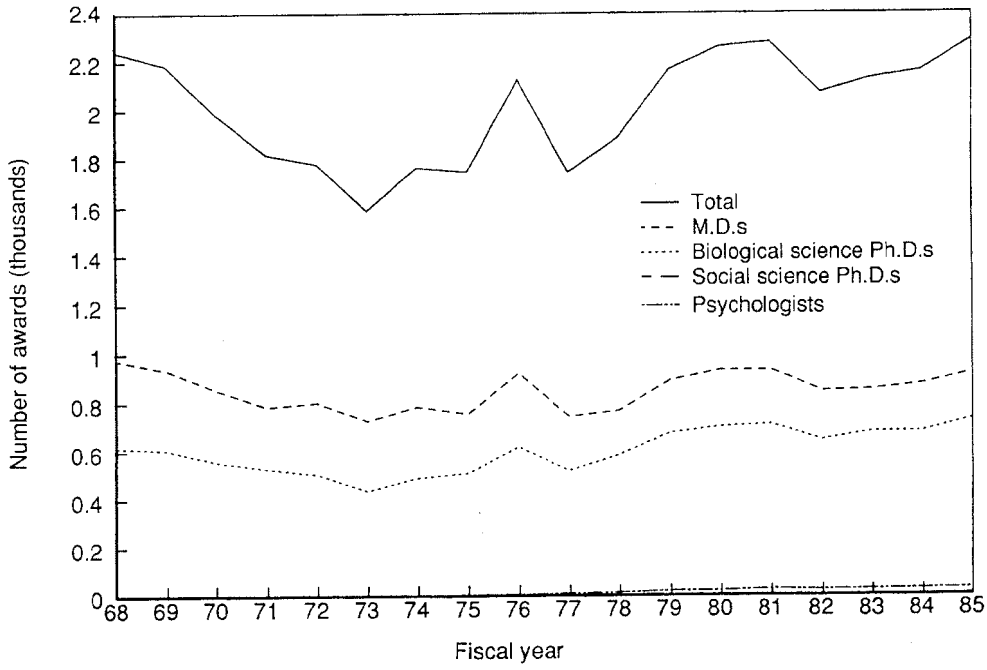

Fig. C.6--R01 awards by NIADDK by fiscal year

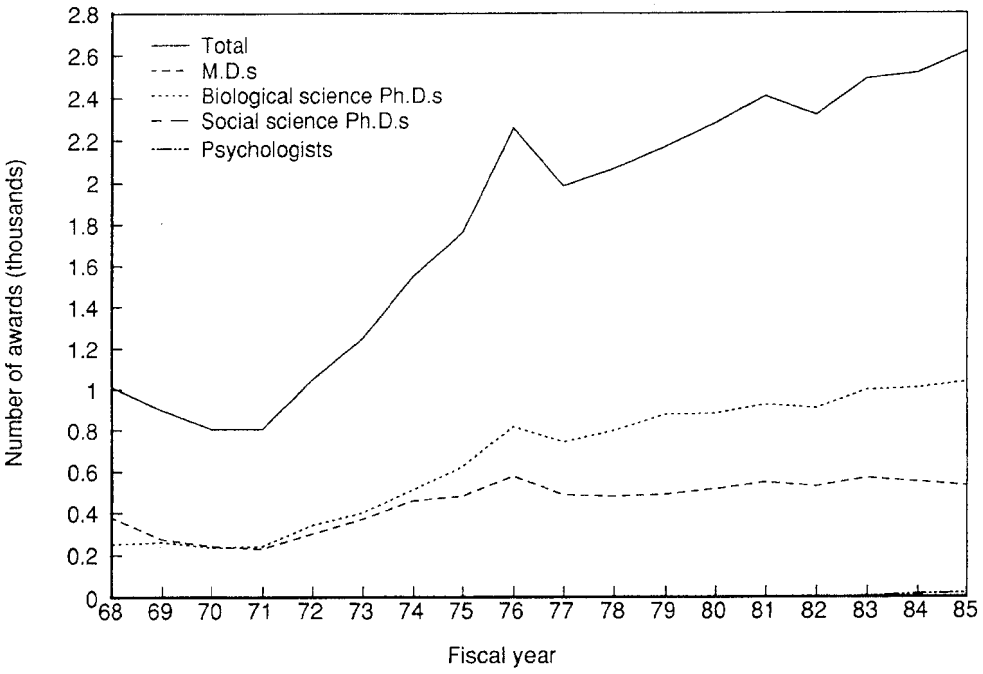

Fig. C.7--R01 awards by NCI by fiscal year

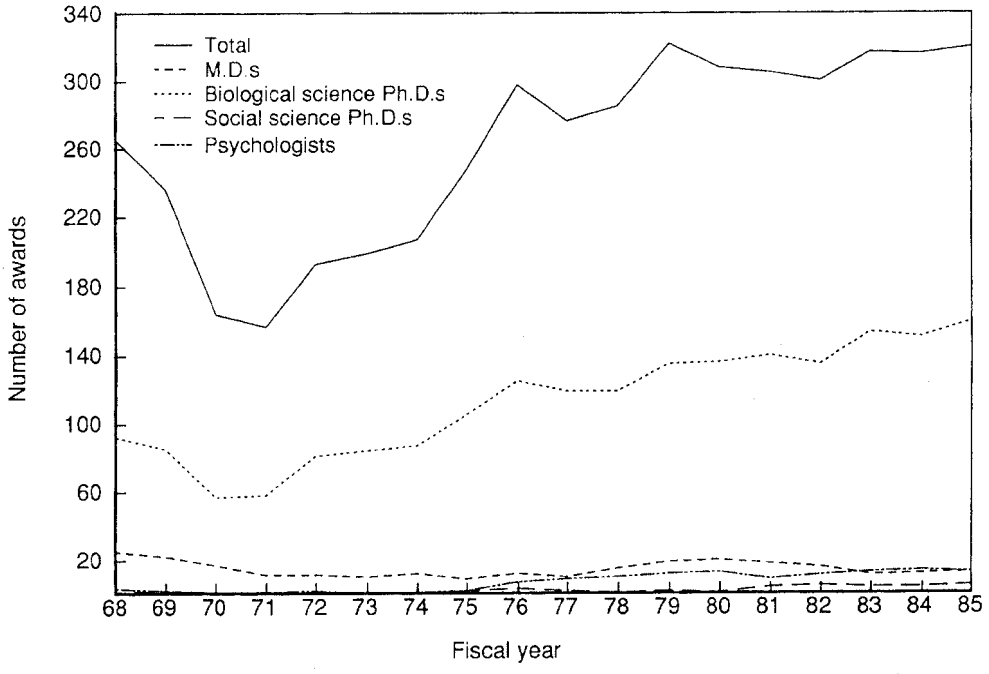

Fig. C.8--R01 awards by NIDR by fiscal year

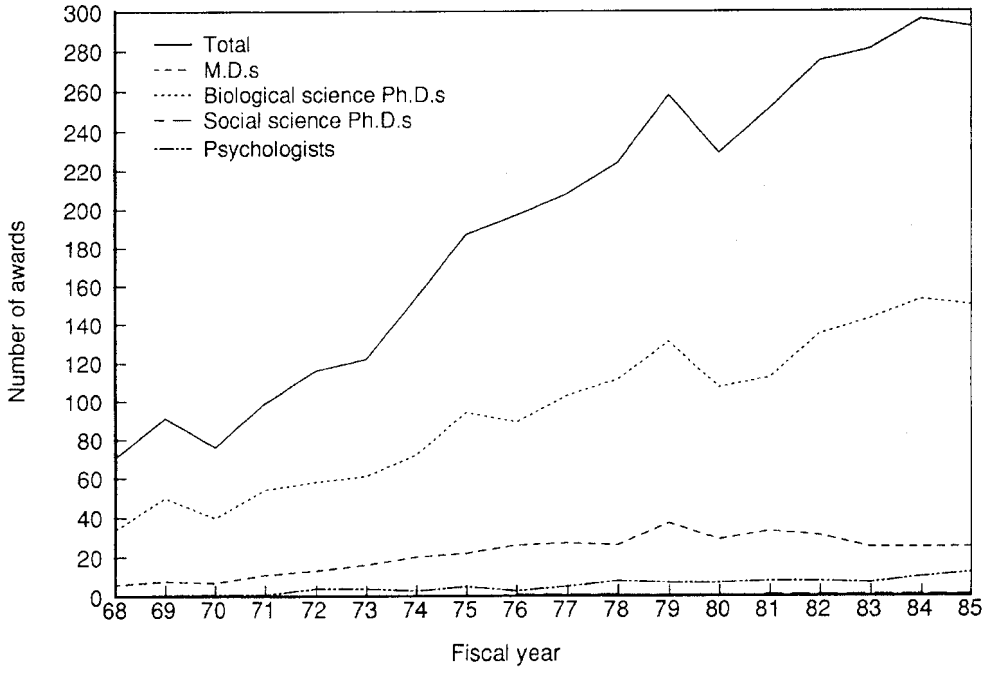

Fig. C.9--R01 awards by NIEHS by fiscal year

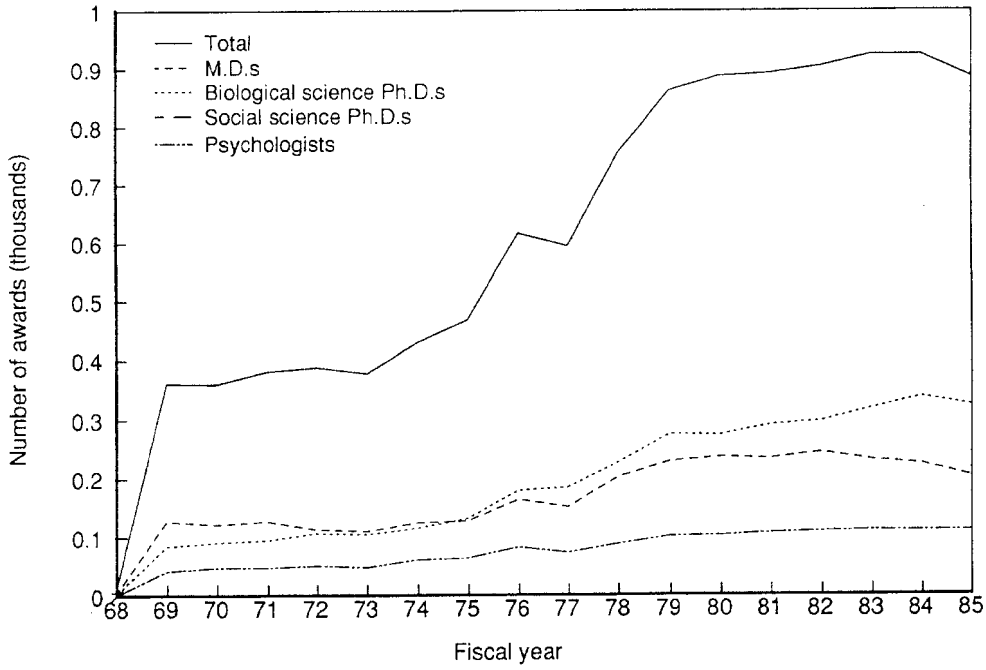

Fig. C.10--R01 awards by NEI by fiscal year

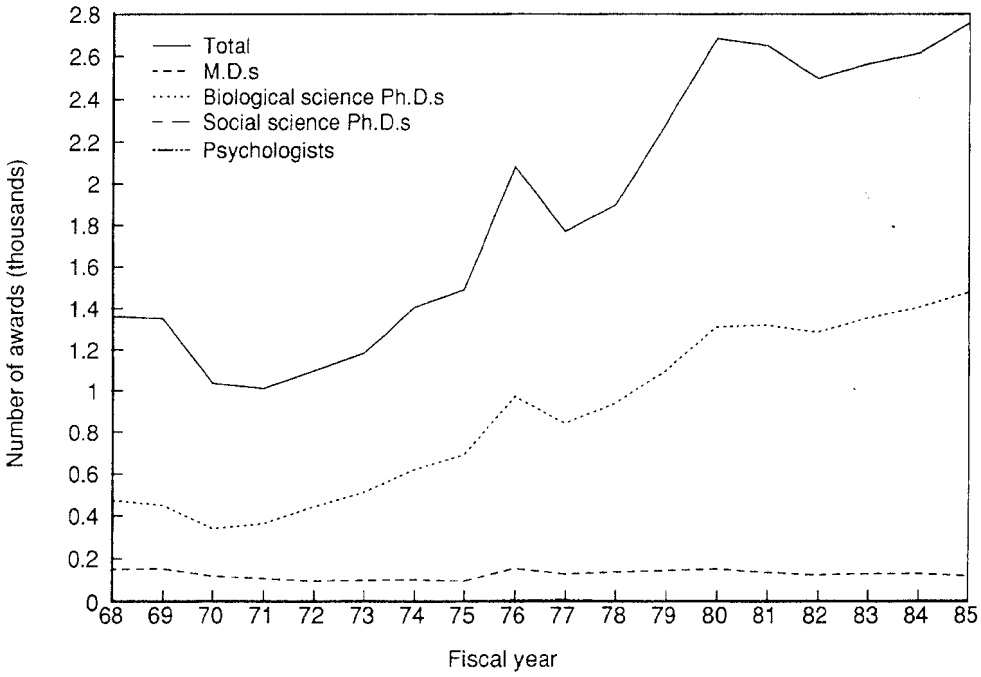

Fig. C.11--R01 awards by NIGMS by fiscal year

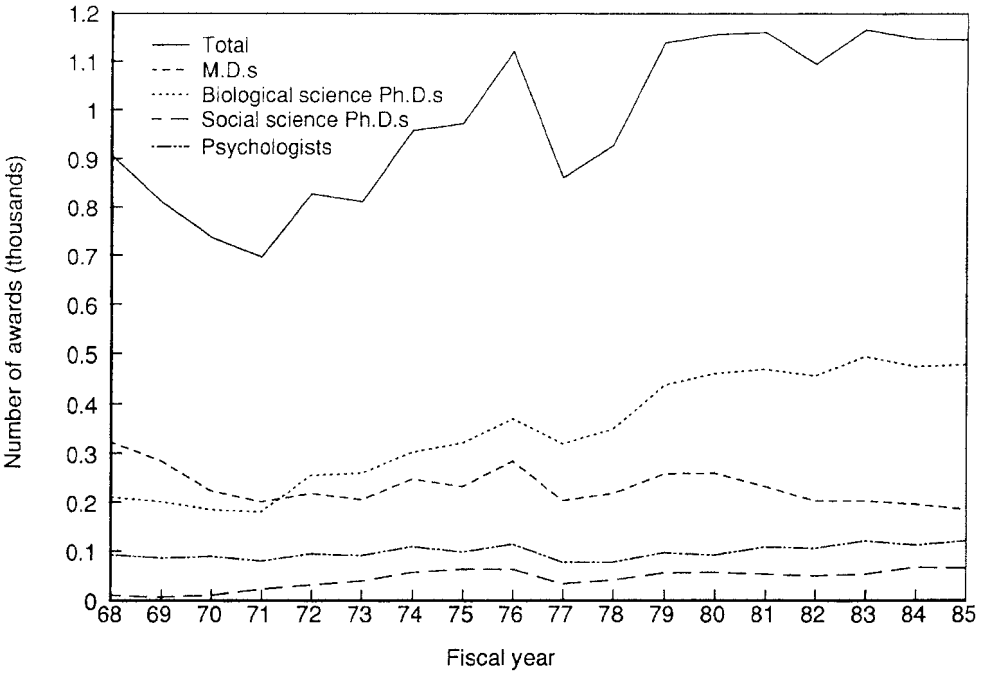

Fig. C.12--R01 awards by NICHD by fiscal year

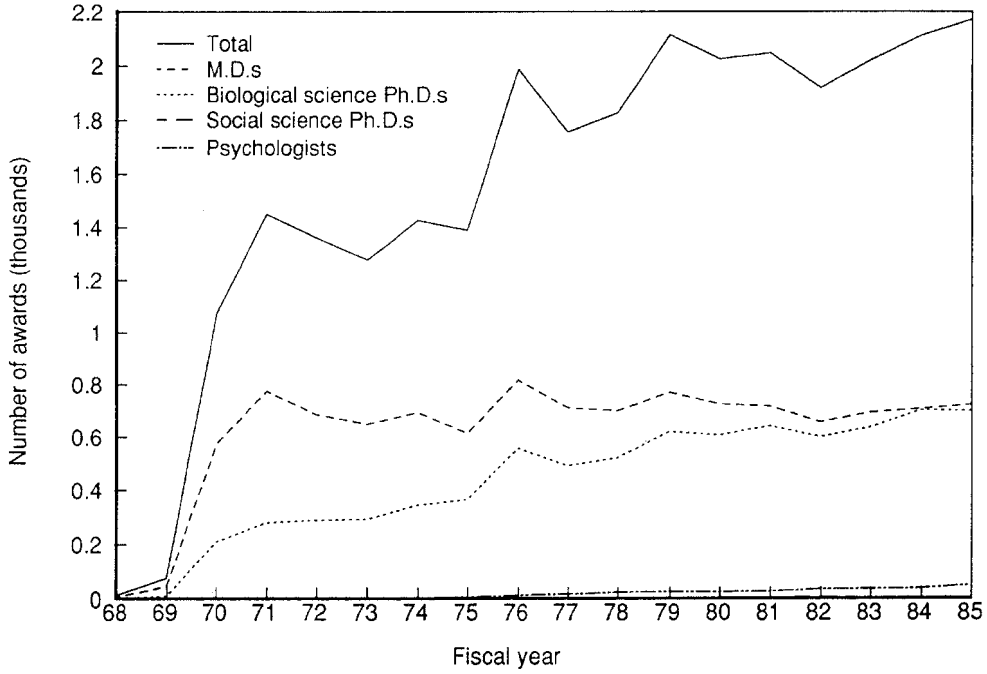

Fig. C.13--R01 awards by NHLBI by fiscal year

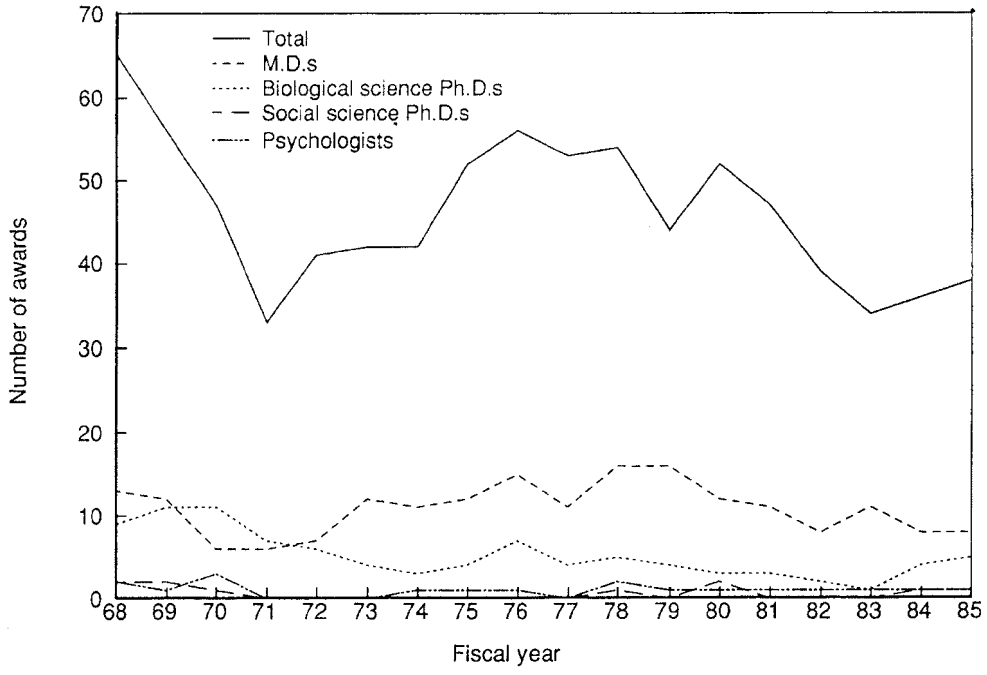

Fig. C.14--R01 awards by NLM by fiscal year

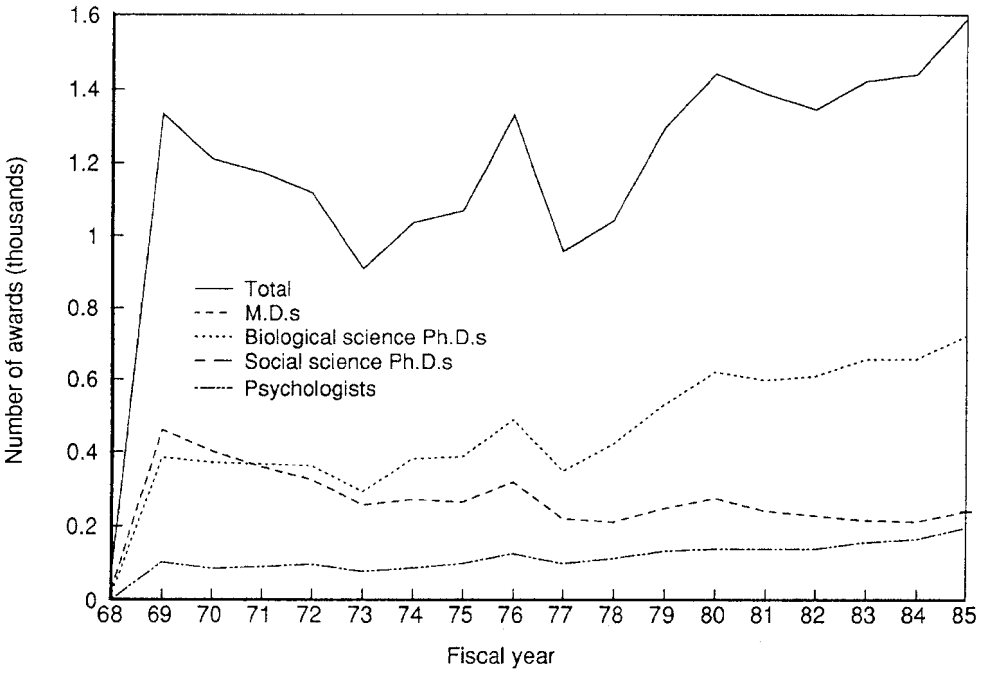

Fig. C.15--R01 awards by NINCDS by fiscal year

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