Collaborative Research in Genetics

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INTRODUCTION

Due to institutionalization and professionalization of science, almost every scientist of today, in contrast to the scientist of the past, works to a lesser or a greater degree in collaboration with other scientific workers. Collaboration in research is said to have taken place "When two or more scientists work together on a scientific problem or project and contribute their effort—physical and intellectual". It can apparently be measured adequately from multiple authorship of papers. There has been much debate over the extent to which the multiple authorship of papers reflects collaboration in research. Nevertheless, it has been considered as an unobtrusive indicator of collaboration in research. Meadows, Gorden and Subramanyam have reviewed the earlier studies in this area. Most of these studies either refer to the world science literature as a whole, or specifically to the literature produced in a country, or on a particular subject. It has been found from the earlier studies that collaboration in research varies from discipline to discipline, and for the same discipline from time to time and from one country to another. It has also been found to be influenced by a number of factors such as funding, use of large scale equipment, etc. The purpose of the present study is to determine the collaborative research in genetics as a whole and in different research fronts, specifically to see the variation among the different research fronts.

METHODOLOGY AND SAMPLE

Collection of data on collaborative research is a difficult problem. The basic reason is that the extent of collaboration cannot be easily determined by traditional methods of survey and observation. The

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bibliometric method offers a convenient and non-reactive tool for studying collaboration in research. Hence this method has been followed in the present study. Authorship data in the different research fronts of genetics were collected from Genetics Abstracts, 1970, 1975, 1980 and 1985. Based on the data, the authorship pattern, average number of authors per paper and the degree of collaboration in genetics and in different research fronts were determined and analysed.

Hypotheses

The following are the hypotheses of the study:

Null hypothesis I. There is no significant difference between pairs of research fronts as far as the proportions of single- and multi-author papers in genetics.

Null hypothesis II. There is no significant difference between the proportions of single and multi-author papers in the majority of research fronts of genetics as a function of time.

Results and Discussion

Two-author papers outnumber single-author papers as well as papers with three, four and more authors and the proportions have changed over the years in favour of multiple authorship. Slightly less than 80% of papers in genetics were multi-author ones, while the single-author papers accounted for 21·36%. The proportion of single- and two-author papers has decreased over the years in favour of papers with three and more authors. The percentage of single-author papers has decreased approximately by half, and two-author papers from 36·72% in 1970 to 28·76% in 1985. On the other hand, the percentage of papers with three or more authors has increased over the years, from 70·8% to 84·31%. This provides an indirect clue to the increase in the size of the research teams over the years: it ranged from two to 14. There is also a significant difference between proportions of single- and multi-author papers over the years ($\chi^2$ 749·78) in the field of genetics as a whole. The average number of authors per paper has increased from 2·3 in 1970 to 3·13 in 1985, with an average over the period of 2·7 authors per paper. The corresponding figures for the degree of collaboration has increased from 0·70 to 0·84. On the whole, nearly 79% of the papers in genetics were the result of collaborative efforts of scientists. Thus, a higher degree of collaboration was found in genetics.

The proportion of single-authored papers was a maximum in four research fronts, two-author papers in 14 research fronts and three-
authored papers in one research front. Thus, two-authored papers were a maximum in 14 out of 19 research fronts. More than 20% of papers had three authors in 10 research fronts. Slightly more than a quarter of papers were by four and more authors in six research fronts. The highest proportion (80%>) of multi-author papers was found in nine research fronts and it ranged between 70% to 79-9% in three, 60% to 69-9% in three, 50% to 69-9% in one and less than 50%, and more than 40% in three research fronts. Hence, the proportion of multi-author papers varies considerably from one research front to another and so also the average number of authors per paper and the degree of collaboration (Table 2), indicating the fact that the collaboration in research varies within the discipline/subject from one research front to another. The average number of authors and the degree of collaboration was found to be high in immunogenetics (3-42/0-90) and low in evolutionary genetics (1-62/0-40).

The data were subjected to a $\chi^2$ test for null hypothesis I stated above. Nineteen research fronts considered in the study gave rise to altogether 171 combinations. The calculated values of $\chi^2$ are compared with the table of $\chi^2$ distribution for one degree of freedom at the 0-05 and 0-01 levels. The $\chi^2$ values fell within the significance level at 0-05 (3-81) and 0-01 (6-635) levels respectively in 22 and 28 pairs. The $\chi^2$ values are found to be much greater than $\chi^2$ at the 0-05 level in 149 pairs and at 0-01 level in 143 pairs. Therefore, the null hypothesis I was rejected. Hence, there is a significant difference between pairs of research fronts as far as the proportions of single and multi-author papers in genetics is concerned and because the calculated values of $\chi^2$ are so large, the difference must be highly significant. This clearly indicates that collaboration in research varies from one research front to another.

The data were also subjected to a $\chi^2$ test for null hypothesis II. The calculated $\chi^2$ values for each research front are compared with the table of $\chi^2$ distribution for three degrees of freedom at the 0-05 level. The $\chi^2$ values fell within the significance level at 0-05 (i.e., 7-815) in four research fronts, while in the remaining 15 research fronts the values were found to be much greater than $\chi^2$ at the 0-05 level. Therefore, null hypothesis II was rejected. Hence, it was concluded that there is a significant difference between the proportions of single- and multi-author papers in the majority of the research fronts (15 out of 19) over a period of time.

**Summary and Conclusions**

In summary, the following are the major findings of the study. Slightly less than 80% of papers in genetics were by multiple authors. Two-
author papers outnumber single-author papers as well as papers with three or more authors and the proportions have changed over the years in favour of multiple authorship. The average number of papers has increased from 2.3 to 3.13 and so also the degree of collaboration from 0.70 to 0.84. The two-author papers were a maximum in 14 research fronts. The highest proportion of multi-author papers (80%) were found in nine research fronts and ranged between 70 to 79.9% in three, 60 to 69.9% in three and less than 50% and more than 40% in three research fronts. The average number of authors per paper and the degree of collaboration was found to be high in immunogenetics and low in evolutionary genetics. There is a significant difference between pairs of research fronts as far as the proportions of single- and multi-author papers in genetics is concerned as indicated by the χ² test. There is also a significant difference between the proportions of single- and multi-author papers in the majority of research fronts as a function of time. This clearly indicates that collaboration in research varies from one research front to another and is also found to vary in the majority of research fronts of genetics as a function of time. The findings of the study have some implications in research planning and policy making and also in planning of more effective information services to accelerate research activities in genetics.