

Motivations of physicists

The interpretations of the history of science and analyses of the sociology of scientists depend crucially on an assessment of the motivations of scientists. It is not easy to generate hard information on such motivations. There are several conceivable ways of conducting a study of them, but none are free of methodological objections.

The purpose of this note is to present the results of a survey carried out to gather information on the motivations of physicists. The method used in the survey is a rather straightforward one and its virtues and shortcomings are likely to be evident.

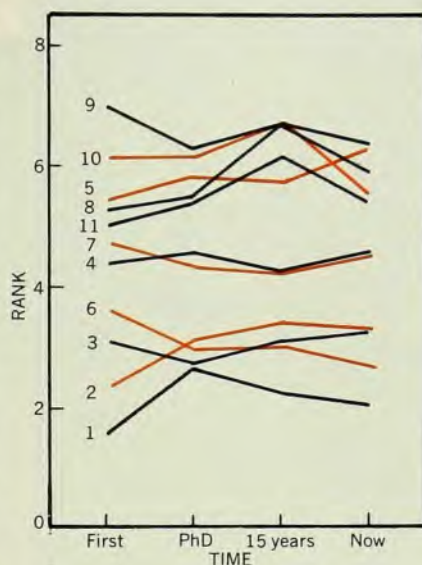
The survey consisted of a letter and ballot sent to 100 physicists, all working within the United States. Their specialities were in experimental or theoretical nuclear or particle physics. No selection by age or other criteria was made, except that virtually all of the addressees were personally known to me. I believe this played an important role in producing a rate of return unusually high for a survey: 61 responses were obtained on the strength of the original letter and one brief reminder note.

The original letter explained the arrangements for anonymity; 13 respondents did not use the opportunity for anonymity.

Instructions on the ballot stated: "Please indicate your motivations to do science by writing '1' for the strongest motivation, '2' for the next strongest, and so on. If a stated motivation does not apply to you at all, write '0.' If a column does not apply to you, leave it blank. Feel free to write in additional items for motivations if they play a significant role in your case."

Below these instructions there were 14 rows and four columns. The columns were headed "When you decided to become a physicist," "When you received your PhD," "15 years later," and "Now." The 14 rows had the following headings:

1. Personal esthetic satisfaction derived from learning about nature.
2. Release of innate curiosity.
3. Urge to convert your talent into achievements.
4. Urge to be the first ever to discover something (i.e. striving for priority.)
5. Urge to compete.
6. Personal satisfaction obtained from



Average ranks of the eleven motivations at various points in the scientific career. The ranks are averaged over all questionnaires in which that motivation is classified with numbers between 1 and 11. The numbers next to the curves correspond to those in the list of motivations shown in the text.

making a discovery (regardless of priority).

7. Peer recognition.
8. Social prestige in society as a whole.
9. Opportunity to have influence.
10. Financial advantage.
11. Service to humanity.

Rows 12, 13, and 14 had no headings, and were intended for "write-in's. Ten of the returned questionnaires elaborated on the categories or commented on the response. Eight of the questionnaires expressed doubts or problems that arose in responding to the survey. The texts of these comments and doubts are available from me on request.

The results of the survey are shown in the figure. The average ranks of the eleven motivations are plotted against the four column entries. The rank is averaged over all questionnaires in which that motivation is classified with numbers between 1 and 11.

For a given motivation, the average rank does not depend very strongly on time. In particular, no motivation changes by more than 1.5 units. Motivations 2, 5 and 8 increase their average with time, while 6 and 9 decrease theirs.

On the whole, however, rankings do not change much.

In terms of importance, there appear to be at least two rather distinct groups. Motivations 1, 2, 3 and 6 appear to be considerably more important than the others. Among the latter, perhaps 4 and 7 form another group by themselves, but the distinction here is not so clear. The same features can be observed in the data if one replaces the abscissa of the figure by the number of "0"s marked against a certain motivation, summed over all four columns of all questionnaires.

The result can be summarized by stating that the *internal* motivations (satisfaction from learning, release of curiosity, conversion of talent, and satisfaction from discovery) play a considerably more important role than the *external* motivations (priority, peer recognition, competition, prestige, influence, finances, or social service).

As a result of the weak dependence on time observed, the relative importance of various motivations hardly changes at all with time. The relatively somewhat decreased role of esthetic satisfaction at the time of obtaining the PhD might be due to a temporary satiation with work. Indeed, this motivation reoccupies its lead at later times.

Finally, the survey appears to indicate the motivation of scientists in doing scientific work is a rather complex superposition of many different components. This would suggest that models that assume one single dominant motivation predestining the history of science or the sociological structure of the scientific community are likely to be grossly in error.

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Lights in the sky

Harley Rutledge's letter "Light Flashes in the Sky" in the September issue (page 11) suffers from deficiencies often found in reports of UFO sightings. It is frustrating that no mention is made of the criteria used to estimate the quoted distance and altitude limits. While these criteria are pedagogically useful in estimating linear sizes, one is left to conclude that they are merely guesses. This is indeed unfortunate for Rutledge.