SOME STATISTICS ON WOMEN IN ASTRONOMY

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ABSTRACT

The number of women in astronomy has doubled in the last decade, a rate of increase three times that of men. Among young astronomers, approximately one in three is a woman. Analysis of the responses to a survey of the AAS membership show that women are, in general, being integrated equitably into the astronomical community. Women publish research papers as often as men and work in the same types of institutions. The influx of young women into astronomy biases the job statistics, but when similar age groups are compared, the same percentage of women and men are being hired into permanent jobs.

1. INTRODUCTION

For many years, the AAS did not collect any information about the demographics of its membership. Then in 1972, the AAS established the Committee on the Status of Women in Astronomy. One of their first efforts was to survey the women in the Society to collect information about their numbers, the types of jobs they held and their status in the profession. Another survey was made in 1980. While providing the impetus for the AAS to adopt a stronger stance in support of non-discrimination, these surveys did not cover a general sample of the membership.

2. AAS MEMBERSHIP SURVEY

In 1990, the American Astronomical Society conducted the first major survey of its members. A number of the questions dealt with the demographics of the membership. The response rate was a respectable 42 percent, sufficient that it was not deemed necessary to send followup requests.

In order to assess the validity of the responses, two independent checks were made. The first was to see if women were more likely to have responded to the survey, possibly biasing the results. In this respect, the responding sample is representative of the Society as a whole. The percentage of women replying to the survey was identical to the percentage of women in the Society as a whole as determined from the AAS membership files.

As a second independent check, we totaled the number of meeting attenders during the past four years from survey responses and projected the meeting sizes to be expected from the membership as a whole. The estimated attendance is very close to the actual recorded attendance at meetings. Since there are very few non-members attending the AAS meetings, we conclude that the sample is not noticeably biased toward the more active members. Given the 42 percent return rate and the confirmation provided by these two independent estimates, we believe that the results of the AAS survey are reliable indicators of the state of the whole AAS membership.
3. SURVEY RESULTS

The AAS is a relatively young Society overall, with a median age of 42. Figure 1 shows the age distribution of AAS members and also gives the percentage of women in the Society as a function of age. Cumulatively, under age 30, 28 percent of the AAS members are female while over age 40, only eight percent are female. This represents a sharp increase in the percentage of women entering astronomy during the last decade. Between 1980 and 1990, the number of women in the AAS more than doubled, going from 320 to 690, while the overall membership rose by 40 percent. There is no tendency for women to preferentially leave astronomy. Among those former members who have left the Society, approximately 10 percent are women. The present age distribution represents a true growth in the number of women astronomers in the U.S.

Figure 1. The age distribution of the AAS Membership as inferred from the responses to the AAS Membership survey binned in five year intervals is shown by the solid line. For each bin, the percent of female astronomers is shown as a dashed line.

4. ANALYSIS BY GENDER

In the AAS survey, a number of questions were asked about where astronomers work, how many papers they publish, what level of job they hold and what the expected stability of their support is. When analyzed by gender, the replies to these questions indicate that women and men within a given age group are virtually indistinguishable from each other. In making comparisons between men and women, it is critically important to compare the same age groups. With the age distributions for men and women differing so markedly, comparing men and women across the total AAS membership can yield very misleading results.
4.1. Type of Job and Place of Work

In comparing the type of job, e.g., faculty, research, administrative, etc., women and men populate the mix of jobs in numbers which are proportional to the male-female ratio for their respective age groups. With one exception, there is no significant deviation in where men and women work and the type of job they hold. As shown in Figure 2, there is a slightly higher percentage of women working in academic jobs with correspondingly fewer women working in government, federally funded research institutions and industry.

Figure 2. The distribution of the type of employer at which male and female AAS members work shows only small differences.

The AAS survey broke down the academic institutions into three types: Ph.D granting University, four-year college and two-year college. There was no statistically significant trend for women to be working in the less research-oriented institutions. If anything, there is a small bias for the positions in two-year colleges to be held by men, but the difference is only marginally significant.

In analyzing the type of job and place of work, we found no significant age-dependent trends. Therefore, we have combined the results for all ages in order to get a more accurate picture.

4.2. Productivity

In trying to assess the relative productivity of AAS members, we asked how many papers each respondent submitted to various journals. A quick check shows the results to be relatively independent of age, and again, the results from all ages have been combined. Figure 3 shows the number of papers submitted to the Astrophysical Journal and the Astronomical Journal by men and women. There is virtually no difference in the productivity of men and women.
Figure 3. In terms of papers submitted to refereed journals, male and female astronomers are equally productive. The data represent the total membership because they show no significant trend with age.

4.3. Stability of Funding

The AAS Membership survey included a question about the stability of funding. Each person was asked to classify their funding as being in one of three classes. Guaranteed funding was defined as the equivalent of tenure or permanent job. Soft funding was covered temporary jobs, dependent on grants or other funding. The third category was stable funding which is not guaranteed, but is backed by an institutional or industrial commitment with good prospects for continued support.

The responses about the stability of funding are strongly dependent upon age and the results for different age groups cannot be combined. Therefore, in analyzing the answers to this question, we have combined the responses into five year age bins. Unfortunately some bins will have very few people, particularly at ages above 50 where the AAS has relatively few female members. However, at ages below 50 the responses are both significant and interesting.

Figure 4 shows for each 5-year age group the percent of members who classify themselves as being on soft funding. Given the small numbers and the corresponding uncertainties, there is no significant difference between the percentage of men and the percentage of women who are on soft funding. As might be expected, younger astronomers start out on soft money and shift over to more stable funding arrangements as they get older. The rate at which this happens is, within the uncertainties, identical for both men and women.
Figure 4. Male and female astronomers holding jobs based on soft money are plotted as a function of age. There is no statistically significant difference between men and women.

Figure 5 shows the same information for respondents on stable funding. Here, the data are striking. Up through age 45, equal percentages of men and women are receiving tenure, or equivalent. The evidence indicates that the system, as a whole, is treating men and women equally in moving young astronomers into permanent jobs.

Figure 5. Same as Fig. 4 for jobs with guaranteed funding. Below age 45 men and women within each age group have found permanent jobs in proportion to the number of astronomers of each gender within that age group.
5. CONCLUSIONS

In summary, the data from the AAS membership survey show that the number of women in the AAS is growing and that after they get their degree, they become an integral part of the astronomical community, virtually indistinguishable from their male colleagues in productivity, place of work and type of job. Two points are particularly important: 1. The pool of young astronomers is about one-third women. To be equitable when hiring young astronomers, employers should, on the average, end up with one out of three being a woman. 2. In the last decade or so, the permanent jobs in astronomy have gone to women in numbers which reflect the available pool of astronomers. The challenge in the next decade will be to see that such equitable treatment continues.

ENDNOTES

1 A. Cowley, R. Humphries, B. Lynds and V. Rubin, BAAS, 6, 412, 1974
2 M. Liller, A. Cowley, P. Hodge, F. Kerr and N. Morrison, BAAS, 12, 624, 1980