

Report on the CfA Gender Survey

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1. Introduction

In early 2004, the CfA Gender Equity Committee conducted an electronic survey of CfA employees. Major results of the survey were presented on May 25, 2004, in a talk by Gerhard Sonnert to the CfA community. The following is a more exhaustive report on the survey.

In addition to this report, the website contains the following documents relating to the survey:

- a copy of the questionnaire
- a spreadsheet containing detailed data
- a text file titled "Notes on the Spreadsheet Data," explaining the spreadsheet format and summarizing the findings for the individual questions
- the PowerPoint presentation of May 25 (slides of that presentation will be referenced in this report).

2. Data and Methods

We received 308 responses, which corresponded to a response rate of 32.4%. Of the participants, 60% were men, and 40% were women. For other basic characteristics of the sample, see **Slide 5**.

2.1. Representativity

A major issue in survey research is the degree to which the collected sample is representative of the population from which it was drawn. For instance, if a particular type of CfA employee was much more likely than other types of employees to participate in the survey, there would be a response bias in the resulting sample, and the findings from the sample would not necessarily be representative of the whole population of CfA employees.

To examine whether our sample was subject to a response bias, we compared some basic characteristics of the sample respondents with figures that were available from the administration for the whole population of CfA employees (**population** figures are **bold** in the following tables).

- Division/Department of affiliation (q0) (Slide 6)

q0	Sample Frequency	Sample Percent	Population Percent
ADM	3	1.04	0.85
AMP	12	4.17	5.18
AST	3	1.04	2.01
CE	12	4.17	7.40
CF	7	2.43	3.38
CGPM	2	0.69	0.95
DO	2	0.69	0.63
HEA	121	42.01	32.56
HR	4	1.39	1.06
LIB	4	1.39	0.74
MS	2	0.69	0.53
OIR	33	11.46	11.73
RG	37	12.85	13.00
SED	14	4.86	6.13
SP	5	1.74	1.37
SSP	19	6.60	6.66
TA	4	1.39	3.59
TR	4	1.39	0.53
FM	-----		1.69
N	288		946
	Frequency Missing = 20		

- Job category of first CfA position (q1)

q1	Sample Frequency	Sample Percent	Population Percent (N=955)
Administrative	52	16.99	17.17
Engineering	20	6.54	8.38
Science Educator	12	3.92	4.08
Scientist	154	50.33	43.56
Technical	68	22.22	26.81

Frequency Missing = 2

- Job category by gender

q1	Women Sample Percent	Women Population Percent	Men Sample Percent	Men Population Percent
Administrative	39.50	39.10	2.26	6.49
Engineering	0.84	2.56	10.17	11.39
Science Educator	5.88	5.77	2.82	3.32
Scientist	30.25	27.88	64.41	51.42
Technical	23.53	24.68	20.34	27.37
N	119	312	177	632

- Gender

In the sample, we have 40.2% women, in the CfA population, there are only 33.1% women.

Overall, our sample is a very good representation of the whole population of CfA employees, in terms of divisional affiliation, job category, and gender. With the exception of a slight overrepresentation of women and of scientists, no response biases were evident.

2.2. Areas covered

The questionnaire went through an extensive developmental phase, in which it was revised several times. It was also pilot-tested. The final instrument was fairly extensive and covered numerous substantive areas (listed on **Slide 7**). The primary focus of the questionnaire was on gender issues at CfA, but the instrument was so comprehensive that it generated a wealth of material much of which is likely to be useful for addressing issues other than gender.

2.3. Item types

The questionnaire contained three major types of items: yes/no questions; rating scales; open-ended questions. Results to the yes/no-type of questions were straightforwardly reported as percentages. The most widely used rating scale was a four-point scale: "disagree strongly" (1)—"disagree somewhat" (2)—"agree somewhat" (3)—"agree strongly" (4), by which the participants could indicate to what extent they agreed or disagreed with a given statement in the questionnaire (**Slide 9**). Strictly speaking, this scale is ordinal, but we converted it to an interval scale by associating the numbers 1 through 4 with the responses, as indicated. This allowed us to use a single number (the mean) to characterize the findings.¹ When interpreting results from the rating scales, one should keep in mind that a mean of 2.5 indicates that the group in question is evenly split between agreement and disagreement. Numbers above 2.5 indicate that agreement prevailed, and numbers below 2.5 indicate that disagreement exceeded agreement on the item in question.

¹ Another way of dealing with a rating scale of this type is to collapse it into a dichotomy of "agree" and "disagree." In this case, the proportion of those who agreed would be the obvious measure for summarizing the empirically found distribution of results. We compared the dichotomous approach to the continuous approach by picking a sample of questions and regressing the continuous ("means") variable on the dichotomous ("proportion") variable. We found that both approaches were highly correlated in a linear manner ($R^2 = .9902$).

The typical standard deviation on the rating scales was around 1. In terms of effect sizes, thus, one should note that most of the reported differences were small (typically smaller than one standard deviation).²

In addition to looking for significant gender differences, analyses of variance (ANOVA) were carried out for four groups (men non-scientists, women non-scientists, men scientists, women scientists). This was done because we recognized that many gender differences went away once one controlled for employment are (science vs. non-science). Each of the four groups was large enough for statistical analyses. More elaborate schemes, which involve the introduction of additional variables, could of course be envisaged, but they appeared inadvisable, because some particular cell sizes would become very small.

Differences were reported at the 0.05 significance level (corresponding to a 95% confidence level or 2 •) and at the 0.01 significance level (corresponding to a 99% confidence level or 2.5 •)

The yes/no and rating-scale questions were complemented by open-ended questions in which the participants could write comments in their own words. Many of these answers provide valuable input also on gender-unrelated issues.

2.4. Trends by duration of service

To discern if the duration of an employee's service at CfA made any difference on the items on which gender differences were found, the year of hire was regressed on the employees' responses. Linear³ time trends exceeding significance levels are noted in this report.

2.5. Factor analysis

A suitable statistical method for reducing the number of variables is factor analysis. This method makes it possible to identify communalities that underlie a group of items. Factor analyses were carried out for the first few substantive areas (see Spreadsheet and Notes on Spreadsheet Data), but were then abandoned. The problem was that missing values drastically reduced the cases that were available for factor analysis. The reported results were generated by using a "multiple imputation" method: Several different complete datasets were created by probabilistically filling in the missing values, and the results were then averaged over the datasets. We decided, however, that the insights gained from the factors did not warrant the methodological exertion.

² Relatively small differences are reported as statistically significant because the standard error (which is used for determining the statistical significance of differences) is the standard deviation divided by the square root of n.

³ We also experimented with quadratic time trends, but settled on a linear approach.

3. Results

3.1. Gender vs. employment area

Differences found between scientists and non-scientists were far more frequent than differences found between men and women (**Slide 10**). Both when assuming a 95% confidence level and when assuming the more stringent 99% level, differences between scientists and non-scientists were about twice as numerous as those between men and women. A small percentage of significant interactions was also found.⁴

3.2. Substantive areas without gender differences

Of the 11 broad substantive areas covered in the questionnaire, 4 did not show any significant gender differences at the 99% level: hiring process, compensation, satisfaction with CfA, and CfA programs and resources (**Slide 12**).

3.3. Perceived gender biases

Gender differences manifested themselves most starkly in the area titled "Perceived Gender Biases." On each of the six items asked, there was a gender difference, which persisted after controlling for scientist/non-scientist status (**Slide 13**). Women agreed less strongly than men did with the statements that staff were treated without regard to gender in terms of work assignments, performance evaluation, and career advancement. The lowest level of agreement pertained to the item about career advancement at CfA. Women scientists consistently were the group with the bleakest view of gender equity.

In all groups, participants consistently rated the situation in their own Division/Department as more equitable than at CfA in general. This pattern persisted when making a distinction between those working within the high-energy astrophysics division (HEA)—the by far largest division—and those outside of it.⁵

Time trends were found for two items pertaining to the area of perceived gender biases. Longer-serving women scientists were less likely than newer hires to agree with the statement "In regard to work assignments, I have observed that staff are treated without regard to gender (Division/Department)," and with the

⁴ The interaction concept is illustrated in **Slide 11**. Among the scientists in this fictitious example, the men agree strongly and the women disagree strongly with an item. The opposite pattern, however, exists found among the non-scientists, where the women agree strongly and the men disagree strongly.

⁵ A gender interaction was found on the item stating that there was no CfA-wide gender bias in performance evaluation. Outside of HEA, men showed a much stronger belief in gender equity than the women did. Inside HEA, the women exhibited a slightly stronger belief in gender equity than their male counterparts did.

analogous statement referring to CfA in general. The first trend was significant at the 95% level, the second, at the 99% level.

In addition to the area of perceived gender biases, perception varied by gender on a few items in the areas of leadership, promotion, balance of work and personal life, hidden rules, and equipment maintenance.

3.4. Leadership

Women agreed less strongly than men with the statement that one's division/department has identified to move women into leadership positions was weaker than the men's agreement (**Slide 16**). Longer-serving male scientists agreed with this statement more strongly than their shorter-serving cohorts did. Fewer women than men reported that they had received a formal opportunity to take on a leadership position at CfA,⁶ and fewer women than men expressed an interest in becoming a project scientist, program manager, or technical team leader (**Slide 17**). The women scientists also appeared even more focused on research—rather than administration, management, or other activities--than did their male counterparts. Compared with the male scientists, the female scientists reported that they spent a higher percentage of work doing research (and both women and men scientists said, on average, that they desired to spend an additional 10% of their work time on research) (**Slide 18**).

3.5. Promotion

Fewer women than men felt supported in their advancement to promotion, and the women's overall satisfaction with the promotion process was lower than the men's (**Slide 19**). On both these items, the shorter-serving women non-scientists had a more negative perception than did the longer-serving women non-scientists. An analogous trend was found among men scientists in regard to their overall satisfaction with the promotion process. In their open-ended comments, several participants called for more opportunities of advancement, and for clear and objective criteria for promotion.

3.6. Work and personal life

Women scientists most strongly felt that they often forwent personal activities because of work, whereas women non-scientists disagreed with that item most strongly (**Slide 21**). Women, and especially women scientists, reported a relatively high collective level of fatigue, and, correspondingly a relatively low level of well-restedness (**Slide 22**).

3.7. Hidden rules

⁶ Again, longer-serving male scientists agreed with the statement that they had received leadership opportunities more strongly than their shorter-serving cohorts did.

Women were more likely than men to report that they encountered unwritten rules concerning how one is expected to interact with colleagues (**Slide 23**), but one should add that even among the women the agreement with this statement was outweighed by disagreement.⁷ Open-ended comments urged that policies, procedures, and decisions should become more transparent. A related theme that emerged from the open-ended questions was that a higher level of communication was desired within the CfA community in general. Several participants said they would like to be better informed about what everyone was doing at CfA. The assignment of mentors to new hires was also recommended by a few survey respondents. A concrete suggestion was to implement some kind of a reward system for mentoring, in hopes that this would boost the interest in becoming a mentor.

3.8. Equipment maintenance

Women as a group agreed more strongly than men did with the statement that they received regular maintenance or updates of equipment (**Slide 26**).

3.9. Satisfaction

Overall, the CfA employees displayed a high level of job satisfaction (**Slide 27**). In comparison, the satisfaction with one's career was somewhat lower, though still at a high level (**Slide 28**). On the latter item, the non-scientists, and especially the women non-scientists, showed slightly elevated levels of dissatisfaction (but those differences do not quite reach significance level).

We also examined whether the duration of the employment at CfA was connected with reported job satisfaction and career satisfaction in our four groups (men scientists, men non-scientists, women scientists, women non-scientists). For job satisfaction, a negative linear time trend was found for men scientists. It was small but significant at the 99% level, indicating that the more recent hires tended to report a slightly lower level of satisfaction. As to career satisfaction, small negative trends (at the 95% level) were found for all groups, except for women scientists. In those three groups, the longer-serving employees tended to report higher levels of satisfaction. For the women scientists, however, the estimated trend parameter was positive (indicating lower satisfaction levels among longer serving employees), but this trend was not significantly different from zero.

To find out what drives the perception of job satisfaction, we compiled lists, one for each of our four groups, of the 10 questionnaire items that correlated most strongly with job satisfaction (**Slide 29**). (The correlations found ranged from .83

⁷ Recently hired male scientists were more likely than their longer-serving counterparts to agree with the statement that they encountered unwritten rules.

to .46.) The lists for the four groups are generally similar. Employees who feel treated with respect and who are satisfied with the promotional process tend to report high job satisfaction. Contentment with one's salary and one's overall compensation influenced job satisfaction more strongly in men than in women. By contrast, beliefs in gender equity were more powerful predictors of job satisfaction for women than for men.

Responses to open-ended questions on this issue afforded another view of the sources of satisfaction and dissatisfaction among CfA employees. In terms of satisfaction, three main themes could be identified: an enthusiasm for the scientific activities at CfA, appreciation of specific aspects of one's job or career, and happiness with the general atmosphere at CfA. Feelings of dissatisfaction were kindled by what participants considered burdensome and inefficient bureaucratic processes, by the level of compensation being perceived as too low, by specific aspects of one's job or career being considered inadequate, and by the belief that CfA paid insufficient attention to gender and family issues.

3.10. Other issues of concern and improvement

Because the survey was very comprehensive, it generated interesting and potentially useful material also about issues not directly connected to gender.

3.10.1. Structural

From the open-ended responses, it became clear that some friction exists around structural characteristics of CfA. First, the compound nature of CfA itself, having a Harvard and a Smithsonian part (which in turn has federal and trust employees) was a source of complaints. Second, some responses recorded certain misgivings between the groups of scientists and non-scientists (who in turn include the distinct groups of administrators and engineers). Third, the administrative processes, especially hiring and purchasing, were often criticized for being too bureaucratic and for having to follow federal policies that do not fit CfA well. Fourth, numerous participants wrote about space—both about the problems created by the geographical fragmentation of CfA into several sites, and about the general dearth of office and laboratory space, which makes the fair allocation of that space a hotly contested issue.

3.10.2. Decision-making

Some participants felt that they were being left out of the decision-making process and desired to have more input into decision-making. A concrete suggestion in this area was to that a wider range of employees should be involved in CfA committees.

3.10.3. Supervisors/leadership

Some participants suggested that management training be given to new supervisors. It was observed that employees are promoted to leadership

positions typically because of the excellence of their research or their other work, and that those newly promoted supervisors cannot be expected to possess the management skills necessary for their position. Another suggestion was to let employees evaluate their supervisors.

3.11. Gender/family

In conclusion, we return to the prime focus on gender. Some of the open-ended responses addressed gender issues, complaining about gender discrimination, and desiring more hiring of women, especially at the highest levels. As to family issues, participants suggested flexible and at-home work schedules and on-site child-care as possible ways to alleviate work-family tensions.

4. Next Steps

Wendy Roth is going to conduct a confidential and anonymous interview study, in which 60 randomly selected CfA employees will participate (15 interviewees each in the four groups [men non-scientists, women non-scientists, men scientists, women scientists]). Furthermore, there will be a survey and analysis of Human Resource data.