STATUS
A REPORT ON WOMEN IN ASTRONOMY

AAS
JANUARY 2011

Women and the Imposter Syndrome in Astronomy

Rachel Ivie and Arnell Ephraim
Statistical Research Center, American Institute of Physics

It's likely that at one time or another, almost anyone who has been to graduate school may have experienced what some psychological researchers call the "imposter syndrome." The imposter syndrome has been defined as the belief that you don't really belong in your chosen field or occupation. This can happen when we doubt ourselves and wonder if we made the right choice to come to graduate school, take a postdoc, or work at a particular university or research institute.

The imposter syndrome was first used by psychologists Pauline Clance and Suzanne Imes in 1978 to describe highly successful women who nevertheless had difficulty internally recognizing their own achievements and continued to feel as though they were imposters in their careers. Since that time, further research has demonstrated that men can also exhibit characteristics of the imposter syndrome. In further describing the imposter syndrome, Langford and Clance (1993) wrote that the syndrome is defined by "believing that one's accomplishments came about not through genuine ability, but as a result of having been lucky, having worked harder than others, and having manipulated other people's impressions." One key aspect of the imposter syndrome is the attribution of your own success to factors beyond your control, such as luck, while attributing the success of others to skill or knowledge. But it is not just external factors to which those with the imposter syndrome attribute their successes. People with the imposter syndrome can also discount their successes by attributing them to hard work, while believing that others sail through based on natural talent. Another version of the imposter syndrome is to feel that you have in some way, probably not consciously, tricked or fooled your colleagues into believing that you are much smarter than you really are. Perhaps you studied really hard and made a high score, but secretly you "know" that these achievements don't reflect your true "inadequate" self.

The issue of the imposter syndrome was interesting to the working group charged with surveying astronomy graduate students as part of a longitudinal study. The working group hypothesized that the imposter syndrome would exist for astronomy graduate students and might even explain why some people eventually drop out of astronomy. Would the imposter syndrome manifest itself more strongly in women, thus contributing to a higher drop-out rate among women than men? The working group set out to answer these questions and others.

continued on next page

Women and the Imposter Syndrome in Astronomy *continued*

Background of the longitudinal study

In 2003, the Pasadena conference on Women in Astronomy adopted a resolution (later adopted by the AAS Council) which expressed their interest in conducting a longitudinal study of women in astronomy using sound statistical methods. In response to this recommendation, the Committee for the Status of Women in Astronomy convened a working group to design a study to track graduate students in astronomy over several years. The working group members were Patricia Knezek, Audra Baleisis, Susana Deustua, Stefanie Wachter, Jennifer Neakrase and Rachel Ivie.

The longitudinal study was designed to:

- collect data on people who obtain graduate degrees in astronomy,
- compare attrition rates, starting in graduate school, for men and women,
- collect data on people who leave the field of astronomy, and
- collect data on astronomers who work outside the traditional employment sectors of academe and the observatories.

The first survey in the study:

- examines whether or not the "imposter syndrome" exists among astronomy graduate students.
- was funded by the AAS Council and the American Institute of Physics (AIP). The AIP Statistical Research Center (SRC) collected the data.
- can't be used to draw conclusions on employment outcomes or attrition because we have only collected data at one point in time.

How we collected the data

The target group for this study was U.S. astronomy and astrophysics graduate students during the 2006-2007 academic year. To survey these students, the SRC gathered contact information from the following: (1) the AAS junior membership list; (2) lists of graduate students supplied to the SRC by physics and astronomy departments; and (3) announcements in the AAS newsletter that invited students to contact the SRC if they wanted to participate in the study. The final contact list included 2,056 names.

The questionnaire was available on paper and on a secure website hosted by AIP. Initially, all students were contacted electronically. The SRC sent a notice describing the study, an invitation to complete the questionnaire on a secure website, follow-up email requests to complete the survey, and a special email to the students who started the survey on the web but did not complete it. Paper versions of the questionnaire were mailed to contacts who had not responded after four months of contacting them electronically.

Survey Questions

The questionnaire asks for demographic information and includes questions about variables thought to influence attrition, including perception of mentorship, feelings of isolation, the imposter syndrome, and self-perception about potential to develop into good researchers or teachers. Because of space constraints, only results explaining the imposter syndrome are presented in this article.

Demographic Variables

Demographic variables include questions about sex, year of birth, number of years in program, part-time v. full-time student classification, citizenship status, source of graduate school funding, educational goals, and parents' education. Details about some of the measures used in the multivariate analysis include:

- Number of years in program was measured by asking the students the month and year they entered the program they attended during 2006-07, and calculating the number of years between entry and academic year 2006-07.
- Citizenship status was measured by asking students to classify themselves into three categories: US citizen, permanent US resident, or temporary visa. US citizens and permanent residents were combined for this analysis, following the system used by the NSF.
- Source of graduate student funding was measured by asking respondents to indicate their primary source of graduate study support during 2006-07. There were nine choices given. The three most common answers were teaching assistantship (21%), research assistantship (57%) and fellowship (16%). The remaining responses were combined into "other funding" for this analysis and include: family, savings, loans, tuition reimbursement from outside employment, students' income from outside employment, foreign government support, and military assistance. The analysis compares research assistants, people who have fellowships, and people who had other funding to teaching assistants.

Mentoring

Mentoring was measured by a simple yes/no question: "Did you feel you were mentored in the astronomy or astrophysics graduate program that you attended during the 2006-2007 academic year?" 72% reported that they felt mentored. This question doesn't allow us to determine what the source of mentoring was for the student. Mentoring could have been received from a faculty member, from another student, or from some other person. We will follow-up on mentoring in the second survey to find out more about the respondents' mentoring experiences.

continued on next page

Women and the Imposter Syndrome in Astronomy *continued*

Imposter Syndrome Measures

Questions from the Clance Imposter Scale (1988) and Harvey Imposter Scale (1981) were used to measure the imposter syndrome but were modified for use with astronomy students. Using a five-point scale (strongly agree to strongly disagree), students were asked to rate the level to which they agreed with the statements below. The tendency to agree with items one through four below is indicative of the imposter syndrome. The tendency to disagree with items five through seven below also is indicative of the imposter syndrome.

1. In general, people tend to believe I am more competent than I really am.
2. Sometimes, I am afraid others will discover how much knowledge or ability I lack.
3. At times, I feel I am in my current career position though some kind of mistake.
4. When I succeed, it is because I work much harder than others.
5. The major cause of success in my life is my high ability.
6. I feel highly confident that I will succeed in my future career.
7. I am at least as smart as my peers.

For this analysis, "strongly agree" and "agree" responses were combined to indicate agreement, and the other responses (neither agree nor disagree, disagree, and strongly disagree) were combined for those who did not agree.

Hypotheses and Methodology

The hypotheses that we tested include:

- The imposter syndrome would be more likely to occur among women than among men. Women are under-represented in astronomy, so we thought that this could contribute to a feeling of not belonging in the field.
- Feeling mentored in graduate school will decrease the likelihood of the imposter syndrome.
- The longer a student stays in graduate school, the less likely they are to experience the imposter syndrome (Although the results related to this finding are not discussed in this article due to space limitations, it is worth noting that this hypothesis was not confirmed).
- Students who have traditional types of funding (research assistantships, teaching assistantships, and fellowships) are less likely to experience the imposter syndrome than those who rely mostly on less traditional funding (family, savings, loans, tuition reimbursement from outside employment, students' income from outside employment, foreign government support, and military assistance).
- Citizenship will make a difference in the imposter syndrome, but we were not sure in which direction.
- Full-time students will be less likely to feel like imposters than part-time students.

We were mostly concerned with discovering sex differences in the imposter syndrome, if they exist. But we knew that what appears to be a sex difference could really be the effect of some other variable, so we included potentially important independent variables in multivariate logit models. If sex differences in these models were shown, we would know that the differences exist independently of the effects of other independent variables. In all, we ran seven different logit models. In each model, one of the seven imposter syndrome measures was the dependent variable, and the independent variables were: sex, feeling mentored, length of time in graduate school, source of funding, citizenship, and full-time status. Each dependent variable had two categories: "agree" and "do not agree."

Results

Due to space constraints, only the effects of mentorship and sex on the imposter syndrome will be discussed in this article. Other results will be published at http://www.aip.org/statistics or are available from the authors.

Responses

We received 1,576 responses to the survey. Of that number, 1,348 respondents identified themselves as graduate students in astronomy or astrophysics. Of these, 1,143 identified themselves as male or female and were therefore included in the analysis.

Demographics

Approximately 40 percent of the respondents identified themselves as women. Most of the respondents' parents have college degrees. The majority of the respondents were U.S. citizens. Twenty-three percent of the respondents reported having temporary student visas.

Table 1. Demographics

Variable Description	Frequency
Female	39%
Mothers have college degrees	64%
Fathers have college degrees	71%
U.S. Citizen	77%
Planning to obtain a PhD	91%
Full-Time status	97%
Median Age	27 years
Median Length of Time in Program	3 years
# Analyzable responses	**1,143**

Mentoring Matters

Feelings of mentorship are linked to positive outcomes for both men and women. Students who reported feeling mentored appear to be less likely than others to exhibit characteristics of the imposter syndrome. Mentored students were more likely than others to report that the major cause of success in their life was due to high ability and that they are at least as smart as their peers. Students who reported feeling mentored were also less likely to report that they felt they were in their current career position through some kind of mistake (Table 2).

Women are more likely than men to show characteristics associated with the imposter syndrome. For example, women were more likely than men to say that they were afraid others would discover how much knowledge or ability they lack. Women were also less likely to attribute their success to high ability and less likely to report feeling confident in their ability to succeed in their future careers (Table 2). Furthermore, women may be more likely than men to report feeling that they had to work much harder than others to succeed (Table 2, $0.05<p<0.10$). The statistical results from Table 2 are summarized on Table 3.

A note about statistical significance levels: On Table 2, results that are considered statistically significant are denoted as either $p<.01$ or $p<.05$. This refers to the probability that the results would have occurred by chance alone. If $p<.01$, the results would have occurred by chance alone less than 1% of the time, and for $p<.05$, the results would have occurred by chance less than 5% of the time.

Conclusion

Our hypothesis that women astronomy graduate students would be more likely than men to feel like imposters was confirmed. Women in graduate school in astronomy or astrophysics do tend to feel more like imposters than men, at least on three of our measures of the imposter syndrome and probably on a fourth. We also found that if students, both male and female, are mentored, they are less likely to feel like imposters in astronomy. Mentoring is often cited as a mechanism for improving retention of students in science, but mentoring has not often been linked in research to outcomes such as graduation rates and employment (George and Neale, 2006). George and Neale also write that "more . . . mentoring studies that follow cohorts of students or scientists

Table 2. Logit Analysis Odds Ratios for Imposter Syndrome Variables[1]

Independent Variables	Dependent Variables						
	People believe I am more competent than I really am.	Others discover I lack ability or know-ledge.	Succeed in my future career.	In my current career by mistake.	The major cause of success in my life is my high ability.	I work much harder than others.	I believe I am at least as smart as my peers.
Feeling mentored	0.86	0.81	1.68**	.50**	1.18	.88	1.34*
# of years in program	0.99	1.04	0.83**	1.06	0.95	1.0	0.97
Not full-time student	1.21	1.20	2.03	0.67	0.77	1.75	1.16
Research Assistantship[2]	1.08	1.02	1.03	1.24	1.08	1.03	1.21
Fellowship[2]	0.86	0.89	1.01	1.26	1.04	1.27	1.14
Other financial support[2,3]	0.40*	0.52*	2.18*	0.61	1.13	0.78	2.44*
Temporary visa	0.83	0.38**	0.65**	0.89	1.08	1.59**	1.49*
Sex: female	0.92	1.60**	0.64**	1.16	0.76*	1.27	0.83

**p<.01

*p<.05

[1]A result <1 indicates that the respondents who fall into the defined group are less likely to agree with the statement than their counterparts, while a result >1 indicates that they are more likely to agree with the statement.

[2]Teaching Assistantship is the comparison group.

[3]Other financial support includes family, savings, loans, tuition reimbursement from outside employment, students' income from outside employment, foreign government support, and military assistance. Teaching assistantship is the comparison group.

continued on next page

Women and the Imposter Syndrome in Astronomy *continued*

and engineers are needed." We plan to continue our focus on mentoring in the follow-up surveys of this cohort of astronomy graduate students. Although we now know that mentoring reduces the imposter syndrome among these students, we still don't know if mentoring will decrease attrition out of astronomy for them or whether the imposter syndrome itself will predict the likelihood of leaving astronomy. We also plan to do further research on whether the effects of mentoring are different for women than they are for men. Our hope is that this longitudinal study will advance our understanding of what helps to keep women and men in astronomy and that this knowledge will be used to implement effective programs that allow access to careers in astronomy for all talented students.

Table 3. Interpretation of Imposter Syndrome Measures for Women

Imposter Syndrome Measure	Women generally	Response Indicates ...
Sometimes, I am afraid others will discover how much knowledge or ability I lack.**	Agree	Imposter syndrome
The major cause of success in my life is my high ability.*	Disagree	Imposter syndrome
I feel highly confident that I will succeed in my future career.**	Disagree	Imposter syndrome

$^{*}p<.05$
$^{**}p<.01$

References

Clance, Pauline Rose, and Suzanne A. Imes. "The Imposter Phenomenon in High-Achieving Women: Dynamics and Therapeutic Intervention." *Psychotherapy: Theory, Research and Practice*, 1978: 241-247.

Clance, Pauline Rose, and Maureen Ann O'Toole. "The Imposter Phenomenon: An Internal Barrier to Empowerment and Achievement." *Women and Therapy*, 1988: 51-64.

George, Yolanda, and David Neale. *Report from Study Group Meetings to Develop a Research and Action Agenda on STEM Career and Workforce Mentoring.* American Association for the Advancement of Science, 2006. http://ehrweb.aaas.org/sciMentoring/MentoringReport.pdf (accessed 3/31/2010).

Harvey, Joan C. *The Impostor Phenomenon and Achievement: A Failure to Internalize Success.* Dissertation. PA: Temple University, 1981.

Langford, Jo, and Pauline Rose Clance. "The Imposter Phenomenon: Recent Research Findings Regarding Dynamics, Personality and Family Patterns and their Implications for Treatment." *Psychotherapy*, 1993: 495-501.