

# Science Networks by Field: Who Seeks Advice and Support from Women?

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**Abstract:** Supporting and advancing women's science careers continues to be of interest to researchers, scientists, science funders and universities. Similarly, collaboration strategies and social networks are important to understanding the advancement of scientific careers. This research aims to marry these two lines of research, women in science and collaboration and network strategies, to investigate and compare the ways in which men and women scientists seek advice and support from women in their networks. Specifically, we use a sample of women and men in electrical engineering, computer science, physics, chemistry, earth and atmospheric sciences, and biology to assess (1) the extent to which female and male scientists seek advice from women colleagues and (2) the extent to which female and male scientists receive support from women in their networks. The results point to important differences in women's and men's advice and support networks across fields of science.

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## **Science Networks by Field: Who Seeks Advice and Support from Women?**

### **Introduction**

For over forty years now, researchers have sought to understand why there are so few women in science and what explains the lack of women in science, technology, engineering, and mathematics. Theories abound as to why women are represented in lower numbers in the sciences, as compared to the general work force. From the 2005 statements of Lawrence Summers, then President of Harvard University, that there are innate biological differences between men and women which may explain why fewer women succeed in academic science and math careers to research on the ways in which the structure of science careers are not conducive to women who wish to balance work and family (Browne 2004), there is much debate on the reasons for the dearth of women in science and how to attract and retain women in these careers.

In addition to, and sometimes as a result of this research, the federal government, advisors to the government, universities, and professional associations have made numerous efforts to nurture and support women scientists. For example, the NSF-funded ADVANCE Institutional Transformation Program aims to “develop systemic approaches to increase the representation and advancement of women in academic science, technology, engineering and mathematics (STEM) careers, thereby contributing to the development of a more diverse science and engineering workforce” (NSF 2009). Similarly, the NIH Office of the Director has mandated that the Office of Research on Women’s Health, develop “opportunities and programs to support recruitment, retention, re-entry, and advancement of girls and women in biomedical careers (PL 103-43, Section 486e)” (NIH 2009). Meanwhile, the National Research Council has a standing committee, the Committee on Women in Science and Engineering, which aims to address issues of women in academic science and engineering. Professional associations work to connect women members to federal programs supporting women scientists, connect women scientists to one another, and create a venue for discussing and addressing work and life issues particular to women scientists. And universities have created programs to support and advance women undergraduates, graduate students, postdoctoral researchers, and faculty. In summary, there is an abundance of research and practical efforts aiming to develop a gender balance in STEM fields and improve the status of women scientists.

Researchers and policymakers have long sought to improve the ranks of women in science – increasing the number of female students pursuing the study of math and science from high school through graduate school. Researchers know that the dearth of women in science is related to career choice, socialization systems, barriers to family and work balance, and an education system that may disadvantage and discourage women students who are interested in science. While important efforts have been made to attract and retain women studying in STEM fields, the challenge remains in retaining women PhDs in academic science careers. Again, government agencies, researchers, and science associations have developed programs, networks, and support mechanisms to increase the pipeline of women trained to take on academic faculty positions. Efforts to increase the number of women in the pipeline and repair or prevent leaks in the pipeline are important mechanisms for nurturing women scientists. However, researchers are becoming increasingly aware that the pipeline repairs are necessary, but not sufficient (Kulis et al. 2002). Instead, women need better networks and supports throughout the pipeline to ensure that they are equally prepared to succeed as scientists.

This research takes a first step and understanding the presence of women in science networks. More specifically, we investigate the presence of women in men and women scientists' advice and support networks. This research asks the following research questions: Do men and women scientists differently report the presence of women in their advice and support networks? And if so, what are some of the determinants of having women in one's advice and support network? For example, is the presence of women in advice and support networks related to field and a critical mass of women in that field? Is the presence of women in a scientist's advice and support network related to the scientist's gender, age, or some other demographic characteristic, such as citizenship, race, or marital status? This research is important because rather than focusing solely on the advice and support networks of women scientists, we use a sample of both men and women scientists in six fields to investigate the prevalence of women in those networks.

This research aims to investigate the pattern of women and men's networks in science, in particular the ways in which scientists in different fields seek advice and support from women scientists. This research uses data from a national survey of scientists (NETWISE) to understand the prevalence of women in science advice

networks. We begin with a discussion of the literature on women in science. From this literature we develop hypotheses about the structure of men and women scientists' professional and collegial networks to seek advice and support.

### **Networks in Science**

In academic science, advice and support networks are critical to the training of undergraduate students, graduate students, postdoctoral research, and faculty. Professional networks are formed in the early stages of science careers in cohorts of students. For example, lab partners, study groups, and students preparing for qualifying exams often rely on one another to learn, reinforce knowledge, and pick up the skills and training needed to succeed. Role models, in the form of advisers and mentors, guide student scientists through an apprenticeship that involved both training and socialization. Social and professional networks in science are critical for the transmission of information, the exchange of ideas and resources, the validation of research, and the encouragement critical to success.

Once a student earns the PhD, networks remain important for job placement and advancement. Etzkowitz and colleagues (2000) describe the science network as a 'Kula Ring' where informal organizing and information sharing ensures that leaders of the groups transmit information to new comers and the community by distributing resources, information, and power. Scientists exchange ideas, resources, information, and support and reinforce one another's work in these formal and informal communities. Thus, social networks and connections within the community are critical to the structure and advancement of science careers (Tierney & Benison 1996; Tierney & Rhoads 1993). Because networks and socialization are critical to the training and professional development of scientists, they become even more important for women scientists who are in the minority in most fields of science. In fact, some researchers (Sonnert & Holton 1996) note that one important reason why women face barriers in science is that women may be socialized with general orientations and attitudes that reduce their professional success as compared to men. Researchers of women in science argue that less visible social cues, negative interactions, and lack of access to important networks create structural impediments to women's careers and accumulate over the course of women's

careers (Merton 1973; Settle et al 2007; Zuckerman 1989) resulting in frustration and withdrawal.

The structure of networks in science communities can result in professional advancement and the transmission of tacit knowledge (Epstein 1970) or the isolation of a scientist (Emmett 1992). Research overwhelmingly points to the importance of formal and informal networks for both men and women scientists, and is hypothesized to be an important link to the advancement of women in science – beyond simply growing the pipeline of women scientists. While it is important to increase the number of women pursuing science training in high school, undergraduate, and graduate programs (Curtin et al. 1997; National Academies of Science 2003; Seymour 1995), and the placement of women scientists in academic departments, integrating women into science networks, at all levels, will undoubtedly improve the ways in which women scientists persist. Etzkowitz and colleagues (2000) argue that differences in scientists’ social networks influence their career success by shaping their level of social capital” (pg. 116).

### **Women’s Networks in Science**

*“My science is different because of my socialization, not because of my gender”*

(Etzkowitz et al. 2000, pg 92)

There is growing evidence that one of the most important barriers to women in science is a work structure and socialization system that presents women with two choices: (1) pursue the “male” model of science or (2) drop out of the academic track. Research suggests that socialization barriers server to isolate women scientists and lower their support, confidence, perseverance, aspirations, and success. If we accept that networks and support are critical to the success of modern scientists, this isolation can put women at a severe deficit compared to their male peers (Kemelgor & Etzkowitz 2001).

Women scientists often report being “more isolated” in their training and careers, with a lack of direction and professional contacts to advance their careers. Even more important, these feelings of isolation can become more intense as women scientists move through their careers, into departments, labs, and senior ranks where women make up even smaller proportions of the community. Isolation of scientists can result in significant barriers to discovery and ultimately the withdrawal of a scientist from academic research (Kemelgor & Etzkowitz 2001; Merton 1968; Lin et al 1981). Isolated scientists can be

less motivated and have lower aspirations than their peers, which can affect their work outcomes (Fox-Keller 1985; Horning 1993).

Many researchers argue that men are regularly given access to information networks (both formal and informal), while women struggle to break into these networks. Etzkowitz and colleagues (2000) note that access points to informal networks can occur at multiple times in a scientist's career, as a student, on the job market, as a junior faculty member and in a variety of venues, in the classroom, in the lab, at social gatherings, or at conferences. Etzkowitz and colleagues (2000) argue that on average women scientists consistently lack access to informal networks leaving them at a severe disadvantage as compared to their male peers. Informal networks can be particularly important in academic science careers as individual scientists negotiate salaries, build strategies to advance their careers, and navigate the academic career system.

Etzkowitz and colleagues (2000) argue that women who make it to earn a PhD in the sciences and a position in a top research department report less dense and fewer connections to the academic system. Specifically, they find that “[w]omen’s networks tend to be poorer in social capital than those of their male peers” (Etzkowitz 2000, pg 171). Thus, earning a degree is not the same as developing the social and professional networks needed to successfully pursue an academic science career.

While some research finds that men in positions of power actively or unintentionally harm the careers of women scientists (Sonnert & Holton 1996), Etzkowitz and colleagues (2000) note that women scientists regularly note that their fathers played an important role in encouraging their career aspirations (pg. 32) and PhD students often credit both women as role models and men as being critically sensitive to gender issues in the workplace. Importantly, Etzkowitz and colleagues (2000) reinforce that through formal and informal networks both men and women are able to mentor and guide women scientists. The gender of the mentor or adviser is less important than that person's understanding of the experiences of women scientists and the potential barriers facing these women. “Thus, women and men faculty do not, simply by virtue of their gender, automatically make good or poor mentors for female students” (Etzkowitz et al. 2000, pg. 81), rather senior men and women are able to assist women scientists in navigating these male-centric work environments or reinforce the cultural and professional barriers

thwarting women in science. In summary, men and women both can play influential roles in shaping the contacts, networks, and support that women scientists require to advance and succeed at the same rate as their male colleagues.

We recognize that both male and female colleagues can play an important role in advancing the careers of women scientists. Rather than investigate the structure of women's networks and men's networks as a way of determining if women and men are connected to the "right people", we are interested in understanding how well women have penetrated the networks of all scientists (male and female). Thus, we investigate the presence of women in advice and support networks. Given the historic underrepresentation of women in science, the continued treatment of women scientists as "token" members of some departments, and efforts to support and better connect women to other women scientists, we expect that women scientists as compared to men scientists will report having a higher number of women in their advice and support networks.

Hypothesis 1: The presence of women in scientists' advice and support networks will vary by gender.

Hypothesis 2: Women scientists will be more likely than men scientists to report seeking advice and support from women colleagues.

While we expect that women will be present in men and women scientists' networks at different rates, we also expect that scientists will call on women colleagues for different types of advice. Because women remain a minority in most STEM fields, we expect that the ways in which women are present in advice and support networks will vary according to the type of advice sought. First, women may seek out the advice of other women when faced with a gender specific issue. Likewise male scientists may seek out a woman scientist for advice related to issues she is familiar with or which he perceives as being more important to women – for example advice about family and life balance. For example, we would expect that a young scientist with children and a gender balanced family life (shared household duties with the spouse) will be more likely to see advice about work / family balance from a woman scientist. Of course, scientists seeking to balance work and family life are not necessarily women scientists. Recent work proposes that young men scientists are also shifting toward more balanced ideas of work

and family and taking on larger responsibilities in the household (Etzkowitz et al. 2000). Just as scientists may turn to women scientists for advice on work and family balance, we expect that scientists are less likely to turn to women scientists for advice on publishing and grant getting. While it is certainly not true that men are better at getting grants and publishing than women, it is true that for most scientists, the successful prolific scientists in the department are more likely to be male – simply because men make up a larger proportion of scientists in the field and an even larger proportion of senior scientist in the field. For example, in their assessment of women in science, Handelsman and colleagues (2005) find that although women are earning PhDs at higher rates the proportion of women in senior faculty positions at top universities remain small. The authors report that women make up a mere 6% of full professors in top physical science departments, 4.56% in mathematics, and less than 4% of the full professorships in electrical, civil, and mechanical engineering departments (Handelsman et al. 2005, pg. 1190). Because of the traditional male dominance in these fields, we expect that the senior, influential, potential advice givers on topics of publishing and grant getting in most scientists' lives will be men. Thus, we expect that women and men scientists will turn to male colleagues for advice and support related to competing and advancing in the field and will turn to women for advice and support with regards to balancing family and work life.

Hypothesis 3: Women and men scientists will seek different types of advice from women in their advice networks.

Hypothesis 4: Women and men scientists will seek different types of support from females in their support networks.

### **Field of Science**

Any study aimed at understanding the presence of women in scientists' advice and support networks must account for the role of field of science. Although women are the minority in most science fields, the size of that minority is important to understanding the progress women have already made in the field, the amount of support they have from one another, and their ability to make up a critical mass to address issues particular to their group. Additionally, the number of women in the field will help to explain the likelihood that men and women scientists will report having women in their advice and

support networks. Clearly, scientists working in a field with few women scientists will be less likely to have women in the network, as compared to those in a field with a high number of women scientists, such as biology (Long & Zakian 1994). For example, Sonnert and Holton (1996) report that there are significant differences across fields when investigating women's academic rank achievement. Specifically, they report that women have passed a threshold of rank achievement in biology, where men and women do not report statistically different career progress, but large disparities between men and women continue in the physical sciences, mathematics, and engineering, where women, on average, are one full rank below men in these fields (Sonnert & Holton 1996).

Researchers have tried to understand the ways in which the presence of women in an academic department or science field may exacerbate or help to alleviate the barriers to women's careers. Research indicates that women suffer when they represent a stark minority, and that small increases in the size of that minority can have large outcomes for women. Kanter (1977) proposes a model in which small minorities, less than 15%, face extensive discrimination, isolation, and tokenism. Because women represent small minorities in some fields, they are more likely to be viewed as "token" members of the group or anomalies rather than a set of individuals that can make demands on the majority. In the case of scientists, the "token" female in the department may be expected to serve on more than an average number of committees, mentor a higher proportion of students, in particular female students, and take on roles that are not conducive to competing with the men in the department and the field. When minority scientists are viewed as "tokens" they run the risk of taking on responsibilities that overburden already disadvantaged scientists.

In contrast to token roles, Kanter (1977) argues that require a "critical minority" of at least 15%. When a minority makes up 15% or more of the group, they constitute a group large enough to organize and work with the majority or take up cases to advance their interests with larger minorities (e.g. 35%) tilting power to their advantage. Researchers argue that when a minority group achieves "critical mass" the group is better situated to protect minority interests and legitimize different ways of doing science (Oliver & Marwell 1988; Kanter 1977). Similarly, researchers note that the more women

that enter the program or field, the more likely they are to increase their share of resources and achievement levels (Gutek 1985; Konrad 1986; Thoits 1985).

Still, some evidence points to an inverse relationship between women's minority size and academic success, noting that a larger proportion of women does not necessarily alter negative treatment of women or the negative perceptions of gender-attributes and science (Settles et al. 2007; Toren & Kraus 1987). It remains possible that as women increase their representation in a field or a department they create a separate class of researchers that rely on one another, but remain isolated from the majority population of male scientists (South et al. 1992). Thus a critical mass of women in a department or field can possibly result in positive effects on women's experiences in science, but can also result in women being divided by rank, subfield, lab, or research group where their feelings of isolation and separateness are exacerbated (Kanter 1977).

In their interviews, Etzkowitz and colleagues (2000) find that when the proportion of women in a department increase, the fragmentation of women into separate labs or research units can result in continued isolation for women scientists (page 105, and 111). Thus, fields that have seen an increase in the presence of women (e.g. biomedical sciences) may see divisions between research fields and generation that perpetuate women's inability to sufficiently access formal and informal networks. Specifically, in their interviews Etzkowitz and colleagues (2000) find that fragmentation is most prevalent in chemistry departments (pg. 111). They conclude that although growth in the proportion of women in fields is important for creating an environment of support and power for women, it is not a sufficient tool for improving women's access to professional, social, formal, and informal networks. Thus, there is "support and safety in numbers" (Etzkowitz 2000, pg 111), but that support and safety without integration can result in the continued isolation of women scientists (Kemelgor & Etzkowitz 2001).

Thus, we propose that field of science will remain important to understanding the presence of women in the advice and support networks of both men and women scientists. Since women make up a larger proportion of biological fields – biology and also the biological subfields of chemistry, engineering, mathematics, and physics – we expect that their presence will increase the likelihood that both male and female scientists will report having women in their advice and support networks. Likewise, with women

making up a mere 16% of those earning doctorates in physics in 2006 (SED 2006) and in 2002 women held 11.11%, 9.41%, and 5.24%, respectively, of assistant, associate, and full professors in the top 50 physics departments (Handelsman et al. 2005), we expect that women will make up a small to negligible proportion of networks of men and women physicists.

Hypothesis 5: Scientists' patterns for advice seeking and support from women colleagues will significantly vary by field.

## **Data and Models**

This research uses data from the National Science Foundation funded study “Women in Science and Engineering: Network Access, Participation, and Career Outcomes” (NETWISE<sup>1</sup> 2006), an NSF-funded study of women and men’s access to collaborative and professional networks and career outcomes. We begin with a description of the NETWISE data. Next, we discuss the patterns of women’s networks in six fields of sciences: chemistry, physics, computer science, electrical engineering, biology, and earth and atmospheric sciences. Third, we use the NETWISE data to test the hypotheses about variation in women’s advice and support networks. We conclude with a discussion of the results.

We test the hypotheses using the NETWISE data, which are from a national survey of scientists and engineers at 151 Carnegie-designated Research I universities (as identified in 2005) from six disciplines: chemistry, physics, computer science, electrical engineering, biology, and earth and atmospheric sciences. The survey collected data on the social and collaborative networks, perceptions, work environment, and work history of scientists and engineers. A random sample of 3,677, stratified by gender, rank and discipline was drawn from the population of approximately 25,000 scientists and engineers at in the six disciplines at Research I universities.

The survey was administered online and closed in early 2007. Overall, 1,628 surveys were returned for a response rate of 46%.<sup>2</sup>

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<sup>1</sup> “Women in Science and Engineering: Network Access, Participation, and Career Outcomes,” (NETWISE 2006) a project funded by the National Science Foundation (Grant # REC-0529642) (Co-PI’s Dr. Julia Melkers and Dr. Eric Welch).

<sup>2</sup> For the calculation of the response rate 155 individuals in the original sample were removed because of bad addresses.

We use two types of data from this research: (1) the respondents (egos) data, which contain detailed personal information about the respondent, and (2) the respondents network data (the alters), which contain information about the different members of the respondents network. The latter includes demographic information about the alters and information about the type of interactions between alters and respondents, as reported by the respondents.

For this analysis, from the Ego data we removed 104 who did not report information about their networks, and 27 emeritus and research scientists. This resulted in the deletion of 131 respondents, for a total sample of 1497. The Egos reported information on a total of 12,727 alters in their respective networks. We removed 140 alters because the ego did not report the alter's gender. Finally, we aggregated the remaining network information for the 12,587 alters, by respondent, to create measures of the presence of women in science networks.

*Network Data.* The NETWISE survey asked each respondent to provide information about their professional, advice, support, and mentoring networks. The respondent was asked to identify up to five of the closest research collaborators at your university (Collaboration includes proposal generation, working on a research project, writing/presenting an academic paper/book or book chapter, or developing industrial products or patents), up to five of the closest research collaborators outside of your institution, up to five individuals you regularly talk with about research, up to five individuals from whom you seek advice about your career or professional development, and up to five individuals with whom you regularly talk about important university or department related issues, and one primary mentor. These questions resulted in a set of up to 26 names generated for each respondent's professional network (see original question wording in table 1).

[Table 1 about here]

After the respondent provided 26 names of people in her network, those 26 names were then inputted into a series of questions about the network. For example, the respondent (ego) was asked the gender of each person in her network (alter), whether the alter works in the same university as the ego, and how long she has known the alter. Rather than analyze the nature of each individual ego-alter relationship, this study uses

the ego as the unit of analysis and aims to assess the general patterns of ego networks with regards to women seeking advice and support from women. Thus, we collapse many of the alter measures to note the overall distribution of women in the ego’s network. We include a number of independent variables about the ego’s networks. For example, the variable, *Women in Network*, indicates the proportion of the ego’s network that is comprised of women – calculated as the sum of women in the network divided by the total number of individuals in the network.

*Dependent Variables.* The hypotheses are tested using 11 dependent variables, which are derived from 8 survey items that asked respondents about their advice and support networks. Rather than treat each individual name in the respondent’s network as a data point, we focus on the overall gender composition of each respondent’s network. All dependent variables are proportions calculated as the number of women in the respondent’s network as a proportion of the total advice or support network. For example, the first dependent variable **Women in Network**, is the number of women in the respondent’s network divided by the total number of individuals reported in the network.

The five dependent variables for seeking advice for **Publishing, Grant Getting, Overall Career Development, Collegial Interactions, and Work/family Balance** are derived from the following NETWISE survey item:

Q. What advice do you typically seek from the following individuals? (Check all that apply)

Advice about:	Publishing	Grant getting	Overall career development strategies	Interactions with colleagues	Work/family balance
Name 1					
Name 2					
Name 3					

The NETWISE survey then inputted all of the names that the respondent generated earlier in the Network Generating Question Items. Thus, we can calculate the number of people in the network from which the respondent seeks publishing advice, and the proportion of those individuals that are women.

From responses to these items we summed the total number of alters for which each ego sought each type of advice. We then calculated the total number of women from which advice was sought. We then calculated the proportion of women from which the

respondent reported seeking each type of advice. For example, **Publishing Advice** is the number of women alters from which the ego seeks publishing advice, divided by the total number of alters from which the ego seeks publishing advice. The variable, **Publishing Advice**, indicates the proportion of the respondent’s publishing advice network that is female. **Grant Advice**, is the number of women alters from which the ego seeks grant advice divided by the total number of alters from which the ego seeks grant advice. **Career Advice** is the proportion of the ego’s career development advice network that is female. **Colleague Advice** is the proportion of women within the network of alters from which the ego seeks advice about interactions with colleagues. **Work/Family Advice**, is the proportion of women in the total network of individuals from which the respondent seeks advice about work/family balance. Finally, we include a variable that is the sum of the aforementioned advice network variables. **Total Advice** is the proportion of the ego’s advice network that is women.

The three dependent variables for seeking support are Review Papers, Introductions, and Nominations. The support variables are derived from the following NETWISE survey item:

*Q. Colleagues often support each other in aspects of career development. Please indicate if the people you named have: (Check all that apply)*

Advice about:	Reviewed your papers or proposals prior to submission (on which they were not a co-author)	Introduced you to potential collaborators outside of your university	Nominated you for an award or as an invited speaker
Name 1			
Name 2			
Name 3			

First, we summed the total number of alters that have supported each ego through reviewing, introductions, and nominations. We then calculated the proportion of support that came from women alters, resulting in three variables for the proportion of women providing support to the ego: **Review** (Total Female Review / Total Review); **Introduce** (Total Female Introduce / Total Introduce); and **Nominate** (Total Female Nominate / Total Nominate). We also created a dependent variable **Total Support**, which is the sum of the three support network variables - the proportion of women in the respondent’s support network.

Finally, we include a variable, **Friendship**, which indicates the proportion of the respondent's network that is composed of close friends. For each network contact that the respondent reported (26 possible) we asked if this person is a close friend. This variable indicates the density of the respondent's networks and the extent to which the respondent relies on friendship as a component of advice and support networks. Because research indicates that women are more likely to have and rely upon colleagues with which they have social and emotional bonds, we expect that friendship plays an important role in women's professional advice and support networks. Research argues that this collaborative and relational approach to science and the workplace is particularly important for the new generation of scientists. Etzkowitz and colleagues (2000) note that "younger academics highly value interpersonal effectiveness . . ." (Etzkowitz 2000, pg 151).

*Independent Variables.* Because the unit of analysis is the respondent's (ego's) network, we include a number of independent variables about the respondent. First, the respondent's gender is measured by the variable **Female** (2=female; 1=male). Three dummy variables indicate the respondent's academic position as **Assistant Professor** (=1), **Associate Professor** (=1), or **Full Professor** (=1). The respondent's field is noted with the following mutually exclusive variables: **Biology**, **Physics**, **Chemistry**, **Earth and Atmospheric Sciences**, **Computer Sciences**, and **Electrical Engineering**.

We control for respondent's age with two variables: **Age** and **Age Squared**. Four binary variables serve as controls for race, citizenship, marital status, and having dependent children. **White**, is coded one if the respondent self-reported her race as white, and zero is not white. **Citizen** is coded one if the respondent is a US citizen and zero if the respondent is not a citizen, has a work permit or visa, or is a permanent resident. We control for race and citizenship, because research indicates that scientists from ethnic and racial minority groups and non-US citizens may have different barriers to socialization and professional networking (Kulis et al. 1999; Lee 2004; Sabharwal 2008).

The variable, **Married**, is coded one if the respondent is married. It is important to control for marital status because research indicates that marital status especially important if an academic scientist is location or geographically constricted by the spouses career options (Rosenfeld 1984; Kulis & Sicotte 2002). Additionally, research indicates

that male scientists perceive marriage and children as impediments to women scientist's careers (Etzkowitz et al. 2000, pg. 134). Finally, we control for the presence of dependent children in the respondent's household. **Dependent Children** is coded one if the respondent reports having at least one dependent child in his household. While research indicates that women scientists have larger family responsibilities, it is becoming more common for younger male scientists to also have more gender equitable domestic duties and increased responsibilities in a household with dependent children.

Summary statistics for all variables are listed in Table 2.

### **Analysis and Results**

We present the analysis and results in two sections. First, we begin with a description of the distribution of women in scientists' advice and support networks, by field. Second, we present results from a set of models predicting (1) the proportion of women in networks, advice networks and support networks and (2) models predicting the proportion of women based on five types of advice (publishing, grant getting, overall career development, collegial interactions, and work/family balance) and three types of support (review, introduction, and nomination).

#### **Women in Scientists' Advice and Support Networks, By Field**

The following tables present the patterns of scientists' networks in six fields of sciences: chemistry, physics, computer science, electrical engineering (EE), biology, and earth and atmospheric sciences (EAS). We begin with a discussion of the presence of women in advice and support networks, by gender, field, and academic position. Second, we highlight the ways in which women are present in different types of advice and support networks. Third, we discuss variation in the types of advice and support sought from women, by field.

Table 3 shows the participation of women in the respondent's network, by field, academic position, and respondent gender. Of all the respondents in the sample, 65.4% have at least one woman in their advice and support network. In general, there are more female respondents with women in the network than male respondents (77.4% and 55.6% respectively). Among STEM fields, earth and atmospheric sciences has the higher percentage of females and males with women in their network (88.1% and 67.8% respectively). Meanwhile, only 70% of women in electrical engineering report having a

woman in their networks and among physicists, only 40% of male respondents report having a female in the network. When we look at the presence of women in scientists' networks, by rank, we find an interesting trend. First, as we would expect, the proportion of women scientists at all ranks reporting at least one woman in their networks is higher than the proportion of men that report having a woman in their networks. Interestingly, when we look at the presence of women in men's networks, we see that a larger proportion of associate professors report having a woman in their network. Since women scientists are more likely to be junior, we might expect younger faculty to be more likely than senior faculty to have a woman in their networks. However, it is interesting to note that just under half of the male assistant professors in the sample report having not a single woman in their networks.

[Table 3 about here]

In addition to differences in the presence of women in networks, by field, we see that there are differences in the presence of women in different types of advice and support networks. Table 4 shows the average percent of women within respondents' networks by type of advice and type of support. On average, respondents report that women make up less than one fifth of their advice networks (16.9%) and support networks (17.3%). Differences emerge when we look at different types of advice. As expected, the type of advice most sought from women in science networks is advice about work/family balance. In fact, scientists report nearly double the proportion of women in work/family balance advice networks as compared to other types of advice networks such as publishing and grant getting advice where women make up 15.1% and 15.7% respectively.

[Table 4 about here]

When we disaggregate the advice and support networks, by respondent gender, there is a stark difference in the average percent of women in women scientists' networks as compared to men. In nearly all types of advice and support networks, women scientists report that women make up one fifth of their networks. In comparison, men report that women make up about 10% of their advice and support networks. Women scientists seek more work/family balance advice (41.2%) than publishing advice (19.5%) from other women scientists. Males show the same pattern as females, turning to women in their

networks for advice about work/family balance (17.3% for work/family balance and 10.9% for publishing). Another, important note about the advice and support network is that men report having a larger proportion of women in their support networks. While this difference is not large, it indicates that men report more women in their networks reviewing papers and introducing them to other scientists, than providing advice about grant getting, publishing, and career development.

Figure 1 shows the average percent of women in advice network by field and respondents' gender. Women in all six STEM fields have, on average, a larger percent of women in their advice networks, as compared to the men in these fields. Biologists have the highest average percent of women in their advice networks (32.4%) and physicists have the lowest (13.2%). Women in EAS, computer sciences and chemistry have roughly the same average percent of women in their networks (25.8%, 25.2% and 25.1% respectively). Among men, the average percent of women in their networks are roughly the same in biology, EAS, and computer sciences - the highest percent of women in male scientists' advice networks. Male physicists have the lowest percent (4.2%) of women in their networks, or said another way, the densest male networks. In general, women report having at least twice as many women in their networks, as compared to the number of women reported to be in men's networks. In physics, male scientists report that women make up 4% of their advice networks while female physicists report that women make up 13% of their advice networks.

[Figure 1 about here]

Figure 2 shows, the percentage of women in scientists' support networks, by respondent gender. The most common type of support from women is being nominated for an award. Women scientists report that, on average, 26.5% of the people in their networks that have nominated them for an award are female. For men, the percentage of women in support networks does not differ by type of support.

[Figure 2 about here]

## **Model Results**

In this section, we present the results from (1) a set of models predicting the proportion of women in scientists' networks, the proportion of women in advice networks and the proportion of women in support networks and (2) a set of models predicting the

proportion of women in the five types of advice (publishing, grant getting, overall career development, collegial interactions, and work/family balance) and three types of support (review, introduction, and nomination). Rather than control for sex with a single independent variable, we present separate models for women and men. Because a model using a single control for sex would capture all the variance between men and women in the intercept, by splitting the sample, we allow each independent variable and the outcomes to vary by sex. Since we know that being married, having children differently affect the careers of men and women scientists, it is important to test these two groups separately. The separate models for men and women can provide significantly different beta estimates on the independent variables, giving a more detailed understanding of how the relationships between all of the variables differ by sex.

[Table 5 and table 6 about here]

Table 6 presents the results from the models predicting the proportion of women in scientists' networks, advice networks, and support networks, by gender. We see that the presence of women in scientists' advice and networks vary significantly by gender and field. For women in physics, chemistry, EAS and EE have significantly fewer women in their overall advice and support networks as compared to women in biology. In comparison, for men, we see that men in physics and EE as compared to men in biology have significantly fewer women in their networks. If we look at advice networks alone, we see that women in physics and EE are significantly less likely to have women in their networks – as compared to women in biology. Meanwhile women in computer science, EAS, EE, and physics are less likely than women in biology to have women in their support networks. In comparison, men in physics, EE, and Chemistry are significantly less likely than men in biology to have women in their advice networks and their support networks.

When we consider rank, we see that female associate professors, as compared to full professors, report significantly more women in their advice and support networks. Interestingly, there are not significant differences between the proportion of women in the support and advice networks of female assistant professors and female full professors. For men, there is no significant difference in the number of women in their advice and support networks based on the man's rank.

For women, age is positively and significantly related to reporting an increased proportion of women in the total network and the advice network, but not in the support network. For female respondents, race, marital status, and having dependent children are not significantly related to the proportion of women in their total support and advice networks. However, citizenship is consistently significantly related to the presence of women in the network. Women scientists who are US citizens are significantly more likely to report an increased number of women in their networks, as compared to women non-citizens.

For men, age, citizenship, and marital status are not significantly related to the presence of women in their networks. Interestingly, having dependent children is significantly related to reporting a lower proportion of women in the overall network. Men with dependent children report having 2.4% fewer women in their networks, as compared to men without dependent children. In general, race is not consistently significantly related to the presence of women in men's advice and support networks. However, there is a slight positive relationship between being a white man and having women in the advice network. White men report significantly more women in their networks than nonwhite men.

Finally, an increase in the number of people in the network that a woman scientist reports are "close friends" is significantly and positively related to the proportion of women in the network that are providing advice and support to the respondent. For men, being close friends with the people in the network is not significantly related to the number of women in the advice or the support network, but is positively related to the proportion of women in the total network.

[Table 7 about here]

The second analysis focuses investigating variance in the types of advice sought from women scientists. Table 7 presents the results, by gender. Table 7A shows the results from the five regression analyses investigating male scientists reporting women in their networks providing advice on grant getting, career development, publishing, interactions with colleagues, and work/faculty balance. Table 7B shows the results from the same regression analyses for women scientists.

First, we consider variation in the presence of women in scientists' advice networks by field. Both male and female physicists report having fewer women in their advice networks, as compared to biologists. More specifically, women physicists report significantly fewer women in all forms of advice networks, while men report significantly fewer women in advice networks, except advice on work/family balance. As compared to biologists, women in physics, EAS, and computer sciences report significantly fewer (or no) women in their work/family advice networks.

Second, we see that for male scientists, rank is not a significantly indicator of having women in the advice network – regardless of the type of advice sought. In comparison, for female scientists, assistant professors (as compared to full professors) report significantly more women in their advice networks providing advice about grant getting, publishing, collegial interactions, and overall career development. We do not know if these female advice givers are senior to the assistant professors or peers, but it is important to note that significant differences in the presence of women in advice networks persist across gender and rank.

When we look at the control variables such as age, race, citizenship, and family structure, we find no consistent significant relationships between these demographic measures and the proportion of women in men's advice networks. However, there are clear differences among women scientists. Women scientists, who are US citizens, consistently report significantly more women in the advice networks as compared to female noncitizens. The positive relationship between women citizens and having women in the network is significant for all types of advice. Marriage, for women, also plays a negative, significant role in the likelihood that a women scientist will have women in her network providing advice about collegial interactions and work/family balance. And, an increase in the number of friends in a woman's advice network is significantly related to an increase in the number of women in the network providing advice about grants and collegial interactions.

[Table 8 about here]

Table 8 shows the results from the models predicting the proportion of women in scientists' support networks. When we consider variation by field of science, we see that men in physics are significantly less likely than men in biology to report having women

in their networks providing support by reviewing papers and proposals and introducing them to potential collaborators outside of the respondent's university. As compared to men in biology, men in chemistry and electrical engineering fields report significantly fewer women in their networks nominating them for an award or as an invited speaker.

The variation in support networks across field is much greater for women scientists than men scientists. For example, women in physics report fewer women in all types of support networks as compared to women in biology. If we look at the prevalence of women supporting other women by type of support, we see that women in physics and electrical engineering report significantly fewer women in their networks supporting them by reviewing papers and proposals. Women in physics, computer sciences, EE, and EAS all report significantly fewer women introducing them to potential collaborators outside of the university, as compared to women in biology. And women in all fields report women in their networks nominating them for an award or as an invited speaker at significantly lower rates than women in biology. Thus, women in biology report significantly more women in their support networks than women in all other STEM fields in this study.

Overall, we see that men's demographic characteristics are not significantly related to the presence of women in their support networks. Interestingly, we do find that male US citizens are significantly more likely to have women in their networks introducing them to collaborators outside of the respondent's university, as compared to male noncitizens. For women scientists, age and citizenship are both positively related to increases in the number of women providing review support, while having dependent children is negatively related to women in the network providing review support. Having dependent children is not related to the presence of women in men's support networks.

In summary, we find overwhelming support for our first hypothesis that the presence of women in scientists' advice and support networks vary by gender. We also find strong support for the second hypothesis; female scientists as compared to male scientists report significantly more women in their networks. For example, women as compared to men in STEM fields have, on average, 10% more women in their support networks and 12.8% more women in their advice networks. The variation of women in women's networks is related to a number of variables including field, rank, citizenship,

and in some cases age, marital status, and having children. Meanwhile, variation in the presence of women in men's networks appears to be largely related to field of science. We find support for both hypothesis three and hypothesis four, which expect that scientists will seek different types of support and advice from women in their networks. For example, junior female scientists (assistant professors) are significantly more likely to report women in their networks providing advice about grants, career development, collegial interactions, and publishing, as compared to senior women (full professors).

Finally, we find strong support for the fifth hypothesis that scientist patterns for advice seeking and support from women colleagues vary significantly by field. Overall, both male and female physicists, as compared to biologists, are the least likely to have women in their advice networks. Computer scientists and electrical engineers report significantly fewer women in their support networks than biologists. And electrical engineers report significantly fewer women in their advice networks.

### **Discussion and Conclusions**

The presence of women in science networks represents not only the integration of women in the field but diverse networks. Of particular importance to this research is not simply the presence of women in women's networks, but the presence of women in men's networks. If women are equally present in men and women's networks, then women are achieving a stronger presence across the field. If women are not present, or only present in other women's networks, then we are seeing an advancement of women in isolated communities.

This research helps to elucidate the challenges of critical mass and isolation. What happens when policy efforts increase the production of women scientists and advancement of women scientists in academia, but those women remain in a separate and, doubtfully, equal system? An increase of women in STEM fields may simply result in a separate community of scientists – a women's community.

Etzkowitz and colleagues (2000) argue that women need a critical minority (15%) to advance the minority's group in a research unit, department, or field. However, Etzkowitz and colleagues note that this critical minority can be subdivided and weak when the 15% of women are of several nationalities. Thus, when a department has 15% women, but those women are divided in to American and non-America or split across

three research labs, they remain unconnected, isolated, and unable to work together to advance the groups interests. Although this research did not set out to test hypotheses about isolation of large minorities, we do see that there are significant differences between women scientists who are US citizens and those who are not. In this sample, 20% of respondents are not US citizens and 17% of the female respondents are not US citizens (7.6% of all respondents). Among women respondents, non-US citizens make up between 6% (EAS) and 34% (electrical engineering) of the female respondents (see Table 9). As non-US citizens begin to make up a larger portion of the women scientists in academia, it will be increasingly important to understand how the presence of women in scientists' advice and support networks is shaped by citizenship status.

[Table 9 about here]

We propose that an increase of women in women and men's networks signifies an integration of women into the networks of all scientists. Not only would this mean that women scientists are indeed advancing in the field and achieving a breakthrough in advice and support networks, but also that men and women alike are developing more diverse networks and benefiting from the presence of women scientists. Diverse networks signal a maturity of contacts and access to social capital that is more expansive as compared to less diverse networks.

Finally, we see mixed relationships between age, rank, and having women in one's networks. Women assistant professors are significantly more likely to have women in their advice networks, but the same is not true for male assistant professors. Additionally, increases in age, for women, are significantly related to seeking advice on grant getting from women and support from women to review papers and proposals. On the other hand, age is not a significant indicator of whether or not men will report having women in their advice and support networks.

Etzkowitz and colleagues (2000) hypothesize that women scientists, and junior women faculty, in particular, may find more comradery and support from junior male colleagues as compared to senior women. Etzkowitz and colleagues (2000) argue that since, in the past women who built successful scientific careers often adopted the male model of science, junior women may not turn to senior women for advice on navigating a path to balancing career and family. Additionally, because junior men have grown up in a

generation with a higher expectation for gender balanced household responsibilities, junior men and junior women might find more in common with one another as compared to the common paths of senior women and junior women. According to Etzkowitz and colleagues, “[y]ounger male faculty members express an understanding and interest in building more productive cross-gender and gender-inclusive networks, yet new strategies are needed and other problems exist” (2000, pg. 177). Our results do not evidence support for Etzkowitz and colleagues’ hypothesis that young men are more “relational” and working with more women in their networks, as compared to senior men or other junior women. While it remains questionable that junior female scientists will rely on junior men to gain access to the science career, it may make sense that science and the nature of academic success is changing – for both men and women scientists. Our future research will hope to untangle the possible generational differences and the ways in which junior men and women may seek support from one another or senior men and women.

While this research offers only a small glimpse into the patterns of scientists’ networks, it raises important questions for future research. This research outlining the ways in which scientists in six STEM fields seek advice and support from women offers some understanding of the ways in which women and men, and junior women in particular are relying on women scientists for advice and support. We hope that further analysis will enable us to understanding the relationships between seeking advice and support from women scientists and seniority, how gender balance networks are related to productivity, and how efforts to increase the presence of women in science may differently affect outcomes for women US citizens compared to non-US citizens – especially when we consider the ways in which federally funded and association based programs for women in science target policy efforts and dollars on US citizens. Because “[o]ne of the underlying barriers to the success of women scientists is the structure of their social networks” (Etzkowitz et al. 2000, pg. 176), these questions remain vitally important to understanding the ways in which policy can best affect the outcomes of women in science and thus, outcomes for all scientists.

## Tables and Figures

**Table 1: Network Generating Question Items**

- Q1. Over the past two academic years, which individuals at your university have been your closest research collaborators? Collaboration includes proposal generation, working on a research project, writing/presenting an academic paper/book or book chapter, or developing industrial products or patents.)
- Q2. Over the past two academic years, who have been your closest research collaborators outside of your institution (including other academic institutions, government and industry?)
- Q3. With which individuals do you regularly talk with about research but have never formally collaborated?
- Q4. From whom do you seek advice about your career or professional development?
- Q5. With whom do you regularly talk about important university or department related issues?
- Q6. Do you have someone you consider to be your primary mentor? What is your primary mentor's name?

Table 2. Summary statistics

Variables	Minimum	Maximum	Mean	Std. Deviation
<b>Women in Network</b>				
Women in Network (%)	.00	1	.17	.18
<b>Women Advice Seeking (%)</b>				
Publishing	.00	1	.15	.27
Grant getting	.00	1	.16	.27
Career development	.00	1	.18	.29
Interaction with colleagues	.00	1	.17	.28
Work/family balance	.00	1	.30	.39
Total Advice (5)	.00	1	.17	.25
<b>Women Support Giving (%)</b>				
Reviewing papers or proposals	.00	1	.18	.28
Introducing to potential collaborators	.00	1	.17	.27
Nominating for award	.00	1	.19	.32
Total Support (3)	.00	1	.17	.24
<b>Position</b>				
Assistant Professor	0	1	.26	.44
Associate Professor	0	1	.28	.45
Full Professor	0	1	.45	.50
<b>Field</b>				
Biology	0	1	.18	.38
Physics	0	1	.17	.37
Chemistry	0	1	.18	.38
Earth and Atmospheric Sciences	0	1	.19	.39
Computer Sciences	0	1	.16	.37
Electrical Engineering	0	1	.13	.34
<b>Demographic</b>				
Age	28	82	48.03	10.10
Age Squared	784	6724	2408.31	1014.26
White	0	1	.79	.40
Citizen	0	1	.80	.40
Married	0	1	.84	.37
Dependent Children	0	1	.40	.49
Female	1	2	1.45	.50
<b>Others</b>				
Friends (%)	.00	1	.22	.25

N = 1497

**Table 3. Participation of women in science networks, by field, academic position and respondent gender**

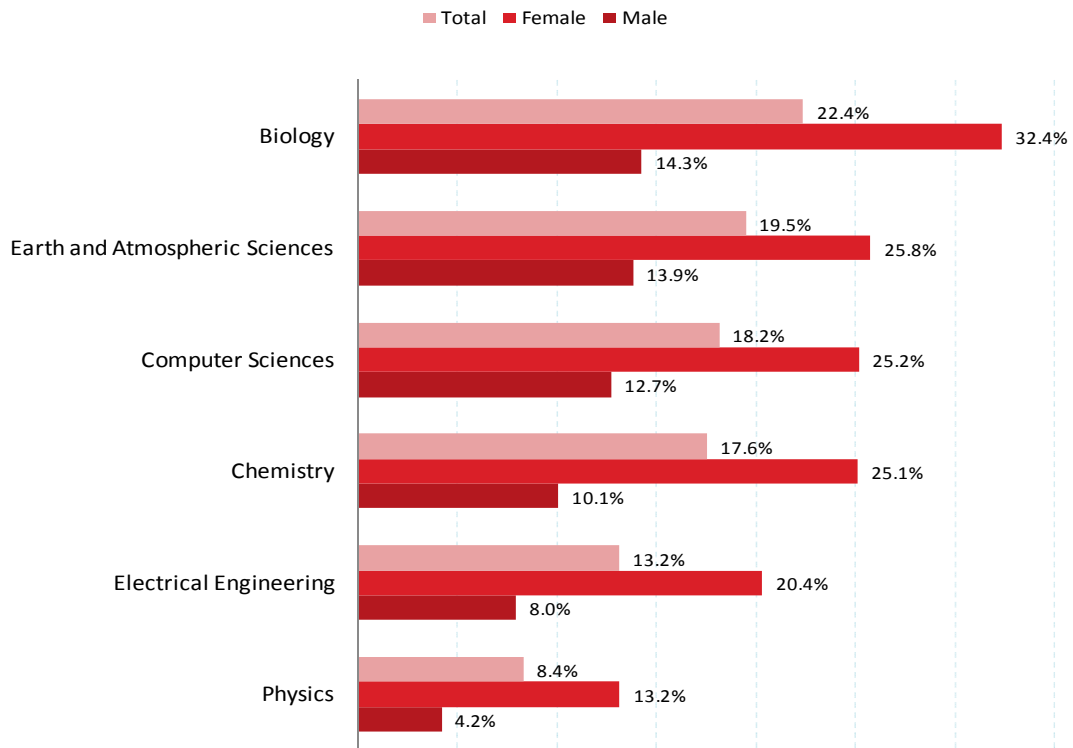
Characteristics	Percentage of respondents that have at least one woman in their network		
	Male	Female	Total
<b>Total Sample</b>	55.6%	77.4%	65.4%
<b>Field</b>			
Biology	63.9%	82.9%	72.3%
Physics	39.7%	72.2%	53.8%
Chemistry	62.6%	73.8%	68.0%
Earth & Atmos. Science	67.8%	88.1%	77.4%
Computer Sciences	49.6%	73.3%	60.1%
Electrical Engineering	46.8%	69.5%	56.5%
<b>Position</b>			
Assistant Professor	53.1%	76.1%	64.1%
Associate Professor	60.4%	76.4%	67.3%
Full Professor	53.9%	78.8%	65.1%

**Table 4. Average percent of women's advice and support networks**

Women in Network	Average %	Average %	Average %
		Female	Male
<b>Advice Seeking</b>			
Publishing	15.1	19.5	10.9
Grant getting	15.7	20.4	11.3
Career development	17.9	24.3	11.3
Interaction with colleagues	17.3	24.5	11.6
Work/family balance	29.7	41.2	17.3
Total Advice (5)	16.9	24.1	10.8
<b>Support Giving</b>			
Reviewing papers or proposals	18.2	23.6	12.9
Introducing to potential collaborators	17.4	23.2	12.3
Nominating for award	18.9	26.5	12.1
Total Support (3)	17.3	22.8	12.5

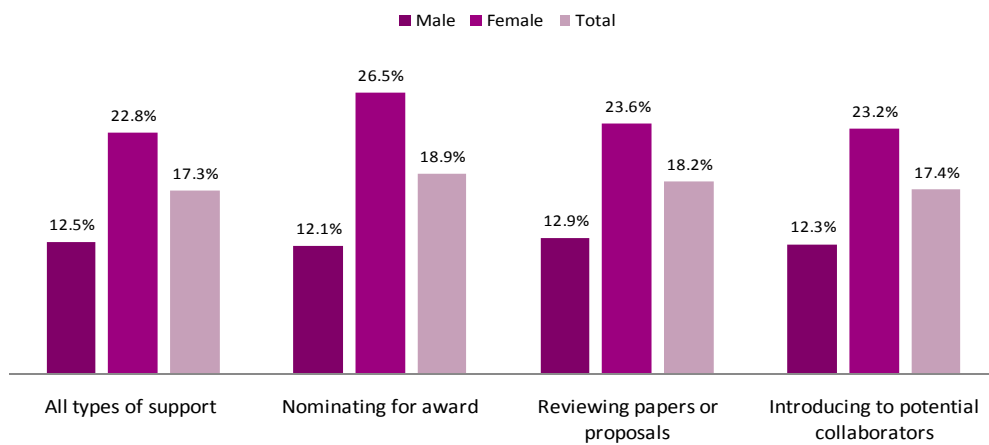
**Figure 1**

**Average percent of women in respondent's advice network, by field and respondent's gender**



**Figure 2**

**Average percent of women in respondents' support network, by type of support and respondents gender**



**Table 5. Proportion of women in scientists' networks, total advice networks, and total support networks, full sample**

Dependent Variable	Women in the Network		Support Total		Advice Total	
	B	Sig.	B	Sig.	B	Sig.
	-0.265		-0.200		-0.410	
<b>Assistant Professor</b>	<b>0.049</b>	<b>***</b>	<b>0.072</b>	<b>***</b>	<b>0.061</b>	<b>**</b>
<b>Associate Professor</b>	<b>0.024</b>	<b>*</b>	0.024		0.016	
<b>Female</b>	<b>0.095</b>	<b>***</b>	<b>0.101</b>	<b>***</b>	<b>0.128</b>	<b>***</b>
<b>Physics</b>	<b>-0.097</b>	<b>***</b>	<b>-0.109</b>	<b>***</b>	<b>-0.132</b>	<b>***</b>
<b>Chemistry</b>	<b>-0.039</b>	<b>***</b>	-0.020		<b>-0.045</b>	<b>**</b>
<b>Earth &amp; Atmospheric Sciences</b>	<b>-0.031</b>	<b>**</b>	<b>-0.042</b>	<b>*</b>	-0.029	
<b>Computer Sciences</b>	<b>-0.033</b>	<b>**</b>	<b>-0.083</b>	<b>***</b>	-0.032	
<b>Electrical Engineering</b>	<b>-0.070</b>	<b>***</b>	<b>-0.111</b>	<b>***</b>	<b>-0.069</b>	<b>***</b>
<b>Age</b>	<b>0.011</b>	<b>**</b>	0.007		<b>0.016</b>	<b>**</b>
<b>Age Squared</b>	<b>0.000</b>	<b>**</b>	0.000		<b>0.000</b>	<b>**</b>
<b>White</b>	0.013		-0.011		0.005	
<b>Citizen</b>	<b>0.033</b>	<b>***</b>	<b>0.052</b>	<b>***</b>	<b>0.043</b>	<b>**</b>
<b>Married</b>	-0.010		0.024		-0.010	
<b>Dependent Children</b>	-0.014		-0.008		<b>-0.029</b>	<b>*</b>
<b>Friends</b>	<b>0.087</b>	<b>***</b>	<b>0.068</b>	<b>**</b>	<b>0.084</b>	<b>***</b>
*** p < .01; ** p < .05; * p < .10						
Reference Category: Full Professor						
Reference Category: Biology						

**Table 6. Models predicting the proportion of women in scientists' networks, total advice networks, and total support networks**

Dependent Variable	Male Model			Female Model		
	Women in Network	Women Advice Network	Women Support Network	Women in Network	Women Advice Network	Women Support Network
	B	B	B	B	B	B
<b>Constant</b>	0.071	-0.025	0.093	-0.333	-0.443	-0.267
<b>Assistant Prof<sup>a</sup></b>	0.010	-0.004	0.040	<b>0.091***</b>	<b>0.135***</b>	<b>0.103***</b>
<b>Associate Prof<sup>a</sup></b>	0.013	-0.014	0.003	<b>0.036*</b>	<b>0.055*</b>	0.048
<b>Physics<sup>b</sup></b>	<b>-0.081***</b>	<b>-0.104***</b>	<b>-0.078***</b>	<b>-0.115***</b>	<b>-0.160***</b>	<b>-0.140***</b>
<b>Chemistry<sup>b</sup></b>	-0.021	<b>-0.053*</b>	0.005	<b>-0.066***</b>	-0.047	-0.047
<b>Earth &amp; Atmospheric Sciences<sup>b</sup></b>	-0.015	-0.008	-0.022	<b>-0.058**</b>	-0.056	<b>-0.067**</b>
<b>Computer Sciences<sup>b</sup></b>	-0.029	-0.014	<b>-0.053*</b>	-0.040	-0.059	<b>-0.120***</b>
<b>Electrical Engineering<sup>b</sup></b>	<b>-0.051**</b>	<b>-0.057*</b>	<b>-0.080*</b>	<b>-0.094***</b>	<b>-0.076*</b>	<b>-0.147***</b>
<b>Age</b>	0.003	0.009	0.000	<b>0.019***</b>	<b>0.024*</b>	0.017
<b>Age Squared</b>	0.000	0.000	0.000	<b>0.000**</b>	<b>0.000*</b>	0.000
<b>White</b>	0.020	<b>0.043*</b>	-0.016	0.011	-0.030	-0.001
<b>Citizen</b>	0.005	-0.006	0.025	<b>0.077***</b>	<b>0.112***</b>	<b>0.101***</b>
<b>Married</b>	-0.022	-0.019	0.018	-0.010	-0.011	0.030
<b>Dependent Children</b>	<b>-0.024*</b>	-0.028	0.003	-0.005	-0.030	-0.025
<b>Friends</b>	<b>0.047**</b>	0.046	0.046	<b>0.151***</b>	<b>0.144***</b>	<b>0.101***</b>

\*\*\* p < .01; \*\* p < .05; \* p < .10

a. Reference category is Full Professor

b. Reference category is Biology

**Table 7. Models predicting the proportion of women in scientists' advice networks**

**Table 7A**

**Male Model**

Dependent Variable	Grant Advice	Career Advice	Publishing Advice	Colleague Advice	Work/Family Advice
	B	B	B	B	B
Constant	-0.026	-0.118	0.112	0.187	0.022
Assistant Professor	-0.035	0.028	-0.064	0.009	0.022
Associate Professor	-0.025	0.014	-0.058	-0.016	-0.006
Physics	-0.125***	-0.130***	-0.084*	-0.141***	-0.098
Chemistry	-0.031	-0.089**	0.002	-0.106***	0.011
Earth & Atmospheric Sciences	-0.041	-0.007	-0.015	-0.045	0.097
Computer Sciences	-0.028	0.012	-0.013	-0.062*	-0.078
Electrical Engineering	-0.068*	-0.037	-0.051	-0.099***	0.004
Age	0.010	0.012	0.006	0.002	0.003
Age Squared	0.000	0.000	0.000	0.000	0.000
White	0.058*	0.029	0.022	0.055*	0.022
Citizen	-0.036	0.001	0.009	-0.024	0.001
Married	0.008	-0.031	-0.044	-0.018	0.067
Dependent Children	-0.043*	-0.034	-0.025	-0.024	-0.023
Friends	-0.021	0.020	0.014	0.056	0.104

\*\*\* p < .01; \*\* p < .05; \* p < .10

**Table 7B**

**Female Model**

Dependent Variable	Grant Advice	Career Advice	Publishing Advice	Colleague Advice	Work/Family Advice
	B	B	B	B	B
Constant	-0.897	-0.374	-0.269	-0.103	0.362
Assistant Professor	0.149***	0.136***	0.124**	0.135***	0.052
Associate Professor	0.040	0.053	0.075*	0.014	0.051
Physics	-0.120***	-0.176***	-0.123**	-0.143***	-0.175**
Chemistry	-0.027	-0.040	-0.039	-0.017	-0.010
Earth & Atmospheric Sciences	-0.046	-0.081*	-0.059	-0.056	-0.122*
Computer Sciences	-0.072	-0.061	-0.058	0.016	-0.127*
Electrical Engineering	-0.071	-0.089*	-0.135**	-0.010	-0.112
Age	0.040***	0.018	0.016	0.010	0.005
Age Squared	0.000***	0.000	0.000	0.000	0.000
White	-0.019	-0.001	-0.006	-0.002	-0.067
Citizen	0.085**	0.100**	0.107**	0.134***	0.141**
Married	0.018	0.021	-0.015	-0.067**	-0.101*
Dependent Children	-0.053*	-0.039	-0.006	-0.014	-0.033
Friends	0.149**	0.092	0.076	0.099*	0.073

\*\*\* p < .01; \*\* p < .05; \* p < .10

a. Reference category is Full Professor

b. Reference category is Biology

**Table 8. Models predicting the proportion of women in scientists' support networks**

Dependent Variable	Male			Female		
	Review	Introduce	Nominate	Review	Introduce	Nominate
	B	B	B	B	B	B
	-0.096	0.394	-0.057	-0.530	0.171	0.139
<b>Assistant Professor</b>	0.032	0.029	-0.029	0.039	0.072	0.122*
<b>Associate Professor</b>	0.024	0.017	-0.050	0.027	0.027	0.056
<b>Physics</b>	-0.110***	-0.071*	-0.073	-0.137***	-0.189***	-0.210***
<b>Chemistry</b>	-0.059	0.067*	-0.057	0.005	-0.060	-0.140**
<b>Earth &amp; Atmospheric Sciences</b>	-0.064*	-0.027	0.006	-0.035	-0.087*	-0.130**
<b>Computer Sciences</b>	-0.104**	-0.026	-0.089*	-0.046	-0.192***	-0.145**
<b>Electrical Engineering</b>	-0.074	-0.064	-0.121**	-0.135**	-0.164***	-0.252***
<b>Age</b>	0.010	-0.015	0.013	0.031**	0.000	0.004
<b>Age<sup>2</sup></b>	0.000	0.000	0.000	0.000**	0.000	0.000
<b>White</b>	0.008	-0.007	-0.011	-0.018	0.010	-0.007
<b>Citizen</b>	-0.030	0.053*	0.024	0.104**	0.105**	0.123
<b>Married</b>	0.044	0.001	-0.047	0.052	-0.004	0.027
<b>Dependent Children</b>	-0.029	0.018	0.024	-0.088***	0.019	0.024
<b>Friends</b>	0.070	0.068*	0.008	0.056	0.097	0.084

\*\*\* p < .01; \*\* p < .05; \* p < .10

a. Reference category is Full Professor

b. Reference category is Biology

**Table 9: Women respondents in the NETWISE sample by citizenship and field of science**

Women Respondents	Physics	Biology	Chem	EAS	Comp Sci	EE
NonCitizen	<b>25%</b>	<b>13%</b>	<b>14%</b>	<b>6%</b>	<b>17%</b>	<b>34%</b>
US Citizen	<b>75%</b>	<b>87%</b>	<b>86%</b>	<b>94%</b>	<b>83%</b>	<b>66%</b>

<b>Table ##: Composition of Dependent Variables</b>	
<b>Advice Network</b>	
<b>%Women Publishing Advice</b>	#women in publishing advice / total publishing advice
<b>%Women Grant Advice</b>	#women in grant getting advice / total grant getting advice
<b>%Women Career Advice</b>	#women in career development advice / total career development advice
<b>%Women Colleague Advice</b>	#women in interaction w/ colleagues advice / total interaction w/ colleagues advice
<b>%Women Work/family Advice</b>	#women in work/family advice / total work/family advice
<b>%Total Female Advice</b>	Sum of five advice variables
<b>Support Network</b>	
<b>%Women Reviewed Papers</b>	#women review papers / total review papers
<b>% Women Introductions</b>	#women provide introductions / total provide introductions
<b>% Women Nominations</b>	#women provide nominations / total provide nominations
<b>%Total Female Support</b>	Sum of three support variables
<b>Women in Network</b>	
<b>Women in Network</b>	Women in network / total network

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