WOMEN IN STEM: UNDERREPRESENTATION AND EQUITY
IN PROFESSIONAL RESEARCH ORGANIZATIONS

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To the Faculty of Washington State University:

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Over the past several decades, the underrepresentation of women in science, technology, engineering, and mathematics (STEM) fields has gained considerable attention at academic institutions as well as at a national level in the United States. It has become clear that increasing the representation of women will require multifaceted changes across all components related to a career in STEM. One area that has received little attention has been the role of professional research organizations on the careers of female and male faculty. Memberships in professional research organizations are typical for professors at research universities, yet little is known about experiences within these organizations. The studies in this dissertation tested whether 1) commitment to professional research organizations relate to career satisfaction, 2) women are underrepresented in the most prestigious positions in research organizations, 3) women differ from men in their views of membership benefits and factors limiting participation in these organization, and 4) an organization’s characteristics are impacting member views of gender equity.
Reports from faculty currently holding tenure-track positions in a sample of 41 research universities across the U.S. revealed that affective commitment to a research organization was positively related to career satisfaction for women and men. There were mixed results when examining whether involvement levels differed by gender. Women and men rated the importance of membership benefits similarly but women consistently recognized less equitable treatment based on gender. Leaders of 21 research organizations identified policies used to address issues potentially limiting the involvement of their female members. The number of policies reported was inversely related to perceptions of gender equity for female members. Male members of these organizations reported greater perceptions of gender equity when the organization had a higher proportion of female leaders and speakers at conferences. The distinct gender differences in how gender equity was perceived and influenced by organization-level characteristics illustrates the need to carefully consider what changes are being implemented and how those changes may differentially impact men and women. Together these data contribute to the understanding of women’s experiences in STEM and demonstrate the need to initiate purposeful and informed changes within professional research organizations.
# TABLE OF CONTENTS

**ACKNOWLEDGEMENT** ....................................................................................................................... iii

**ABSTRACT** ........................................................................................................................................ iv

**LIST OF TABLES** ................................................................................................................................. ix

**LIST OF FIGURES** ............................................................................................................................... xi

**CHAPTER ONE**  
The Underrepresentation of Women in STEM ................................................................. 1  
Current Status of Women in Science ................................................................. 3  
Explaining the Underrepresentation of Women in Science ........................................ 4  
Involvement and Connections in STEM ............................................................ 13  
Professional Research Organizations ......................................................... 14

**CHAPTER TWO**  
Affective Commitment to Research Organizations .................................................. 16  
Method ............................................................................................................................. 19  
Participants ............................................................................................................... 19  
Procedure ................................................................................................................. 20  
Measures .................................................................................................................. 21  
Organizations ......................................................................................................... 22  
Analysis ...................................................................................................................... 23  
Results ......................................................................................................................... 25  
Measurement Invariance ......................................................................................... 25  
Latent Mean Differences ............................................................................................ 26  
Structural Invariance ................................................................................................. 27  
Discussion ................................................................................................................... 29

**CHAPTER THREE**  
Involvement Trends of Women in Research Organizations: A Case Study ............. 41  
Method ............................................................................................................................. 44  
Organization ............................................................................................................. 44  
Archived Data ............................................................................................................ 44  
Survey Participants ................................................................................................... 45
<table>
<thead>
<tr>
<th>Analysis</th>
<th>46</th>
</tr>
</thead>
<tbody>
<tr>
<td>Results</td>
<td>47</td>
</tr>
<tr>
<td>Archived Data</td>
<td>47</td>
</tr>
<tr>
<td>Survey Data</td>
<td>49</td>
</tr>
<tr>
<td>Discussion</td>
<td>49</td>
</tr>
</tbody>
</table>

**CHAPTER FOUR**

Experiences of Women and Men in Research Organizations | 59
---|---
Method | 63
Participants | 63
Organizations | 63
Measures | 64
Procedure | 67
Analysis | 67
Results | 68
Importance of Benefits | 68
Limiting Factors | 70
Involvement | 73
Discussion | 76

**CHAPTER FIVE**

Perceptions of Gender Equity in Research Organizations | 95
---|---
Method | 99
Participants | 99
Individual Level Measures | 99
Organizations | 100
Organization Level Measures | 101
Analysis | 104
Results | 107
Organization Descriptive Characteristics | 107
Policies and Strategies Identified | 108
Measure of Gender Equity | 111
Multilevel Regression Analysis | 112
Discussion | 113
LIST OF TABLES

2.1 Total Faculty Survey Invitations and Percent Responses by U.S. Geographic Region

2.2 Demographic Information of Surveyed Faculty Members

2.3 Measurement and Factor Invariance Tests for ACR, ACI, and Career Satisfaction of STEM Women and Men

2.4 Standardized Latent Mean Differences for ACR, ACI, and Career Satisfaction for STEM Women and Men

2.5 Means for Productivity Measures and Control Variables by Gender

3.1 Demographic Information of IASP Survey Respondents

3.2 Historical Trends in Participation by Gender Across Time

4.1 Zero-Order Correlation Coefficients, Means, and Standard Deviations among Hard Science Faculty Importance Ratings of Benefits

4.2 Zero-Order Correlation Coefficients, Means, and Standard Deviations among Life Science Faculty Importance Ratings of Benefits

4.3 Zero-Order Correlation Coefficients, Means, and Standard Deviations among Social Science Faculty Importance Ratings of Benefits

4.4 Zero-Order Correlation Coefficients, Means, and Standard Deviations among Technology, Engineering, and Mathematics Faculty Importance Ratings of Benefits

4.5 Zero-Order Correlation Coefficients, Means, and Standard Deviations among Hard Science Faculty Ratings of Limitations

4.6 Zero-Order Correlation Coefficients, Means, and Standard Deviations among Life Science Faculty Ratings of Limitations

4.7 Zero-Order Correlation Coefficients, Means, and Standard Deviations among Social Science Faculty Ratings of Limitations

4.8 Zero-Order Correlation Coefficients, Means, and Standard Deviations among Technology, Engineering, and Mathematics Faculty Ratings of Limitations
4.9  Mean Involvement and Percent of Faculty Involved by Type of Involvement, Academic Category, and Gender .......................................................... 90

4.10 Counts of Faculty Committee Involvement Since 2012 ................................................. 91

5.1 Importance and Effectiveness Rating of Policies Identified by Research Organization Leaders ........................................................................................................... 120

5.2 Measurement Invariance between Women and Men for Perceptions of Gender Equity in STEM Research Organizations ................................................................. 121

5.3 Item Means and Standardized Factor Loadings for Perceptions of Gender Equity Scale ................................................................................................................ 122

5.4 Multilevel Regression for Perceptions of Gender Equity in Research Organizations ................................................................................................................... 123
LIST OF FIGURES

2.1 Relationship of Affective Commitment to a Research Organization with Career Satisfaction and Commitment to Academic Institution.................................39

2.2 Unique Relationship between Measures of Affective Commitment and Career Satisfaction........................................................................................................40

3.1 Relationship Between the Chair and Speaker Genders for Workshops in 2002 and 2012...............................................................................................56

3.2 Relationship Between the Last Author and Presenting Author Genders for Posters in 2002 and 2012..............................................................................57

3.3 Current Members’ Selection of Future Plenary Speakers by Gender........58

4.1 Importance Rating of Having Childcare Available at Organization-Sponsored Events..............................................................................................................92

4.2 Rating of Childcare Responsibilities Limiting Participation in Research Organizations for Participants with Children Under the Age of 18.........................93

4.3 Level of Agreement that Gender Bias or Discrimination Limits Participation in Research Organizations..................................................................................94
CHAPTER ONE
THE UNDERREPRESENTATION OF WOMEN IN STEM

The underrepresentation of women in science, technology, engineering, and mathematics (STEM) fields has been a subject of both interest and concern for decades (e.g., Helene, 1950; National Academy of Sciences [NAS] et al., 2006; Perrucci, 1970; Rosser, 2004a; Rossi, 1965; White, 1970). Women are more likely than men to leave STEM disciplines at each transitional stage (Preston, 2004). A multitude of reasons have been identified to explain the attrition of women in academic science (e.g., Adamo, 2013; Aiston, 2011; Bain & Cummings, 2000; Ceci & Williams, 2011; Clark & Hill, 2010; Wright et al., 2003). Some of those most commonly studied include institutional climate issues (Sandler & Hall, 1986; Settles, Cortina, Malley, & Stewart, 2006), reduced financial and professional support (Massachusetts Institute of Technology [MIT], 1999; NAS et al., 2007), increased work-family conflict (Fox, 2005; Fox, Fonseca, & Bao, 2011; Monosson, 2008), and gender bias and discrimination (Alpay, Hari, Kambouri, & Ahearn, 2010; Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012; Wright et al., 2003). These issues limit the involvement of women in STEM at each educational and professional stage and can have significant detrimental effects on the careers of those who persist.

Potential solutions to these problems are being implemented in higher education institutions across the United States (e.g., Bystydzienski & Bird, 2006; Institute for Research on Women, 2002; NAS et al., 2007). Most of the proposed solutions require institution-wide or departmental policy changes where women in STEM are employed. The unique barriers women face when pursuing a career that is largely male-dominated are systemic (Cahusac &
Kanji, 2014; Hanappi-Egger, 2012; Hatchell & Aveling, 2008); they infiltrate all facets of
career progression and must be understood and challenged from as many directions as
possible. Improvements made at the institutional level are undoubtedly important but should
be supplemented by identifying and addressing broader issues in STEM.

For individuals pursuing STEM careers in academia, considerations for granting
tenure and promotions include how involved a person is within the scientific community and
the level of recognition earned for their research and scholarship. Many academic institutions
refer to involvement in professional research organizations specifically in their guidelines and
expectations for faculty advancement. Professional research organizations are a main venue
where a connection to the scientific community can be fostered. Research organizations host
regular meetings where data are presented and discussed among members and other
professionals. Involvement within these organizations allows academics at all stages of their
career to build broader networks, form and maintain collaborations, promote their research,
find funding sources, and gain recognition.

The barriers that exist for STEM faculty in academic institutions are likely mirrored
within research organizations and may reduce the involvement of women at conferences,
which is where many membership benefits are obtained. Reduced access to these benefits
may have a negative effect on career advancement consistent with what occurs at academic
institutions. Following is a review of the current status of women in STEM, theories
explaining their underrepresentation, and what issues remain as barriers. Much of the research
reviewed below is based on individuals in academic science, but similar barriers and solutions
are identified across technology, engineering, and mathematics departments, as well as in
careers outside academia (e.g., Gallaher & Pearson, 2000; Haines, Wallace, & Cannon, 2001; Herzig, 2010; Lim, 2007; Miller, 2004).

**Current Status of Women in Science**

The number of women in STEM is closely monitored by the National Science Foundation (NSF), including those in academic positions. The number of women and men pursuing science degrees is nearly equal. In 2010, women earned approximately half of all science bachelor (55.6%), master (54.0%), and doctoral (46.7%) degrees (NSF, 2013). These numbers are promising and demonstrate the great strides already made toward achieving gender equality within science. Though the number of women earning science degrees nearly matches or exceeds the number of men at each degree level, there remains significant room for improvement. Compared to earning degrees in other fields, a higher percentage of the associate degrees earned by men are in the sciences (10.5%) compared to science associate degrees earned by women (4.78%). Women trail men by 1.9%-4.8% when examining the percentage of science degrees earned at each level beyond associate degrees compared to other fields. This discrepancy indicates women are pursuing science degrees at a lower rate than degrees in other fields when compared to men. Additionally, there are substantial differences across disciplines within STEM. The percentage of women earning physics, computer science, engineering, and chemistry doctoral degrees in 2010 was only 19.4%, 21.5%, 23.2%, and 38.8%, respectively. In contrast, women earned 52.9% and 70.4% of doctoral degrees in biological sciences and psychology that same year.

Across all disciplines in STEM, women are vastly underrepresented at the highest levels in academia (NSF, 2013). Women comprised 34.5% of all science faculty in 2010 but
only 21.2% of full professors. Regardless of discipline, the trend remains that women are found in decreasing numbers as rank increases from assistant to associate to full professor status. In the physical sciences, women make up 21.8% of all faculty positions but only 13.3% of full professors. Women in psychology comprise 37.9% of all faculty members but only 22.6% of full professors. The number of women being tenured does appear to be shifting, where a higher percentage of early career female scientists are being tenured compared to males (NSF, 2013). However, reports still show that women are held to higher standards during hiring, promotion, and tenure processes (e.g., Sabatier, Carrere, & Mangematin, 2006; van den Brink & Benschop, 2011) and that women are generally promoted at a slower pace overall compared to their male colleagues (Wright et al., 2003). Even when controlling for variables like career length and institution type, men are more likely than women to hold a higher position and be promoted in academic science positions (National Research Council, 2006).

**Explaining the Underrepresentation of Women in STEM**

A number of causes could explain the underrepresentation of women in STEM and the frustratingly slow rate at which the proportion is changing. Some postulate that biological or innate psychological differences between males and females explain the deficit of women in STEM (e.g., Summers, 2005; Valla & Ceci, 2011). However, most scientists agree that any biological differences that may exist are likely too small to meaningfully explain the underrepresentation seen in STEM careers (e.g., Ceci & Williams, 2010; Halpern et al., 2007; Penner, 2008; Spelke, 2005).
A more common explanation is that women have too recently entered science education training to be equally represented in the top positions in STEM. The upward transition in a career resembles a pipeline, where there are important transitional stages that form junctures during career progression. For those in academic STEM careers, these junctures represent earning multiple degrees, being hired into a tenure-track position, and then earning promotions to advance in rank. A ‘leaky pipeline’ metaphor has been used to describe the higher rate at which women leave STEM careers at each juncture. This pattern of attrition contributes to the persistent underrepresentation of women in academic STEM positions and is cause for serious concern (Bystydzienski & Bird, 2006; Long, 2001; NAS, 2006; Preston, 2004). Marschke, Laursen, Nielsen, and Rankin (2007) calculated the time it would take the proportion of women in faculty positions to reach the proportion of those earning doctoral degrees. They found that without addressing hiring and retention inequities, the faculty proportion at their institution would never match the proportion of those in the potential hiring pool. Increasing the number of women in the hiring pool would increase the proportion in faculty positions, but qualified women remain less likely to reach top STEM positions and more likely to leave altogether (Preston, 2004). Achieving an equal rate of attrition across genders will require solutions targeted at organizational, social, and systemic issues because merely adding women to the pipeline will not be enough to end their underrepresentation (Blickenstaff, 2005; DiBenedetto & Bembenutty, 2013; Hanson, Schaub, & Baker, 1996; Holmes & O’Connell, 2007; Maltese & Tai, 2011; NAS, 2006; Pell, 1996).

Women consistently enter tenure-track positions less often than men (Nettles, Perna, & Bradburn, 2000; Perna, 2005). Promotions for women in tenure-track positions occur at a
slower rate compared to men (Modern Language Association, 2009; Tesch, Wood, Helwig, & Nattinger, 1995). In 1993, women held 11.7% of assistant professor positions in engineering, 17.7% in computer sciences and mathematics, 20.6% in physical sciences, 37.8% in biological sciences, and 42.2% in social science and psychology (NSF, 1996). Nearly two decades later in 2010, women hold only 7.9% of full professor positions in engineering, 15.5% in computer sciences and mathematics, 10.5% in physical sciences, 24.0% in biological sciences, and 28.0% in social sciences and psychology (NSF, 2010). The gap between women in an assistant professor position in 1993 and full professor in 2010 ranges from 2.2% in computer sciences and mathematics to 13.8% in biological sciences. These data show that a slow rate of promotion, or lack of promotion, may be another factor keeping women disproportionately represented in the lowest professorial ranks.

Biological explanations and a lack of women in the pipeline cannot fully explain the persistent underrepresentation of women in STEM. An alternative idea that women simply prefer not to pursue STEM careers has emerged. Ceci and Williams have spent recent years endorsing this theory while calling into question a large majority of alternative explanations (e.g., Ceci & Williams, 2007, 2011; Ceci, Williams, & Barnett, 2009; Ceci, Williams, Sumner, & DeFraine, 2011; Williams & Ceci, 2012). Some truth may exist in the idea that women choose not to pursue STEM careers, but many men also make this choice. Gendered preferences alone cannot fully explain the difference in attrition rates. There is little reason to believe that innate career preferences exist between men and women without acknowledging the influence of the social and structural barriers women face when entering a male-dominated field. Ceci and Williams recognize the influence of biological and sociocultural
factors but emphasize that these factors result in a choice made by women to leave. Stephens and Levine (2011) found that propagating the myth that women merely choose to leave careers rather than acknowledging the significant barriers they encounter results in the belief that discrimination and biases no longer exist. Women who have made it to the top of their institutions add to this theory of choice by blaming the underrepresentation of women in STEM on the idea that the women who leave science did so because they lacked the skills and merit to succeed (Cech & Blair-Loy, 2010). Women who have successful careers often deny experiencing overt discrimination and bias but identify these as challenges other women face (Bevan & Learmonth, 2012; Rhoton, 2011). Initiating change will require recognition of the systemic issues that exist for women in STEM careers, finding solutions to reduce or eliminate these issues, and gaining a more complete understanding of women’s experiences overall.

**Barriers Identified.** Many barriers have been identified as central reasons for the persistent gender gap in STEM positions. The most highly researched and discussed issues involve balancing work and family life (e.g., Adamo, 2013; Bilimoria, Joy, & Liang, 2008; NAS et al., 2006; Williams & Ceci, 2012), overt and covert discrimination and bias (e.g., Easterly & Ricard, 2011; NAS et al., 2006; Settles, Cortina, Buchanan, & Miner, 2012), as well as general institutional and departmental climate issues (e.g., Bilimoria et al., 2008; Greene, Stockard, Lewis, & Richmond, 2010; NAS et al., 2006; Settles et al., 2012).

**Work-family interferences.** The responsibilities associated with progressing in a rigorous science career while simultaneously maintaining an active family life can be stressful and result in damaging effects to career, family, or both. Careers in STEM are demanding and
to advance in rank at an academic institution requires a significant time commitment across many years. The impact of having to balance work and family responsibilities has often been portrayed as more greatly impacting the careers of women rather than men (e.g., Keene & Quadagno, 2004; Morrison, Rudd, & Nerad, 2011). Women and men holding doctoral degrees in science or engineering with no children work approximately the same number of hours per week, but women with one, two, or three or more children living in their household work an average of 1.7, 2.4, or 2.6 hours less per week, respectively, than men with the same number of children (Hoffer & Grigorian, 2005). Women continue to bear more household and childcare responsibilities than men (U.S. Department of Labor, 2013) and this trend may partially explain why women with children are working fewer hours each week. Women rate having greater work flexibility without negative consequences as one of the most important changes still necessary for faculty members with family responsibilities (McGuire, Bergen, & Polan, 2004). Keene and Quadagno (2004) also showed that women feel more balanced in their lives compared to men when choosing family over working overtime, which further demonstrates the importance of these issues for women.

Family responsibilities can interfere with work, but this factor alone does not fully explain the underrepresentation of women in STEM. A similar amount of work-family interference is reported across most disciplines in STEM (Fox et al., 2011), yet there remain drastic discrepancies in the percentage of women across these disciplines (NSF, 2013). The presence of work-family conflicts across all disciplines cannot explain why men remain predominantly present in certain areas of STEM. In the U.S., policies to help alleviate work-family conflict are becoming more accessible, yet women with children are still utilizing only
a fraction of this aid (Spalter-Roth & Erskine, 2005). The hesitation to use family-related policies, like working part-time temporarily, may be due to the perception that those individuals are not committed to their career (Kahn et al., 2005). Women remain largely underrepresented in science faculty positions that have had family-friendly policies in place for decades (Mayer & Tikka, 2008). These issues underscore the need to address other barriers in addition to work-family interferences. Regardless of the reason, women do appear more affected by balancing work and family responsibilities, but balancing these responsibilities is a concern for both men and women (Fox et al., 2011; Villablanca, Beckett, Nettiksimmons, & Howell, 2011).

**Confidence.** When surveying professors, men report more confidence in their eventual promotion in faculty rank compared to women (Baker, 2010) and greater confidence in their abilities overall (Viefers, Christie, & Ferdos, 2006). Women displaying less confidence in their STEM-related abilities as students directly relates to discontinuing their STEM education (Cech, Rubineau, Silbey, & Seron, 2011). Women also report feeling less confident that a career in STEM is the right choice for them and therefore have higher intentions to leave. Differences in confidence ratings between women and men vary throughout their training and careers, but professional relationships and general climate appear to influence these differences. For example, female and male graduate students in science and engineering report similar confidence in their abilities and career choice, but perceptions of positive future interactions with faculty predicted greater levels of confidence (Santiago & Einarson, 1998).

**Climate issues.** Conversations with women in science about career obstacles they face often lead to a discussion about climate (e.g., Ginorio, 1995; Miller & Moehlmann, 1993;
Sandler & Hall, 1986; Sharma, Hartline, Zorzenon dos Santos, & Ugur, 2005); however, the climate of an institution or department is an abstract concept that can be defined in many ways. When quantifying academic climate, social interactions, access to resources, and perceptions of bias and discrimination are typically measured (e.g., Callister, 2006; Foster et al., 2000; Maranto & Griffin, 2011).

*Gender equity.* An academic department that prevents the use of biased or discriminatory processes, allows equal access to resources and support, and values the unique contributions of all its members would be considered gender equitable. Overt bias and discrimination are frequently dismissed as being virtually nonexistent in recent years, but gender biases and discriminative acts still explain at least part of women’s underrepresentation in science (e.g., Easterly & Ricard, 2011; Moss-Racusin et al., 2012; Stark, 2008; Steinpreis, Anders, & Ritzke, 1999; Trix & Psenka, 2003). The structure of many organizations, especially those related to STEM, is inherently gendered in terms of measuring success and progress (Acker, 1990; Roth & Sonnert, 2011; Smith-Doerr, 2004; van den Brink & Benschop, 2011). When beginning graduate school, top students devote a similar amount of time to research and studying, participating in educational opportunities, and also have similar life preferences and commitment to their careers, regardless of gender (Ferriman, Lubinski, & Benbow, 2009). Yet throughout their careers, women are more likely to be recognized for and funneled into teaching and service tasks compared to men who are more likely to be recognized and encouraged in research (Fogg, 2003; Lincoln, Pincus, Koster, & Leboy, 2012; Misra, Lundquist, Holmes, & Agiomavritis, 2011; Park, 1996). Though research, teaching, and service all play important roles in the careers of academic faculty, most institutions value
research above the rest, which creates a significant disadvantage for women (Sonnert, 1995). Implementing gender equitable practices when assigning departmental tasks and responsibilities would reduce any imposed differences in how professors spend their time. Perceptions of gender equity are also positively related to men’s perception of departmental climate (Maranto & Griffin, 2011; Miner-Rubino & Cortina, 2004; Settles et al., 2012), so this measure is relevant for both men and women.

*Professional support.* Departmental support allows faculty members to flourish. Department heads largely influence faculty perceptions of equity and can create a supportive environment by making the faculty feel respected, influential in departmental decisions, and ensure they have equal access to important resources and professional support (Settles, Cortina, Stewart, & Malley, 2007; Wright et al., 2003). Departmental support has also been linked to work-family conflict where a more positive departmental climate or supportive mentor has been shown to reduce work-family conflict for both women and men (Fox et al., 2011; Nielson, Carlson, & Lankau, 2001). O’Laughlin and Bischoff (2005) reported no apparent difference between women and men in perceptions of departmental support for balancing work and family responsibilities but that women perceived negative family and career outcomes due to work-family conflicts. Overall, women are more likely to report lower perceptions of departmental support for family issues compared to their male colleagues (Bilimoria et al., 2008; Callister, 2006; Parson, Sands, & Duane, 1992).

Unlike departmental support, support from colleagues is not related to resource access or interactions with the department head specifically. Support from colleagues is measured in terms of feeling valued by colleagues, respected, and unified. Women report receiving less
support from colleagues (e.g., Olsen, Maple, & Stage, 1995). Informal interactions are instrumental in feeling supported, but female faculty members report fewer informal interactions with colleagues (Roth & Sonnert, 2011; Fox, 2010; van den Brink & Benschop, 2011) and less support from colleagues with shared research interests compared to male faculty (Parson et al., 1992). Women rate earning respect and being perceived as credible by colleagues as one of the top issues still facing women in STEM (Rosser, 2004b), which further illustrates the importance of support.

**Sense of belonging.** Belonging can be considered from psychological, sociological, physical, or spiritual perspectives, and each of these perspectives takes a distinct view about what it means to belong (Hagerty, Lynch-Sauer, Patusky, Bouwsema, & Collier, 1992; Hagerty & Patusky, 1995). The psychological measure of belonging is considered one’s *sense of belonging* and can be defined as “a person's experience of being valued or important to an external referent and experiencing a fit between self and that referent” (Hagerty et al., 1992, p. 174). Anderson-Butcher and Conroy (2002) identified perceptions of commitment, engagement, and connectedness as important aspects of sense of belonging. Climate factors, like support and gender equity, impact an individual’s sense of belonging (Hagerty & Williams, 1999; Johnson, 2012; Lindholm, 2003; London, Rosenthal, Levy, & Lobel, 2011; Maramba, & Museus, 2011; Moody, 2004; Richman, vanDellen, & Wood, 2011; Rosenthal, Levy, London, Lobel, & Bazile, 2013; Rosenthal, London, Levy, & Lobel, 2011; Stout, Ito, Finkelstein, & Pollock, 2013; Turner & McLaren, 2011). The importance of sense of belonging becomes even more apparent when discussing possible climate improvements with current science faculty, especially women (Steinert et al., 2009). Women who are students,
both undergraduate and graduate, report a lower sense of belonging to STEM (Good, Rattan, & Dweck, 2012; Herzig, 2010).

**Involvement and Connections in STEM**

The issues outlined above limit the involvement of women and the connection they feel to STEM and can be detrimental to several career outcomes. Work-family interference results in less time spent on work (Hoffer & Grigorian, 2005) and fewer interactions with colleagues, reduced overall career satisfaction (Post, DiTomaso, Farris, & Cordero, 2009), and greater intentions to leave a job (Kelloway, Gottlieb, & Barham, 1999). A supportive or gender equitable climate can help mitigate these negative impacts, leading to lower intentions to leave and greater productivity (Fox et al., 2011; Neumann & Finaly-Neumann, 1990; Nielson et al., 2001; Settles et al., 2006). Support is important regardless of gender, but women report placing a higher value on relationships with their colleagues compared to men (Ferriman et al., 2009) and may benefit more from this increased support. Career satisfaction increases when the climate is perceived as supportive (Olsen et al., 1995; Post et al., 2009; Rosser, 2004b) and gender equitable (Callister, 2006; Settles et al., 2006). Greater career satisfaction results in lower turnover intentions (Heckert & Farabee, 2006) and is associated with an increased sense of belonging (Lim, 2007; Westover, Westover, & Westover, 2010; Winter-Collins & McDaniel, 2000).

In addition to a general sense of support and belonging, connections with others in STEM play an important professional role for faculty. Research is arguably the most heavily weighted measure of career progress for tenure-track professors being judged by colleagues and committees making decisions about promotions. In addition to being important for career
progress, activities and discussions involving research create opportunities to connect and interact with faculty spanning the scientific community. There is no difference in the degree to which women and men value their research (Olsen et al., 1995), yet female faculty report spending more time in service and teaching roles rather than research; conversely, men are able to focus more time on their research (Park, 1996; Santo, Engstrom, Reetz, Schweinle, & Reed, 2009; Wimsatt, Trice, & Langley, 2009). Women who spend a disproportionate time on service and teaching tasks have fewer opportunities to advance and display their research skills. The connections formed with others in their field may also increase feelings of support and fit within STEM, but these benefits would be reduced for women who are less involved in research and potentially more disconnected from other researchers.

**Professional Research Organizations**

Participating in national and international STEM organizations is a common activity throughout a career in academia. Professional research organizations provide opportunities for collaboration, a sense of community, and support and recognition for modern researchers. Many scientists agree that involvement in these organizations should be encouraged and may help alleviate feelings of isolation, especially for women in science (e.g., MacNamara, Taylor, Grimm, Taylor, & Gottlieb, 2012). Fassinger and Asay (2006) also argue that one way to cope with a negative institutional climate would be to network in broader organizations at a national or international level. In fact, the formation of external support networks is strongly related to the probability that students will stay in science (Fuchs, von Stebut, & Allmendinger, 2001). Understanding women’s experiences within these organizations is important for fostering and maintaining their sense of belonging to the broader scientific
community along with providing career development opportunities. However, the issues women face in academic STEM settings may also be limiting the involvement of women in these research organizations and preventing them from reaping the maximum benefits available.

There has been virtually no research examining whether belonging and being involved in professional research organizations is positively associated with career satisfaction for academic faculty in STEM. The relationship between affective connections to research organizations and career satisfaction as well as whether this relationship differed between women and men was examined in Chapter 2. The purpose of Chapter 3 was to gain a better understanding of how involvement has shifted across time. Considering the career barriers women face within academic institutions where they are employed, factors limiting the involvement of women in research organizations were also measured in Chapter 4 along with the perceived importance of membership benefits. Finally, the barriers that negatively impact many women within STEM academic departments are being addressed across the country (e.g., Bilimoria et al., 2008; Bonnekessen, 2011; Laursen & Rocque, 2009; NAS et al., 2006; Preston, 2004; Rosser, 2004b), so an examination of organizational characteristics and processes influencing perceptions of gender equity was undertaken in Chapter 5. Together, these studies provide a general overview of the status of women in research organizations and emphasize the necessity of considering experiences outside academic institutions in order to increase the representation of women in STEM.
CHAPTER TWO

AFFECTIVE COMMITMENT TO RESEARCH ORGANIZATIONS

Women leave most science, technology, engineering, and mathematics (STEM) fields at a higher rate than men at all stages of career training and advancement (Preston, 2004). Considerable attention is now being placed on identifying and addressing the issues contributing to the disproportionate attrition of women. One area of particular interest is career satisfaction, which is a broad measure of satisfaction with one’s overall career progress and achievements (Greenhaus, Parasuraman, & Wormley, 1990). Identifying factors that positively relate to career satisfaction may help to uncover new targets for improving the experiences of women in STEM in hopes of reducing attrition rates. One common experience for researchers is involvement within professional research organizations. A positive relationship between commitment to these organizations and career satisfaction would offer a new direction from which to address potential issues contributing to the persistent underrepresentation of women in STEM.

There are several benefits associated with belonging to a research organization that may positively relate to overall career satisfaction. These benefits include interacting and meeting with students and colleagues. Positive student relations and department climate are significantly related to career satisfaction for women in research universities (August & Waltman, 2004). Afonso, Ramos, Saraiva, Moreira, and Figueira (2014) found that psychiatrists reporting greater career satisfaction were also more involved in scientific activities and displayed greater motivation to continue learning. Greater engagement with colleagues reduces feelings of isolation and creates a more positive work environment.
(MacNamara, Taylor, Grimm, Taylor, & Gottlieb, 2012; Maranto & Griffin, 2011). In turn, feelings of belonging relate to greater career satisfaction, especially for underrepresented individuals (Collison, 1999; Lim, 2007; Winter-Collins & McDaniel, 2000). Career satisfaction is inversely related to turnover intentions (Eby, Freeman, Rush, & Lance, 1999; Heckert & Farabee, 2006) and appears to mediate the link between many negative climate factors and turnover intentions (Chen, Chang, & Yeh, 2004; Heckert & Farabee, 2006; Rosser, 2004b). These findings portray a clear relationship between career satisfaction and positive experiences with colleagues and students.

Compared to men, women in STEM view relationships in their careers as more important (Ferriman, Lubinski, & Benbow, 2009), but unfortunately, women in STEM often report fewer positive interactions with colleagues (Roth & Sonnert, 2011; Fox, 2010; Parson, Sands, & Duane, 1992; van den Brink & Benschop, 2011). The disconnect between what women are experiencing within their academic environment and what they perceive as important in regard to forming both informal and formal relationships needs to be addressed. Avenues outside academic institutions, such as research organizations, could be used to foster a sense of belonging, connectedness, and community, but these organizations are seldom studied.

Fassinger and Assay (2006) advise women in male-dominated fields to reach beyond their department and connect with researchers throughout the scientific community. Research organizations provide an obvious approach to forming such connections. Belonging to professional research organizations provides many benefits for faculty, including the opportunity to attend meetings and interact with researchers from other academic institutions.
Forming positive connections with other individuals in an organization is an antecedent of commitment, specifically affective commitment (Allen & Meyer, 1990). Affective commitment refers to an “affective or emotional attachment to [an] organization such that the strongly committed individual identifies with, is involved in, and enjoys membership in, the organization” (Allen & Meyer, 1990, p. 2). Affective commitment to the institution where a person is employed relates positively to career satisfaction and commitment to one’s career (Allen & Meyer, 1996; Ariani, 2012; Meyer & Allen, 1997), but affective commitment to a research organization where membership is voluntary and possibly transitory has yet to be examined. The first hypothesis in this study was developed to test this relationship:

_Hypothesis 1: Affective commitment to a professional research organization will positively correlate with career satisfaction._

In addition to testing this basic relationship, determining whether affective commitment to a research organization is uniquely related to measures of productivity was also of interest. Research organizations provide many important benefits for faculty in STEM that could increase overall productivity for both women and men. For example, networking has been rated as one of the most important benefits of belonging to a research organization for women and men alike (see Chapter 4) and may lead to new collaborative relationships. The number of collaborators an individual works with is directly related to their publication productivity (Lee & Bozeman, 2005). Continuing collaborations with former students is another predictor of research productivity, particularly when those students go on to work in high ranking institutions (Adams, Black, Clemmons, & Stephan, 2005). Connecting students and early-career faculty with mentors is incorporated into the meetings and activities
sponsored by most research organizations. Faculty members involved and committed to research organizations will likely have increased student interactions, and a greater number of graduate students relates to more publications per year after controlling for discipline (Blackburn, Behymer, & Hall, 1978). The added connections with both potential collaborators and students associated with belonging to research organizations led to the following hypothesis:

Hypothesis 2: Affective commitment to a professional research organization will relate to greater publication productivity and mentoring activities.

METHOD

Participants

Faculty members were selected from 41 doctoral/research universities across the United States with very high research activity as classified by the Carnegie Commission (Carnegie Foundation, 2010). Faculty members from all nine geographic regions identified by the U.S. Census Bureau were sampled (see Table 1). Only tenure-track faculty members were included in the analyses due to the importance of involvement in research organizations (90 respondents not in a tenure track position were excluded). Participants also were excluded if they did not indicate their gender (n = 25). Any individuals completing the survey about organizations that were not research organizations were excluded (see Organizations section for details). These included individuals naming academic or government institutions (n = 12) or leaving the organization field blank (n = 6). The total sample after exclusions was 645 (women = 334, men = 311). The age of participants ranged from 27 to 89 (M = 49.5, SD =
The majority of participants were White (84.3%), followed by multiracial/ethnic (4.0%), Asian (4.0%), Black (2.8%), Hispanic/Latina/o (2.4%), other (0.8%), or non-resident (1.7%). Assistant (27.6%), associate (27.1%), full (35.2%), and distinguished or emeritus (10.1%) professors were surveyed.

The number of women represented across science disciplines varies greatly, where women are least represented in the hard sciences, followed by the life sciences, and are most equally represented in social science disciplines. In 2010, women were 20.6% of full, associate, and assistant professors in physical science, 31.2% in biological sciences, and 40.9% in social science and psychology (National Science Foundation [NSF], 2013). Science professors were divided into these three academic categories based on the differences in representation. Hard sciences included chemistry, physics, astronomy, geology, and earth sciences. Life sciences included biology, neuroscience, agriculture, and environmental science. Social sciences included psychology, sociology, anthropology, and political science. The final category was comprised of technology, engineering, and mathematics (TEM) faculty because of the drastic underrepresentation of women in these disciplines. Only 17.9% of professors in these disciplines were women in 2010 (NSF, 2013). Table 2 provides a summary of the demographic information grouped by gender in these four academic categories.

Procedure

Faculty email addresses were retrieved from their respective university webpages from all departments related to those already defined (see Participants section). Attempting to achieve an equal distribution of women and men in each academic category, email addresses
for all individuals in the least represented gender category for each department were gathered along with a random selection of approximately the same number of individuals of the remaining gender. Women were anticipated to have a higher response rate than men, so 10% more men were randomly selected and sent email invitations.

The electronic survey was designed and managed using Qualtrics (see Appendix A for complete survey). A link to the survey was sent in an email to each selected faculty member. Participants first had to read and agree to an informed consent page prior to beginning the survey and could discontinue their participation at any time. Up to three reminders were sent over the period of a month and participants could unsubscribe from these reminders. The survey and procedure were deemed exempt by the Washington State University Institutional Review Board.

**Measures**

**Career satisfaction.** Greenhaus et al. (1990) developed a 5-item measure of career satisfaction. Each item was rated on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*) and examples of two items follow: “I am satisfied with the success I have achieved in my career” and “I am satisfied with the progress I have made toward meeting my goals for income.” The complete scale and factor loadings can be found in Appendix B.

**Affective commitment to academic institution.** The 8-item scale developed by Allen and Meyer (1990) was used to measure affective commitment to the academic institution where participants were employed. The word *organization* originally used in this scale was replaced with *institution* to prevent confusion with questions about a professional research organization. The complete scale and factor loadings can be found in Appendix B.
Affective commitment to research organization. The same 8-item affective commitment scale was used to measure affective commitment to professional research organizations identified by participants in the survey. The word organization was left unaltered in these prompts. Appendix B displays the complete prompts and factor loadings for this scale.

Productivity. Productivity is most commonly measured by counting publications made over a set amount of time or across one’s career (e.g., Braisher, Symonds, & Gemmell, 2005; Sax, Hagedorn, Arredondo, & Dicrisi, 2002; Taylor, Fender, & Burke, 2006; van Arensbergen, van der Weijden, & van den Besselaar, 2012). For the current study, participants were asked to report the number of publications in which they were an author over the past two years to gauge their current level of productivity.

Mentoring. Participants were asked to report the number of graduate students for which they served as the primary mentor over the past two years. One participant reported serving as the primary advisor for 216 graduate students; this was over 15 standard deviations above the mean and was excluded from analysis.

Organizations

Within the survey, participants were asked to identify two professional research organizations in their discipline and report their perceptions about the organization they chose. Only one organization identified was analyzed for each participant. A random selection of organizations identified first and those identified second were used. There were 201 unique organizations identified by participants in the survey that were included in the data analysis. Women \((n = 334)\) identified a total of 149 and men \((n = 311)\) identified a total of 128
organizations. The number of participants selecting each organization ranged from 1 to 20 for women \( (M = 2.24, SD = 2.56) \) with 55.7% of organizations identified by only one individual and 1 to 16 for men \( (M = 2.43, SD = 2.84) \) with 61.7% of organizations identified only once.

**Analysis**

Mplus 7.2 software was used to examine the measurement and latent construct of affective commitment to a research organization (ACR), affective commitment to the institution of employment (ACI), and career satisfaction among women and men in STEM using robust maximum likelihood estimation procedures (Muthén, & Muthén, 2012). Missing data were handled using the missing-at-random (MAR) procedure incorporated into Mplus software (Muthén, & Muthén, 2012). There were very little missing data. The variables with the most missing data were reports for the number of graduate students mentored with coverage of 95% and career tenure with 98% coverage.

An agreed upon standard for indices of global model fit has not been established (Barrett, 2007; Hu & Bentler, 1999; Savalei & Bentler, 2006). For the current study, comparative fit index (CFI) with a criterion of CFI > 0.90, a standardized root mean-square residual (SRMR) with a cutoff value of SRMR < 0.08, and a root-mean squared error of approximation (RMSEA) with a criterion of RMSEA < 0.08 were considered acceptable. CFI compares the null model to the hypothesized model. SRMR is a measure of how close the hypothesized model correlations match the observed correlations and RMSEA takes into account model complexity, favoring a parsimonious model. The current sample size was moderately large, so even small residual covariances were likely to result in a significant chi-
square test (Floyd & Widaman, 1995); therefore, the chi-square test was not relied upon for measuring global fit in the current study.

**Measurement invariance.** When testing differences between groups and relationships among latent factors, it is important to first determine whether the measures used are invariant across groups (Vandenberg & Lance, 2000; Wang & Wang, 2012; Widaman & Reise, 1997). Participants were grouped into two broad categories: those in hard sciences, technology, engineering, and mathematics compared to those in life science and social science. These categories were used because of the low proportion of women as tenure-track faculty in hard sciences and TEM (19.0%) compared to women in life sciences and social sciences (36.5%; NSF, 2013) and enabled a comparison by representation while maintaining a sample size in each group equal to or exceeding 100. Women and men were tested separately, resulting in four distinct groups. A Satorra–Bentler scaled chi-square statistic ($SB\chi^2$) was used to measure invariance as constraints were imposed (Satorra & Bentler, 2001). Cheung and Rensvold (2002) also recommend using a change in CFI $\leq .01$ to indicate invariance comparing nested models.

First, each group was tested separately and had acceptable global fit. The *configural model* was estimated next to examine whether each group had the same underlying factor structure. This model was used to measure invariance in the subsequent models. When invariance across groups held, the constraints were included in subsequent invariance tests. *Metric invariance* was tested by constraining the factor loadings to be equal across the four groups. *Scalar invariance* was tested by constraining item intercepts in addition to the factor loadings. Finally, *factor invariance* was tested by constraining the variance in each of the
three factors to be equal across the four groups. The factor covariances were constrained to be equal across groups to examine factor covariance invariance.

**Latent mean differences.** The mean differences in the latent factors were estimated using women in life science and social science as the reference group. The z-score for years since tenure hire was used to represent career tenure and entered as a control for career satisfaction and affective commitment to the institution of employment. The z-score for membership tenure was entered as a control for affective commitment to the research organization identified.

**Structural invariance.** Each of the three factors measured was hypothesized to positively relate to two measures of productivity: number of publications and graduate students mentored over the past two years. Publications and number of graduate students were entered as z-scores. The number of years since tenure hire was again entered as a control for career satisfaction and affective commitment to the institution of employment. Membership tenure was entered as a control for affective commitment to the organization. There were 12 parameters tested for invariance: correlations among factors (3 parameters), each factor predicting publications (3 parameters), each factor predicting number of graduate students (3 parameters), and career or membership tenure as controls (3 parameters).

**RESULTS**

**Measurement Invariance**

First, each group was tested separately and had acceptable global fit (see Table 3). The configural model was estimated next to examine whether each group had the same underlying
factor structure. This model was used to measure invariance in the subsequent models. Next, *metric invariance* was tested by constraining the factor loadings to be equal across the four groups and there was no significant decrement in fit, determined by the lack of change in CFI and non-significant chi-square test. Invariance at this stage indicates the items relate to a similar increase in their respective factor in each group. *Scalar invariance* was tested by constraining item intercepts in addition to the factor loadings, which held across groups. This indicates that none of the four groups tested responded systematically higher or lower than the other groups and the factor intercepts were similar.

The measurement of these factors was invariant across the four groups examined and allowed for testing of factor relationships. First, *factor invariance* was tested by constraining the variance in each of the three factors to be equal across the four groups. At this point, the SRMR exceeded the minimum threshold for acceptable fit (< .08), but there was no decrease in CFI and the change in SBχ² was non-significant, indicating no significant decrement in overall fit and similar factor variability across the four groups. The *factor covariance* structure was also invariant and indicates the relationship between the factors was the same. There was a significant relationship between all three latent factors, providing support for the main hypothesis that affective commitment to a research organization would significantly relate to career satisfaction.

**Latent Mean Differences**

The latent factor mean differences are summarized in Table 4. Men in the life science and social science academic category reported significantly higher career satisfaction compared to women in life science and social science. There were no significant latent mean
differences between groups for either affective commitment to the institution or research organization.

**Structural Invariance**

The measurement and factor relationships were invariant across the four groups examined and allowed for testing of relationships with career outcomes. The main interest of the structural invariance testing was to examine differences between women and men. Women from the life sciences and social sciences were first tested on each of these parameters using a Wald test of parameter constraint. None of the 12 parameter constraints were significantly different for women in life or social sciences compared to women in hard sciences or technology, engineering, and mathematics (TEM). The result of all parameters constrained simultaneously was also not significant, $\chi^2(12) = 11.97, p = .45$. Parameters tested individually were invariant when comparing men in life and social sciences to men in hard science and TEM. All 12 parameters tested simultaneously for men were invariant, $\chi^2(12) = 5.24, p = .95$. Therefore, all women were analyzed together and all men were analyzed together for the final structural invariance testing.

Table 5 provides the means and standard deviations of productivity measures and control variables. The number of published articles over the past two years did not differ significantly between women and men, $t(625) = 0.076, p = .94, d = .006$. Women reported mentoring significantly more graduate students than men, $t(606) = 2.580, p = .010, d = .21$. Men had a longer average career tenure compared to women, $t(631) = 6.502, p < .001, d = .52$. Men also had a longer average membership tenure in their specified research organization compared to women, $t(643) = 6.004, p < .001, d = .48$. 
The global fit of the model was acceptable; $\chi^2(566) = 1,065.14, p < .0001; \text{RMSEA} = 0.053$, 90% CI (0.048 - 0.058); CFI = 0.932; SRMR = 0.054. Figure 1 shows a summary of the final model for women and men. Control variables that were not significant for either gender were not shown in the figure but were retained in the analysis. Standard errors were corrected for clustering by organization for relationships including ACR and for affiliation in the correlation between career satisfaction and ACI. Career tenure was significantly associated with ACI for women ($\beta = 0.163, SE = .06, p = .004$) as well as for men ($\beta = 0.154, SE = .06, p = .009$). Career tenure on ACI was invariant across gender, $\chi^2(1) = 0.505, p = .48$. Career tenure did significantly relate to career satisfaction for men ($\beta = 0.190, SE = .05, p < .001$) but not women ($\beta = 0.106, SE = .05, p = .053$). Regardless, this relationship was invariant across gender, $\chi^2(1) = 0.195, p = .66$, indicating the relationship between career tenure and career satisfaction did not differ between women and men. Years of membership was significantly related to ACR for women ($\beta = 0.288, SE = .05, p < .001$) and men ($\beta = 0.285, SE = .05, p < .001$), and was invariant across gender, $\chi^2(1) = 2.403, p = .12$. Neither ACI nor ACR were significantly associated with the number of publications or the number of graduate students mentored over the past two years. Career satisfaction was related to both of these outcomes for men but only with publication productivity for women. Regardless, the relationship between career satisfaction and number of graduate students was invariant across gender, $\chi^2(1) = 1.91, p = .17$. Each of the correlations between factors remained invariant as determined when testing measurement invariance. There was no overall difference between women and men for the 12 parameters tested, $\chi^2(12) = 9.415, p = .67$. 
A regression analysis was used to determine whether the positive correlation between ACR and career satisfaction remained significant when controlling for the relationship between ACI and career satisfaction. Figure 2 shows that the relationship between ACR and career satisfaction is positive and significant. There were no gender differences when comparing the unique relationship between ACR and career satisfaction, $\chi^2(1) = 0.021, p = .88$, or ACI and career satisfaction, $\chi^2(1) = 0.713, p = .40$.

**DISCUSSION**

Affective commitment to a research organization was found to positively correlate with overall career satisfaction. This relationship was maintained when holding constant the influence of affective commitment to the academic institution on career satisfaction. There was no significant gender difference in the relationship between career satisfaction and affective commitment to a research organization. There was also no mean gender difference in ratings of affective commitment to a research organization or the academic institution. In general, this indicates that research organizations have a similarly positive relationship with the careers of STEM faculty regardless of gender, but improving the experiences of women within research organizations may still be warranted. In at least some organizations, a disproportionate recognition of men remains (see Chapter 3; Casadevall & Handelsman, 2014; Isbell, Young, & Harcourt, 2012), and there is also evidence that women perceive more gender bias within research organizations in general (see Chapter 4). The current study is the first to relay the important relationships between research organizations, where faculty choose to become and stay members, with overall career satisfaction. The correlation between
affective commitment and career satisfaction indicates that a greater level of one is associated with a greater level in the other for both women and men.

Affective commitment was of particular interest because many of its antecedents relate to feelings of fit and belonging to the organization (Allen & Meyer, 1990). Women consistently report greater dissatisfaction with colleague relationships and a lower sense of belonging in STEM compared to men (e.g., Good, Rattan, & Dweck, 2012; Herzig, 2010; Steinert et al., 2009) but positive interactions with others correspond to an increased sense of belonging (e.g., Lindholm, 2003; London, Rosenthal, Levy, & Lobel, 2011). In the current study, a significant positive relationship was shown to exist between the measures of affective commitment to a research organization and the academic institution of employment for faculty. This positive relationship implies that there are similarities in the experiences related to a sense of belonging, interactions with others, and general connectedness in research organizations as there are in academic institutions. There has been a significant focus on improving these experiences for female faculty in academic institutions where they are employed (e.g., Bystydzienski & Bird, 2006; Institute for Research on Women, 2002; National Academy of Sciences [NAS] et al., 2006, 2007). Implementing these same improvements within research organizations would more fully address the negative elements that remain as part of the gender climate in STEM.

An interesting gender difference did appear in regard to ratings of career satisfaction, where women in life and social sciences rated their career satisfaction significantly lower than men in these same fields. Considering the current focus on women in male-dominated disciplines, the difference in ratings of career satisfaction was unanticipated for women in life
and social sciences where they are most equally represented (NSF, 2013). There was no
gender difference when examining career satisfaction reported by faculty in hard sciences or
TEM. Women report less satisfaction with many specific elements of their careers compared
to men (e.g., Bilimoria et al., 2006, Callister, 2006), but this pattern is largely dependent on
which control variables are included (Sabharwal & Corley, 2009). The difference in career
satisfaction between women and men was calculated in the current study because the measure
used was invariant across gender. However, previous studies have shown that career
satisfaction and what is perceived as career success may be conceptualized differently by men
and women (Hofmans, Dries, & Peremans, 2008; Sheridan, Brennan, Carnes, & Handelsman,
2006). A closer examination of this measure is warranted considering most studies assess
specific job-related factors rather than overall career satisfaction but both are important
predictors of turnover intentions (e.g., Callister, 2006; Chen et al., 2004; Heckert & Farabee,
2006; Morrow & Ackermann, 2012).

Affective commitment to a research organization did not uniquely predict the number
of articles published within a two-year period or the number of graduate students mentored.
Productivity is more commonly predicted by job satisfaction, which includes measures more
specific to the work environment (e.g., Spector, 1985) rather than general satisfaction with
career achievements or affective commitment. However, the relationship between
productivity and career satisfaction has been shown previously (e.g., Afonso et al., 2014) and
a similar positive relationship was seen in the current study. Women have repeatedly been
documented as being less productive than their male colleagues (e.g., Bird, 2011; Braisher et
al., 2005; Long, 1992; van Arensbergen et al., 2012; Xie & Shauman, 1998); however, once
controlling for career tenure and family demographics, there is no significant difference in productivity across gender (Carr et al., 1998; DesRoches, Zinner, Rao, Iezzoni, & Campbell, 2010). Participants in the current study also had an equal number of self-reported publications across gender.

The cross-sectional nature of these data prevents a clear interpretation of any causal relationship between career satisfaction, published articles, and number of graduate students mentored. The relationships of more interest in the current study were between affective commitment to a research organization and these same outcomes, which were not significant for women or men. However, a longitudinal study would better determine whether a significant relationship between affective commitment to a research organization and measures of productivity. Research abilities displayed early on in a scientist’s career predict the likelihood of later promotions and overall career progress (Bjerk, 2008). Research organizations provide unique opportunities to display and discuss research within the broader scientific community. Measuring the impact of organizational involvement at various career stages would provide information about whether displaying research abilities and forming connections within professional research organizations predict more productive careers overall.

The results of this study are the first to reveal a significant link between commitment to an entity outside an academic institution and the careers of faculty in STEM. Involvement in research organizations is an integral element of the professional lives of tenure-track professors at research universities. Changes made to address any issues negatively impacting members of research organizations could in turn lead to greater career satisfaction. Although
the relationship between affective commitment to a research organization and career satisfaction did not differ between women and men, reducing the higher attrition rates of women will require targeted solutions across all facets of faculty careers. These data uncover the potential value in directing more attention toward research organizations in the future and the following chapters examine the experiences and representation of women within professional research organizations.
Table 1

Total Faculty Survey Invitations and Percent Responses by U.S. Geographic Region

<table>
<thead>
<tr>
<th>Region</th>
<th>Institutions</th>
<th>Sent</th>
<th>Male Respondents</th>
<th>Female Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>n</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>New England</td>
<td>5</td>
<td>992</td>
<td>43</td>
<td>8.0</td>
</tr>
<tr>
<td>Middle Atlantic</td>
<td>4</td>
<td>726</td>
<td>24</td>
<td>5.9</td>
</tr>
<tr>
<td>South Atlantic</td>
<td>7</td>
<td>1,603</td>
<td>63</td>
<td>7.3</td>
</tr>
<tr>
<td>West South Central</td>
<td>4</td>
<td>683</td>
<td>47</td>
<td>12.1</td>
</tr>
<tr>
<td>East South Central</td>
<td>5</td>
<td>713</td>
<td>33</td>
<td>8.3</td>
</tr>
<tr>
<td>East North Central</td>
<td>5</td>
<td>1,450</td>
<td>53</td>
<td>6.6</td>
</tr>
<tr>
<td>West North Central</td>
<td>4</td>
<td>732</td>
<td>34</td>
<td>8.3</td>
</tr>
<tr>
<td>Mountain</td>
<td>4</td>
<td>1,197</td>
<td>48</td>
<td>7.2</td>
</tr>
<tr>
<td>Pacific</td>
<td>3</td>
<td>687</td>
<td>22</td>
<td>5.9</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>41</strong></td>
<td><strong>8,783</strong></td>
<td><strong>367</strong></td>
<td><strong>7.6</strong></td>
</tr>
</tbody>
</table>

Note. Percent response rates were calculated prior to exclusions for male and female respondents separately based on the number of surveys originally sent to male and female faculty in each region. Total response rate was 8.9%.
## Table 2

### Demographic Information of Surveyed Faculty Members

<table>
<thead>
<tr>
<th></th>
<th>Hard Science</th>
<th></th>
<th>Life Science</th>
<th></th>
<th>Social Science</th>
<th></th>
<th>TEM</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Women</td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>N</td>
<td>41</td>
<td>41</td>
<td>88</td>
<td>89</td>
<td>143</td>
<td>122</td>
<td>62</td>
<td>59</td>
</tr>
<tr>
<td>Mean Age (SD)</td>
<td>45.2 (11.7)</td>
<td>53.4 (12.0)</td>
<td>49.9 (12.1)</td>
<td>56.5 (12.6)</td>
<td>45.9 (10.7)</td>
<td>50.8 (14.1)</td>
<td>44.1 (11.3)</td>
<td>50.9 (12.6)</td>
</tr>
<tr>
<td>Relationship Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>12.2%</td>
<td>2.4%</td>
<td>11.4%</td>
<td>1.1%</td>
<td>13.3%</td>
<td>5.7%</td>
<td>9.7%</td>
<td>10.2%</td>
</tr>
<tr>
<td>Committed</td>
<td>2.4%</td>
<td>0.0%</td>
<td>3.4%</td>
<td>4.5%</td>
<td>8.4%</td>
<td>2.5%</td>
<td>9.7%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Separated/Divorced</td>
<td>7.3%</td>
<td>2.4%</td>
<td>6.8%</td>
<td>3.4%</td>
<td>12.6%</td>
<td>6.6%</td>
<td>4.8%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Married</td>
<td>73.2%</td>
<td>95.2%</td>
<td>77.3%</td>
<td>88.8%</td>
<td>64.3%</td>
<td>84.4%</td>
<td>71.0%</td>
<td>81.4%</td>
</tr>
<tr>
<td>Children</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>36.6%</td>
<td>12.2%</td>
<td>35.2%</td>
<td>20.2%</td>
<td>37.8%</td>
<td>24.6%</td>
<td>45.2</td>
<td>23.7%</td>
</tr>
<tr>
<td>1</td>
<td>29.3%</td>
<td>26.8%</td>
<td>30.7%</td>
<td>10.1%</td>
<td>23.1%</td>
<td>23.8%</td>
<td>16.1</td>
<td>13.6%</td>
</tr>
<tr>
<td>2 or more</td>
<td>31.7%</td>
<td>61.0%</td>
<td>30.7%</td>
<td>67.4%</td>
<td>36.4%</td>
<td>48.4%</td>
<td>35.5</td>
<td>62.7%</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>87.8%</td>
<td>87.8%</td>
<td>86.4%</td>
<td>88.8%</td>
<td>83.2%</td>
<td>86.9%</td>
<td>80.6</td>
<td>71.2%</td>
</tr>
<tr>
<td>Asian</td>
<td>2.4%</td>
<td>0.0%</td>
<td>3.4%</td>
<td>1.1%</td>
<td>2.8%</td>
<td>3.3%</td>
<td>6.5%</td>
<td>15.2%</td>
</tr>
<tr>
<td>Black</td>
<td>4.9%</td>
<td>2.4%</td>
<td>0.0%</td>
<td>2.2%</td>
<td>6.3%</td>
<td>1.6%</td>
<td>0.0%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.0%</td>
<td>0.0%</td>
<td>2.3%</td>
<td>1.1%</td>
<td>2.1%</td>
<td>4.1%</td>
<td>3.2%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Other</td>
<td>0.0%</td>
<td>9.8%</td>
<td>7.9%</td>
<td>3.4%</td>
<td>3.5%</td>
<td>3.3%</td>
<td>9.7%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Rank</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assistant</td>
<td>34.1%</td>
<td>12.2%</td>
<td>26.1%</td>
<td>18.0%</td>
<td>32.8%</td>
<td>25.4%</td>
<td>43.6</td>
<td>25.4%</td>
</tr>
<tr>
<td>Associate</td>
<td>29.3%</td>
<td>24.4%</td>
<td>22.7%</td>
<td>19.1%</td>
<td>34.3%</td>
<td>30.3%</td>
<td>27.4</td>
<td>22.0%</td>
</tr>
<tr>
<td>Full</td>
<td>22.0%</td>
<td>58.5%</td>
<td>39.8%</td>
<td>44.9%</td>
<td>28.0%</td>
<td>31.1%</td>
<td>25.8</td>
<td>42.4%</td>
</tr>
<tr>
<td>Distinguished</td>
<td>14.6%</td>
<td>4.9%</td>
<td>11.4%</td>
<td>18.0%</td>
<td>4.9%</td>
<td>13.2%</td>
<td>3.2%</td>
<td>10.2%</td>
</tr>
</tbody>
</table>

*Note.* Percent was calculated separately for women and men in each academic category. Totals include non-respondents, which accounts for demographic categories not summing to 100%. TEM = Technology, Engineering, and Mathematics.
### Table 3

**Measurement and Factor Invariance Tests for ACR, ACI, and Career Satisfaction of STEM Women and Men**

<table>
<thead>
<tr>
<th>Model and Level of Invariance</th>
<th>Overall Fit Indices</th>
<th>Comparative Fit Indices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SBχ²</td>
<td>df</td>
</tr>
<tr>
<td>Women in HTEM</td>
<td>285.6*</td>
<td>186</td>
</tr>
<tr>
<td>Men in HTEM</td>
<td>261.5*</td>
<td>186</td>
</tr>
<tr>
<td>Women in LSS</td>
<td>272.6*</td>
<td>186</td>
</tr>
<tr>
<td>Men in LSS</td>
<td>321.4*</td>
<td>186</td>
</tr>
<tr>
<td>1. Configural</td>
<td>1,142.2*</td>
<td>744</td>
</tr>
<tr>
<td>2. Metric</td>
<td>1,185.5*</td>
<td>798</td>
</tr>
<tr>
<td>3. Scalar</td>
<td>1,265.9*</td>
<td>861</td>
</tr>
<tr>
<td>4. Factor variance</td>
<td>1,275.2*</td>
<td>870</td>
</tr>
<tr>
<td>5. Factor covariance</td>
<td>1,283.1*</td>
<td>879</td>
</tr>
</tbody>
</table>

*Note. Measurement and structural invariance was tested between women in hard science, technology, engineering, and mathematics (N = 103), men in hard science, technology, engineering, and mathematics (N = 100), women in life and social science (N = 231), and men in life and social science (N = 211). ACR = affective commitment to research organization; ACI = affective commitment to academic institution of employment; STEM = science, technology, engineering, and mathematics; SBχ² = Satorra–Bentler scaled chi-square statistic; CFI = robust comparative fit index; SRMR = robust standardized root mean square residual; RMSEA = robust root mean square error of approximation; Δ = change between comparison models; df = degrees of freedom; HTEM = hard science, technology, engineering, and mathematics; LSS = life science and social science. * p ≤ .001
<table>
<thead>
<tr>
<th>Latent Factor</th>
<th>Men Life/Social</th>
<th></th>
<th>Women HTEM</th>
<th></th>
<th>Men HTEM</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Difference</td>
<td>S.E.</td>
<td>Z</td>
<td>d</td>
<td>Mean Difference</td>
<td>S.E.</td>
</tr>
<tr>
<td>Affective Commitment to Research Organization</td>
<td>0.109</td>
<td>0.100</td>
<td>1.08</td>
<td>.11</td>
<td>0.099</td>
<td>0.124</td>
</tr>
<tr>
<td>Affective Commitment to Institution of Employment</td>
<td>0.059</td>
<td>0.101</td>
<td>0.58</td>
<td>.06</td>
<td>0.010</td>
<td>0.130</td>
</tr>
<tr>
<td>Career Satisfaction</td>
<td>0.356</td>
<td>0.116</td>
<td>3.07*</td>
<td>.34</td>
<td>0.191</td>
<td>0.136</td>
</tr>
</tbody>
</table>

*Note. Reference group is women in life or social sciences. A positive difference indicates a higher latent mean score compared to women in Life/Social. ACR = affective commitment to research organization; ACI = affective commitment to institution of employment; STEM = science, technology, engineering, and mathematics; HTEM = hard science, technology, engineering, or mathematics; Life/Social = life science or social science; d = Cohen’s d.

* p ≤ .01
Table 5

*Means for Productivity Measures and Control Variables by Gender*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publications</td>
<td>4.91 (5.58)</td>
<td>4.88 (5.32)</td>
</tr>
<tr>
<td>Graduate Mentees</td>
<td>3.97* (3.58)</td>
<td>3.29 (2.88)</td>
</tr>
<tr>
<td>Career Tenure</td>
<td>14.35** (10.94)</td>
<td>20.96 (14.31)</td>
</tr>
<tr>
<td>Membership Tenure</td>
<td>14.05*** (9.52)</td>
<td>19.64 (13.63)</td>
</tr>
</tbody>
</table>

*Note.* Standard deviations are in parentheses. Participants reported publications and the number of graduate students mentored over the previous two years.

* $p \leq .01$; ** $p \leq .001$
Figure 1. Relationship of affective commitment to a research organization with career satisfaction and commitment to academic institution. Standard errors are in parentheses. The coefficients for women are listed above the coefficients for men. Career tenure was entered as a control for career satisfaction and affective commitment to the institution of employment. Affective commitment to the organization was controlled for years of membership. The control variables were not displayed.

* p ≤ .05; ** p ≤ .01; *** p ≤ .001
Figure 2. Unique relationship between measures of affective commitment and career satisfaction. Standard errors are in parentheses. The coefficients for women are listed above the coefficients for men. Career tenure was entered as a control for career satisfaction and affective commitment to the institution of employment. Affective commitment to the organization was controlled for years of membership. The control variables are not displayed.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$
CHAPTER THREE

WOMEN IN RESEARCH ORGANIZATIONS: A CASE STUDY

Women are underrepresented as faculty members in most science, technology, engineering, and mathematics (STEM) fields, where there are disproportionately fewer women as rank increases (National Science Foundation [NSF], 2013). This underrepresentation is mirrored within research organizations. Members and leaders of several STEM and social science research organizations have been calling attention to these trends for years (e.g., Morgan & Ingram, 2006; Pell, 1996; Simon, Morris, & Smith, 2007; Schroeder et al., 2013; Valian, 2013) and recent studies support these concerns by highlighting the disproportionate recognition of men at conferences (e.g., Casadevall & Handelsman, 2014; Isbell, Young, & Harcourt, 2012). Even in a female-dominated area of anthropology, women account for a disproportionately low number of those invited as speakers compared to the proportion of women in the field and the number presenting posters (Isbell et al.). However, there is one element that appears to disrupt the persistent disproportionate recognition of men at these events. Women organizing symposia were much more likely to have women speaking on those panels than symposia organized by men (Isbell et al.). After reporting the same trend at a microbiology conference, Casadevall and Handelsman urged research organizations to ensure women are helping to make decisions about who is invited to speak and which members are recognized at conferences.

An interesting relationship is highlighted in both these studies where women appear to be more likely than men to support other women. Finding this supportive relationship in other STEM settings has proved more of a challenge. Women scientists were no more likely to hire
female applicants to a lab manager position than male scientists (Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012). Women were also just as likely as men to offer the female applicants lower pay and rate them as less competent than male applicants. Knobloch-Westerwick, Glynn, and Huge (2013) found no evidence that women would be more likely than men to show interest in collaborating with a woman in a male-dominated field, and interest in collaborating with a woman was significantly lower than interest in collaborating with a man regardless of respondent gender. In the same study, men and women rated the quality of an abstract reporting research in a male-dominated field significantly lower when it was associated with a female name compared to a male name. Male and female graduate students report the same commitment to their careers, but female faculty still view the female students as being significantly less committed than their male peers (Ellemers, van den Heuvel, de Gilder, Maass, & Bonvini, 2004).

Collectively, these experiments seem to contradict the implication that integrating more women as decision-makers in research organizations will lead to greater involvement of women overall (Casadevall & Handelsman, 2014; Isbell et al., 2012). It is possible that research organizations provide an environment more conducive for these supporting behaviors. There is currently only data published about two research organizations, in which women accounted for nearly 60% in the primatology and nearly 50% in the microbiology organizations examined in Isbell et al. and Casadevall and Handelsman, respectively. The first goal of the current study adds to the literature in this area by examining these trends in an organization with lower female membership: the International Association for the Study of Pain (IASP). Approximately 40% of members in IASP were women as of 2012. Another
important element that was not examined in previous studies was whether the supportive nature of women in selecting female speakers also applied to poster presentations. Many posters are presented by those at the beginning of their careers or still in training. The number of women in male-dominated fields will only increase if there is sufficient support for early-career and graduate-level women pursuing careers in STEM. The following hypothesis was developed to test these relationships among presenters in IASP:

*Hypothesis 1: Women chairing workshops will have more female speakers and female last authors will be more likely to have a female presenting posters compared to men.*

Archived data from IASP spanning the past 30 years were used to more closely examine historical shifts in the proportion of women at various levels of participation, ranging from poster presenters to plenary speakers. IASP is a largely interdisciplinary organization that brings researchers from both life and physical science backgrounds. Considering the number of women earning degrees and entering faculty positions in all areas of STEM have continued to rise since 1980 (Burrelli, 2008; NSF, 2013), a similar increase in involvement is anticipated within IASP. In line with the trends observed in other research organizations, a disproportionate number of men speaking at IASP conferences was hypothesized:

*Hypothesis 2: The proportion of women presenting will increase in all presentation categories but men will remain disproportionately represented as plenary speakers.*

The last goal of the current study was to test whether the supportive behaviors portrayed by women were indicative of a deliberate choice. Women appear to portray a
similar bias in favor of men when choosing who to hire or work with professionally (e.g., Knobloch-Westerwick et al., 2013; Moss-Racusin et al., 2012). Members of IASP were surveyed to determine whether women were more likely to promote the work of other women by suggesting them as future plenary speakers. The same trend of support already witnessed within research organizations for speakers was hypothesized:

*Hypothesis 3: Women will be more likely to choose a woman when asked to suggest future plenary speakers.*

**METHOD**

**Organization**

IASP has over 7,000 members from 126 countries. Women make up 39.4% of the total membership. The organization currently hosts a large international conference every 2 years in locations spanning the globe. Conferences held approximately a decade apart were used to analyze shifts in women’s representation across time and were held in Scotland in 1981, Australia in 1990, the United States in 2002, and Italy in 2012. Attendance at these conferences increased steadily from approximately 1,600 in 1981 to over 7,500 in 2012.

**Archived Data**

Published conference proceedings from 1981, 1990, 2002, and 2012 were used to identify the names of presenters and program committee members at these meetings. The gender of individuals from the archived data was determined by searching for their identity on the Internet. Their names were matched with their affiliation, career position, or research
specialty to verify their identity. If gender could not be determined, those individuals were excluded from the analysis.

All basic science posters were analyzed in 1981, 1990, and 2002. Given the large number of posters presented at the most recent conference, a random sample of basic science posters was examined for 2012. Names were collected for first and last authors for poster presentations, which in this field commonly indicate the presenting author and the principal investigator, respectively. In 2002 and 2012, workshops highlighting 3-4 speakers on a single topic were added to the conference schedule. All plenary speakers and program committee members were included in the analyses.

Survey Participants

A subset ($N = 4,329$) of IASP members were sent an electronic survey invitation one month following the conference held in August 2012. Analysis of the gender of a random sample ($n = 877$) of those who were sent a survey invitation indicated that the proportion of women (40.2%) invited to participate was consistent with the overall proportion of female members in IASP (39.4% women). Survey participants were asked to report basic demographic information (e.g., gender, age, relationship status) and to suggest their top three choices for plenary speakers at the next conference. All three choices were analyzed simultaneously. The gender of individuals suggested as plenary speakers was determined by an Internet search. The gender of all suggested individuals except one could be positively identified. This data point was excluded from analysis.

There was a response rate of 12.1% ($n = 524$) and though approximately 60% of the survey invitations sent were to men, only 51% of the surveys were completed by men ($n =$
267). A total of 111 men (41.6%) who responded to the survey attended the conference and 119 (46.3%) of the 257 women attended. Men ($M = 48.1$, $SD = 11.27$) were older on average than women ($M = 43.0$, $SD = 12.17$). A greater number of women were graduate students or post-doctoral fellows (66.3%). A majority of those identifying as psychologists were women (81.5%) and approximately half of industry professionals or researchers were women (52.4%). Men outnumbered women as medical professionals (60.2%) and full-time faculty (58.6%). Table 1 displays complete demographic information by gender and shows that most men and women were married or in a committed relationship (81.3%) but a greater proportion of women were single (18.3%) than men (6.4%). A total of 61 countries were represented, with the majority of respondents living primarily in the United States (27.9%), United Kingdom (12.4%), or Canada (8.8%).

**Analysis**

Chi-square tests of independence with Yates’ correction (Preacher, 2001) were used to determine whether there was a significant improvement in the number of women represented in each involvement category across the four years examined and whether there was a relationship between participant gender and the gender of speakers suggested. This same test was used when determining whether women were more supportive of women as workshop speakers and poster presenters. Fisher’s exact test was used when counts were low and violated the assumptions of expected frequency for chi-square tests (SISA, n.d.).
RESULTS

Archived Data

Plenary lectures are the most prestigious presentation type at the conference, and the gender of every plenary speaker from all four conferences was positively identified. The gender of all program committee members, workshop speakers, and session chairs were determined and included in the analyses. In contrast, identifying the gender of poster presenters was more difficult. In 1981, 88.2% of poster first authors and 76.7% of poster last authors were identified. In 1990, 94.4% of poster first authors and 87.1% of poster last authors were identified. In 2002, over 99% of both first and last poster authors were identified. In 2012, over 97% of both first and last poster authors were identified from those sampled. Table 2 shows the counts by gender for each presentation category.

The number of women serving on the scientific program committee has increased from zero in 1981 to ten in 2012 (40.0%) and this proportion closely matches the proportion of female members (39.4%). A significant increase in the proportion of women represented on the program committee occurred in 2002 compared to 1990, \( \chi^2(1) = 5.768, \quad p = .016 \). There were no other significant increases in the proportion of women serving on the program committee.

Men gave 93.1% of plenary presentations in 1981 and 91.7% in 1990. There was a non-significant drop to 80% of the plenary talks given by men in 2002, \( \chi^2(1) = 0.465, \quad p = .495 \), and that percent remained constant in 2012. The 35.7% of workshop chairs being women in 2012 was not a significant increase from the 22.0% of women chairing workshop sessions in 2002, \( \chi^2(1) = 2.88, \quad p = .090 \). There was a significant increase in the proportion of
women speaking at workshops from 2002 (24.8%) to 2012 (33.9%), $\chi^2(1) = 5.125, p = .024$. However, 15 additional female workshop speakers would have been needed to match the percentage of women in the organization (39.4%).

As an objective measure of whether women were more willing to highlight the work of other women, the relationship between the gender of the workshop chair and the gender of the speakers in 2002 and 2012 was examined. Women chairing a workshop made it significantly more likely for women to be selected as speakers (54.1%) compared to women speaking in sessions chaired by men (16.3%) in 2002, $\chi^2(1) = 34.959, p < .0001$. Women were still significantly more likely to select a female speaker in 2012 (59.2%) compared to men selecting a female speaker (18.7%), $\chi^2(1) = 34.088, p < .0001$ (see Fig. 1). Workshops were not part of the 1981 and 1990 conferences, so a more detailed historical analysis is not possible for this form of presentation.

The proportion of women named last as poster presenters has not changed significantly from 1981 (20.5%) to 2012 (29.8%), but the proportion of women presenting posters as first authors increased from 21.7% in 1990 to 37.9% in 2002, $\chi^2(1) = 16.411, p < .0001$, and increased again from 2002 to 2012 (54.5%), $\chi^2(1) = 17.905, p < .0001$ (see Table 2). Another measure of whether women are more willing to support the work of other women was determined by examining the relationship between the gender of the first and last authors on posters. There was no significant relationship by gender for the first and last authors in 1981, $\chi^2(1) = 0.825, p = .364$, or 1990, $\chi^2(1) = 0.449, p = .503$. In contrast, men listed as the last author were less likely to have a female first author (34.5%) compared to women listed as the last author having a female first author (49.6%) in 2002, $\chi^2(1) = 8.502, p = .004$. This
difference was maintained in 2012, when a female last author was more likely to have a female first author (67.6%) compared to men having a female first author (50.3%), $\chi^2(1) = 5.337, p = .021$ (see Fig. 2).

**Survey Data**

When members of the organization were asked to suggest plenary speakers for the next conference, women suggested a greater proportion of female speakers (25.6%) compared to men suggesting female speakers (13.6%), $\chi^2(1) = 14.388, p = .0002$ (see Fig. 3).

**DISCUSSION**

The proportion of women involved in the program committee, speaking at workshops, and presenting posters in IASP has increased over the past 30 years. However, the proportion of women giving plenary lectures, serving as workshop chairs, and listed as the principal investigator on a poster has not improved significantly. Plenary speakers, workshop chairs, and principal investigators are the most revered and recognized individuals at a research conference. The lack of improvement in the proportion of women filling these roles in IASP over a three decade period is discouraging.

The underrepresentation of women in these conference roles may negatively impact their careers. Advancing in an academic science career typically involves earning multiple degrees, being hired into a tenure-track position, and then earning promotions to advance in rank. The requirements for promotion are relatively subjective and often unclear (Fox & Colatrella, 2006; Roth & Sonnert, 2011), but holding leadership positions and being selected to speak at research conferences are established measures of success in academia. However,
the selection of plenary speakers appears to be biased in IASP, resulting in a disproportionate number of men selected to give plenary lectures at every conference examined. The number of men presenting at conferences should coincide with the proportion of male researchers in a given field. Most members in IASP were medical professionals or individuals doing basic research. In 2010, 42.3% of health professionals, chemists, and biological scientists with doctoral degrees were women (NSF, 2013). This number far exceeds the 20% of women recognized as plenary speakers in IASP and is noticeably higher than the 33.9% speaking in workshops. The disproportionate number of men giving oral presentations relative to their proportion in the field indicates the careers of women may be held back by a lack of opportunity for a more prominent professional role.

The overarching tendency is still for men and women to show a preference toward selecting men for science-related positions (Moss-Racusin et al., 2012), and this was supported in the current study. Men were more likely to have their research promoted and positions of prestige acknowledged compared to women by both males and females; however, women promoted and encouraged the participation of other women more readily than men. Women appear to be promoting positive changes in IASP by supporting other women as presenters. This important relationship between gender and decision-making may begin to reduce the persistent underrepresentation of women filling the most prestigious roles at research conferences. When surveyed, women were significantly more likely than men to suggest a female future speaker. This relationship of women supporting women also was evident in practice. Women listed as the last author on a poster or serving as workshop chairs were significantly more likely to select women as poster presenters or speakers compared to
men in these roles. These data demonstrate that the gender of those making decisions regarding the selection of presenters at research conferences needs to be considered by organizations. A minor change of including more women in these decisions may help alter the persistent underrepresentation of women in science by increasing the research profile of women.

Women supporting women in IASP is a promising relationship and one that appears consistent in other STEM organizations (Casadevall & Handelsman, 2014; Isbell et al., 2012). However, this relationship may not be enough to create an increase in women’s involvement across time, especially in top positions. Roughly 40% of the program committee in IASP were women in 2002 and 2012, yet women chosen as plenary speakers and workshops chaired by women did not increase significantly in those years. In a business setting, an increased number of women in top managerial positions led to an increased number of women in lower-level management (Kurtulus & Tomaskovic-Devey, 2012). Unfortunately, the increased representation of women was transient and indicates the need to explore other factors that may help maintain the gender diversity initiated by women.

Incorporating an increased number of women making decisions about the conference program is a positive start, but the lack of change in female plenary speakers and workshop chairs across time indicates that having a proportionate number of women serving on the program committee does not substantially increase the number of women recognized at IASP conferences. Individual women in IASP were more likely than men to suggest women as future plenary speakers when surveyed, but this tendency may not be demonstrated where men maintain a dominant presence (60% of the program committee). The program committee
differs from workshop chairs and poster authors in part because there is a group component to the decisions being made by the committee. In a sociology organization, the amount of time women in the audience took to address speakers at several conferences increased as the proportion of women in attendance increased (Kriwy, Gross, & Gottburgsen, 2013). The presence of men may be having an inhibitory effect on women’s active involvement and preventing a lasting increase in the involvement and recognition of women in research organizations. Gender-diverse groups can lead to increased conflict, but creating an organizational climate that is inclusive results in fewer conflicts and leads to more productive outcomes (Nishii, 2013).

Factors related to the climate within IASP were not measured in the current study but should be incorporated in future studies. Women may be hesitant to promote other women in a group setting for other reasons. For example, women displaying greater agency than is considered stereotypically feminine receive backlash and sabotage when taking a leadership role (Rudman, Moss-Racusin, Phelan, & Nauts, 2012). Backlash may limit the ability of women in leadership positions to create change or may lead to them making more cautious suggestions. Ensuring women have the opportunity to make decisions in research organizations is undeniably important, but organizational leaders and members must also create an environment where women’s voices are heard and incorporated fully into those processes for their presence to have a lasting impact.

In sum, these data show that women are already exhibiting critical support for other women in their field, but this support does not result in a more proportionate representation of women in the most prestigious conference roles across time. Less recognition granted to
women in STEM organizations may impede their career advancement and add to the issues already faced within the academic institutions at which they are employed. There is very little research about issues existing within research organizations, but the relationship between affective commitment to these organizations and career satisfaction (Chapter 2) further supports the important role of these broader experiences on the professional lives of women and men in STEM. The following chapter will more closely examine the importance of benefits associated with being a member of these organizations and whether women perceive several factors as more greatly limiting their involvement. Regardless of personal limitations, the general lack of improvement across time in IASP demonstrates the need to examine the processes currently being used and identify issues that may be responsible for the underrepresentation of women. Lastly, striving to maintain an inclusive climate to ensure opportunities for members are equitable at all levels of involvement within research organizations will reinforce the efforts being made across the U.S. to improve the overall climate for women in STEM.
### Table 1

*Demographic Information of IASP Survey Respondents*

<table>
<thead>
<tr>
<th>Demographic Category</th>
<th>Total</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N</strong></td>
<td>524</td>
<td>257</td>
<td>267</td>
</tr>
<tr>
<td><strong>Mean Age (SD)</strong></td>
<td>45.6 (11.98)</td>
<td>43.0 (12.17)</td>
<td>48.1 (11.27)</td>
</tr>
<tr>
<td><strong>Demographic Category</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Professional Position</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graduate Student</td>
<td>49</td>
<td>31</td>
<td>18</td>
</tr>
<tr>
<td>Post-doctoral Fellow</td>
<td>55</td>
<td>38</td>
<td>17</td>
</tr>
<tr>
<td>Full-time/Tenured Faculty</td>
<td>152</td>
<td>63</td>
<td>89</td>
</tr>
<tr>
<td>Industry/Researcher</td>
<td>42</td>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td>Medical Professional</td>
<td>186</td>
<td>74</td>
<td>112</td>
</tr>
<tr>
<td>Psychologist</td>
<td>27</td>
<td>22</td>
<td>5</td>
</tr>
<tr>
<td>Other</td>
<td>13</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td><strong>Research</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>86</td>
<td>36</td>
<td>50</td>
</tr>
<tr>
<td>Basic/Clinical/Both</td>
<td>432</td>
<td>218</td>
<td>214</td>
</tr>
<tr>
<td><strong>Relationship Status</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single, Never Married</td>
<td>64</td>
<td>47</td>
<td>17</td>
</tr>
<tr>
<td>Separated/Divorced</td>
<td>21</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>In Committed Relationship</td>
<td>68</td>
<td>39</td>
<td>29</td>
</tr>
<tr>
<td>Married</td>
<td>358</td>
<td>151</td>
<td>207</td>
</tr>
<tr>
<td>Widowed</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>Number of Children</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>296</td>
<td>162</td>
<td>134</td>
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<tr>
<td>1</td>
<td>71</td>
<td>30</td>
<td>41</td>
</tr>
<tr>
<td>2</td>
<td>98</td>
<td>40</td>
<td>58</td>
</tr>
<tr>
<td>3 or more</td>
<td>35</td>
<td>11</td>
<td>24</td>
</tr>
</tbody>
</table>

*Note.* The number of participants is listed first in each column followed by the percent (excluding the rows for N and *Mean Age*) for the total, female, and male groups. Each group is self-contained and only includes statistics for those individuals; thus, percentages for females are taken from the total number of female participants (*n* = 257), rather than all participants. Percentages may not sum to 100% because those leaving specific demographic questions blank were included in the total.
<table>
<thead>
<tr>
<th>Activity</th>
<th>Year</th>
<th>Total</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>n</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Scientific Program Committee</td>
<td>1981</td>
<td>11</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>17</td>
<td>1</td>
<td>5.9</td>
</tr>
<tr>
<td></td>
<td>2002</td>
<td>19</td>
<td>8</td>
<td>42.1</td>
</tr>
<tr>
<td></td>
<td>2012</td>
<td>24</td>
<td>10</td>
<td>40.0</td>
</tr>
<tr>
<td>Plenary Speaker</td>
<td>1981</td>
<td>29</td>
<td>2</td>
<td>6.9</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>24</td>
<td>2</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>2002</td>
<td>20</td>
<td>4</td>
<td>20.0</td>
</tr>
<tr>
<td></td>
<td>2012</td>
<td>15</td>
<td>3</td>
<td>20.0</td>
</tr>
<tr>
<td>Workshop Chair</td>
<td>2002</td>
<td>82</td>
<td>18</td>
<td>22.0</td>
</tr>
<tr>
<td></td>
<td>2012</td>
<td>70</td>
<td>25</td>
<td>35.7</td>
</tr>
<tr>
<td>Workshop Speaker</td>
<td>2002</td>
<td>274</td>
<td>68</td>
<td>24.8</td>
</tr>
<tr>
<td></td>
<td>2012</td>
<td>283</td>
<td>96</td>
<td>33.9</td>
</tr>
<tr>
<td>Poster Presenter (Last Author)</td>
<td>1981</td>
<td>148</td>
<td>31</td>
<td>20.9</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>176</td>
<td>36</td>
<td>20.5</td>
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<td></td>
<td>2002</td>
<td>501</td>
<td>127</td>
<td>25.3</td>
</tr>
<tr>
<td></td>
<td>2012</td>
<td>242</td>
<td>72</td>
<td>29.8</td>
</tr>
<tr>
<td>Poster Presenter (First Author)</td>
<td>1981</td>
<td>187</td>
<td>33</td>
<td>17.6</td>
</tr>
<tr>
<td></td>
<td>1990</td>
<td>203</td>
<td>44</td>
<td>21.7</td>
</tr>
<tr>
<td></td>
<td>2002</td>
<td>507</td>
<td>192</td>
<td>37.9</td>
</tr>
<tr>
<td></td>
<td>2012</td>
<td>244</td>
<td>133</td>
<td>54.5</td>
</tr>
</tbody>
</table>

Note. Counts of males and females involved in conference activities from 1981, 1990, 2002, and 2012 are displayed above. Percentages are calculated from the total number of individuals in the sample in each involvement category for a given year. The * indicates a significant change in the proportion of women and men compared to the previous years’ counts using a chi-square test with Yates’ correction or Fisher’s exact test. 

*p < .05; **p < .001
Figure 1. Relationship between the chair and speaker genders for workshops in 2002 and 2012. Numbers inside the bar represent the actual count observed in each category. Male workshop chairs were significantly more likely to select male speakers and female workshop chairs were more likely to select female speakers in both 2002 ($p < .0001$) and 2012 ($p < .0001$).
Figure 2. Relationship between the last author and presenting author genders for posters in 2002 and 2012. Numbers inside the bar represent the actual count observed in each category. Female principal investigators (i.e., the last author) were significantly more likely than male principal investigators to have a female first author in both 2002 ($p = .004$) and 2012 ($p = .02$).
Figure 3. Current members’ selection of future plenary speakers by gender. Numbers inside the bar represent the actual count observed in each category. There was a significant relationship between participant gender and the gender of suggested speakers ($p = .0002$).
CHAPTER FOUR
EXPERIENCES OF WOMEN AND MEN IN RESEARCH ORGANIZATIONS

A faculty appointment at a research institution involves a combination of teaching, service, and research responsibilities. All of these are used to measure faculty success; however, research progress is the ultimate criterion used for promotion purposes and when being evaluated by peers (e.g., Park, 1996; Sonnert, 1995). Faculty who spend more time teaching and mentoring, and thus less time doing research, are promoted more slowly than research-focused faculty (e.g., Thomas et al., 2004). Becoming an active member of professional research organizations provides many opportunities to enhance research, such as attaining recognition, fostering new research ideas, and enhancing research networks. Research awards serve as an objective measure of earning recognition for research and many are awarded through these professional membership organizations, but Lincoln, Pincus, Koster, and Leboy (2012) found that women were less likely to be recognized for their research efforts compared to men. Many issues facing female professors at academic institutions in science, technology, engineering, and mathematics (STEM) departments have been identified (e.g., Alpay, Hari, Kambouri, & Ahearn, 2010; Bilimoria, Joy, & Liang, 2008; Fox, Fonseca, & Bao, 2011; National Academy of Sciences [NAS] et al., 2006). Issues within research organizations have received minimal attention, but the careers of women in STEM are likely further disadvantaged if their involvement and recognition is limited in these organizations.

Participating in professional research organizations, where professors choose to become members, is a common part of progressing in an academic career, yet little is known
about the experiences of women and men in these organizations. Benefits of becoming a member are commonly highlighted on membership pages. The stated benefits range from those which are tangible, including monetary discounts and product promotions, to career development opportunities through networking and gaining recognition from colleagues (e.g., American Chemical Society, 2014; American Institute of Chemical Engineers, 2014; American Mathematical Society, 2014; American Psychological Association, 2014; Society for Neuroscience, 2014). Quotes from members about how their membership has benefited them professionally often accompany these promises made by research organizations. However, the importance of these benefits to members has yet to be quantified. Forming relationships and gaining recognition have the most potential for impacting broader career outcomes for researchers and are hypothesized to be rated as most important:

Hypothesis 1: Benefits related to social interactions and gaining recognition will be rated as most important.

The regular research events hosted by these organizations generally provide the greatest number of benefits at one time and make attendance at these meetings important for members. The travel necessary to attend the meetings requires time and money and creates conflict with home and work responsibilities. Factors limiting participation in research organizations, including work responsibilities, travel costs, and requirements for preparing presentations, are likely similar for both genders; however, interferences with family responsibilities are often cited as putting more pressure on women compared to men across all fields of study (e.g., Fox et al., 2011; Keene & Quadagno, 2004; Morrison, Rudd, & Nerad,
The following hypotheses were proposed regarding potential factors limiting involvement within research organizations:

**Hypothesis 2a:** Women with children will rate childcare responsibilities as a greater limiting factor compared to men with children.

**Hypothesis 2b:** Women with children will rate having childcare available at conferences as more important compared to men with children.

**Hypothesis 3:** There will be no gender differences in ratings of other general limitations.

Attendance at these events is important for many reasons, including networking, meeting with collaborators, and staying informed about current research advances. In addition to these benefits, presenting at research events in front of other professionals provides an important source of recognition and opens up greater networking opportunities for faculty that will advance their career and research progress. In many research organizations, posters and smaller oral presentations require members to submit an abstract for review. There is no clear evidence that women are less productive than men in STEM careers once controlling for factors like career age, professional activities, and family demographics (e.g., Carr et al., 1998; DesRoches, Zinner, Rao, Iezzoni, & Campbell, 2010), and women are hypothesized to be equally likely to submit poster and presentation abstracts for consideration at research organization conferences:

**Hypothesis 4:** The average number of poster and oral presentation submissions made by women will not differ from the number of submissions made by men.
The process of submitting and selecting presentations varies between organizations, but there is evidence from several research organizations that fewer women are being invited to give oral presentations. This trend has been supported by three case studies (e.g., Casadevall & Handelsman, 2014; Isbell, Young, & Harcourt, 2012; see Chapter 3) but has yet to be reviewed for research organizations in general. Subtle gender bias affects women in STEM careers in many ways (e.g., Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012; Wright et al., 2003) and women are aware of inequities resulting from these biases (e.g., Easterly & Ricard, 2011; Maranto & Griffin, 2011). Whether these perceptions of bias also exist within research organizations has not been determined. The following hypotheses regarding potential biases were proposed in the current study:

**Hypothesis 5:** On average, women will be invited to give fewer oral presentations and plenary talks compared to men.

**Hypothesis 6:** Women will rate gender bias as a greater limiting factor compared to men.

A final area of involvement within research organizations is serving on committees. These committees range from those highly organization-specific or field-specific to committees responsible for governing the organization. Women are more likely than men to be encouraged into and recognized for teaching and administrative roles rather than leadership and research roles (Lincoln et al., 2012; Park, 1996). These same trends may exist within research organizations, where women may be directly or indirectly encouraged to serve on education committees, student committees, or committees relating to underrepresented members rather than leadership-oriented committees, like the executive council:
**Hypothesis 7a:** The proportion of women serving on education committees or committees involving underrepresented populations will be higher than the proportion of men on these committees.

**Hypothesis 7b:** Men will report serving on more governing committees than women.

No study has yet examined whether there are differences in the level at which women and men are involved in research organizations in general. This study provides the first overview of attempted and actual involvement, ratings of the importance of membership benefits, the degree to which certain factors limit access to these benefits, and perceptions of bias that may result in additional barriers for women pursuing careers in STEM.

**METHOD**

**Participants**

Tenure-track faculty members were sampled from 41 doctoral/research universities across the United States with very high research activity as classified by the Carnegie Commission (Carnegie Foundation, 2010). The total sample was 645 (women = 334, men = 311), which included a selection of assistant (27.6%), associate (27.1%), full (35.2%), and distinguished or emeritus (10.1%) faculty. See Chapter 2 for complete participant demographic information.

**Organizations**

Participants were asked to identify two research organizations in their discipline and report whether they had attended any research-focused events sponsored by these
organizations over the past two years. These events were defined as including presentations and discussions of current research. Follow-up questions regarding their involvement were posed to those who reported attending at least one research event.

**Measures**

**Importance of benefits.** Participants were asked to rate the importance of 14 potential benefits associated with belonging to research organizations. The list of potential benefits was determined by searching research organization webpages for advertised membership benefits and career development opportunities. The list was considered comprehensive once no new opportunities or benefits were discovered in three consecutive organization searches. An opportunity to identify and rate up to two unlisted benefits was also available. In the prompt, participants were asked to identify how important the benefit was for them personally on a scale from 1 (*not at all important*) to 7 (*extremely important*). The following prompts were used:

1. Opportunity to attend research-focused conferences or events
2. Discounts offered (e.g., event registration, subscriptions, etc.)
3. Access to journals/published materials
4. Access to career services (e.g., continuing education credits, webinars, etc.)
5. Access to mentoring programs
6. Access to member directory
7. Ability to network or collaborate with other members
8. Opportunity to have input regarding organization decisions
9. Opportunity to get involved in education or advocacy events
10. Gaining recognition for your research/scholarship
11. Access to grants/fellowships through the organization
12. Belonging to special interest groups or committees
13. Opportunity to travel to conference locations
14. Access to childcare during organization conferences/events.

Factors limiting participation. In order to create a list of factors that may limit participation in research organizations, a series of pilot questions were posed in the survey described in Chapter 3. Members of the International Association for the Study of Pain were asked to describe factors that limited the amount of time they spent at the conference. Those not able to attend the conference were also asked to identify what reasons they had for not attending. From those responses, a comprehensive list of 12 possible limitations was compiled for use in the current survey. Participants in the current survey were asked to rate how much they agreed on a scale from 1 (strongly disagree) to 7 (strongly agree) that the following list of factors limited their personal participation in research-focused professional organizations:

1. Cost
2. Work obligations
3. Health issues
4. Language barriers
5. Time or distance required to travel
6. Caring for dependents (not including children)
7. Biases/discrimination based on gender
8. Biases/discrimination based on race/ethnicity
9. Research topics being irrelevant or outdated
10. Not having data to present
11. Not having submissions accepted for presentation
12. Childcare responsibilities

The opportunity to identify and rate up to two other factors was also available.

Participants agreeing that gender or racial bias significantly limited their participation in research organizations were also prompted to explain their answer in an open-ended response.

**Presentations.** Participants were asked to report the number of posters they submitted for presentation, oral talks submitted for presentation, oral talks they were invited to give, actual oral talks they gave, invitations to give a plenary lecture, and the actual number of plenary lectures given over the past two years at research events sponsored by the organization identified. Since attendance at these events dropped substantially for the second organization named (data not shown), involvement was calculated for the first organization only.

**Committees.** Participants who were involved in the organization they named over the past two years were asked to indicate the number of committees they served on within that period of time. Participants were asked to identify the name of the committee and the years in which they served on it. All committee involvement with service ending in 2012 or later was included. Five main categories were created: council/executive committees, program committees, award committees, editorial committees, and student/minority committees. Most other committees are specific to the organization or field of study and were combined into one category titled ‘Other.’ The category for student and minority committees included committees focused on minorities or women in the organization or broader discipline. Any
education committees or committees focused on students or young members of the organization were also included in this category.

**Procedure**

Email addresses for faculty were obtained from their department webpages. Participants were sent an electronic survey invitation (see Appendix A for complete faculty survey) and up to three reminders over the period of a month. See Chapter 2 for complete procedure information regarding the survey and categorization of academic departments.

**Analysis**

Several statistical tests were utilized in this study. Pearson correlations were performed between importance ratings of benefits to determine whether they were positively and significantly related. A multivariate analysis of variance (MANOVA) was then used to protect against Type 1 errors. Academic rank was entered as a control for these analyses due to the greater underrepresentation of women at higher ranks in STEM (National Science Foundation [NSF], 2013). Following a significant MANOVA, post-hoc univariate ANOVAs were used to examine gender differences while controlling for rank. Each of the four academic categories was analyzed separately. This same procedure was implemented to examine ratings of factors limiting participation. Responses about childcare were examined using independent samples t-tests and only included individuals who reported having children under the age of 18. An alpha level of .05 was used for all correlations, MANOVAs, and post-hoc analyses for hypotheses about benefits and limitations (H₁, H₂a/b, and H₃). Agreeing that gender bias or discrimination limited participation in research organizations was analyzed.
separately to test Hypothesis 6 directly. Independent samples t-tests were used to examine gender differences in each academic category with an alpha level of .05.

There were several hypotheses regarding involvement across gender (H$_4$, H$_5$, and H$_{7a/b}$). Gender differences were hypothesized to diverge in some involvement categories but not others. Thus, each involvement category was analyzed separately. Univariate ANOVA was used to determine whether the average number of submissions or presentations in each category differed by gender while controlling for academic rank. To further test involvement, a chi-square test of independence with Yates’ correction (Preacher, 2001) was also used to compare the proportion of women and men reporting at least some involvement in each category. A more conservative alpha level of .01 was used for these analyses.

RESULTS

Importance of Benefits

Pearson correlations were performed between importance ratings of the 13 benefits for the hard sciences (see Table 1), life sciences (see Table 2), social sciences (see Table 3), and TEM (see Table 4); the means and standard deviations are reported for women and men in their respective tables. A large majority of the 78 bivariate correlations in each of the academic categories were significant and positive (82-92%). The majority of correlations were moderate or trivial in size with only the correlation between mentoring and career services greater than 0.7 in life sciences and technology, engineering, and mathematics (TEM), indicating these benefits were related but distinct.
Controlling for academic rank, a MANOVA revealed no overall differences in benefit importance ratings between women and men in the hard sciences; $F(13, 59) = 0.685$, Pillai’s trace $= 0.131, p = .77$; life sciences, $F(13, 149) = 0.733$, Pillai’s trace $= 0.06, p = .73$; or TEM; $F(13, 94) = 1.310$, Pillai’s trace $= 0.15, p = .22$. There was a significant overall difference between females’ and males’ importance ratings of organization membership benefits in the social sciences, $F(13, 240) = 1.922$, Pillai’s trace $= 0.094, p = .028$. Opportunities for additional funding was rated more important by women compared to men in social sciences, $F(1, 255) = 5.784$, $p = .017$, $\eta^2 = .02$. Being part of a special interest group or committee, $F(1, 255) = 3.908$, $p = .049$, $\eta^2 = .02$, mentoring opportunities, $F(1, 255) = 8.103$, $p = .005$, $\eta^2 = .03$, and career services, $F(1, 255) = 7.832$, $p = .006$, $\eta^2 = .03$, were rated more important by women compared to men in social sciences. There were no significant differences in the ratings of importance for the remaining benefits between women and men (see Table 3).

The benefits related to social interactions ranked in the top four most important benefits for women and men in all academic categories. These benefits included attending the conference, gaining recognition, and networking. The average importance ratings for these benefits ranged from 5.3 to 6.2. Mentoring, having access to the membership directory, and opportunities to utilize career services were rated as the three least important membership benefits by women and men in all academic categories. The average importance ratings for these benefits ranged from 2.7 to 4.2.

**Childcare availability.** The importance of having childcare options available during organization-sponsored events was analyzed separately to include only participants with
children under the age of 18. There was no difference in ratings of the importance of having childcare available at organization-sponsored research events between women \((n = 16)\) and men \((n = 16)\) in the hard sciences, \(t(30) = 1.897, p = .07, d = .67\). There was also no difference between women \((n = 18)\) and men \((n = 19)\) in TEM, \(t(35) = 0.613, p = .54, d = .20\). Women \((n = 22)\) in life sciences rated the importance of childcare being available at organization-sponsored research events significantly higher than men \((n = 24)\), \(t(44) = 2.270, p = .028, d = .67\), and so did women \((n = 52)\) in comparison to men \((n = 34)\) in the social sciences, \(t(84) = 2.358, p = .021, d = .52\) (see Fig. 1).

**Limiting Factors**

Pearson correlations were performed between 10 ratings of factors that may limit participation in research organizations. The hard sciences (see Table 5), life sciences (see Table 6), social sciences, (see Table 7), and TEM (see Table 8) were analyzed separately. A majority of the 45 zero-order correlations in each of the academic categories were significant \((48.9 - 84.4\%)\). All significant correlations were positive and moderate or low. Controlling for academic rank, a MANOVA revealed no overall differences in how women and men rated the personal impact of limitations in the hard sciences, \(F(10, 60) = 0.692, \text{ Pillai's trace} = 0.103, p = .73\); in TEM, \(F(10, 95) = 1.369, \text{ Pillai’s trace} = .126, p = .21\); or in life sciences, \(F(10, 156) = 1.566, \text{ Pillai’s trace} = 0.091, p = .12\). There was a significant overall difference in how much women and men agreed the limiting factors hampered their participation in the social sciences, \(F(10, 236) = 2.245, \text{ Pillai’s trace} = 0.087, p = .016\).

Follow-up univariate ANOVAs controlling for academic rank were used to examine gender differences in ratings of factors that limit participation in research organizations. In the
social sciences, women rated cost as a greater limiting factor compared to men, $F(1, 253) = 11.030, p = .001, \eta^2 = .04$. The remaining limitations were rated similarly between women and men (see Table 7).

**Childcare responsibilities.** Figure 2 displays the ratings of whether childcare responsibilities limit participation in research organizations for faculty with children under the age of 18. In the hard sciences, women rated childcare responsibilities as a greater limitation than men, $t(30) = 2.577, p = .015, d = .91$. This same difference was seen in the ratings between women and men in life sciences, $t(45) = 3.121, p = .003, d = .90$; and in TEM, $t(38) = 2.090, p = .043, d = .66$. There was no significant difference in how limiting women and men viewed childcare responsibilities in social sciences, $t(84) = 1.687, p = .095, d = .37$.

**Gender bias.** Women agreed more than men that gender bias or discrimination limited their participation in research organizations. This was true for women in hard sciences, $t(79) = 2.240, p = .028, d = .50$; life sciences, $t(174) = 2.863, p = .005, d = .43$; social sciences, $t(259) = 2.327, p = .021, d = .29$; and TEM, $t(114) = 2.240, p < .001, d = .73$ (see Fig. 3).

**Gender bias feedback.** Seven women in hard sciences (17.1%), six in life sciences (6.8%), nine in social sciences (6.3%), and ten in TEM (16.1%) somewhat agreed, agreed, or strongly agreed that gender bias limited their participation in research organizations in general. Four men in social sciences (3.3%) also somewhat agreed, agreed, or strongly agreed that gender bias significantly limited their participation. Only 27 women left open-ended remarks, but 16 (59.3%) of those emphasized that the likelihood of men earning recognition and leadership positions within research organizations is greater than for women. One participant responded:
Less opportunity to give invited talks, present research. Offers to be involved in the organization are acceptable, but not things associated with research (like invited talks).

Another individual pointed out that this may be due to men earning more respect for their work compared to women:

[These organizations] can feel like a boys' club at times -- men just dominate more, and I believe their research is taken more seriously.

The next most common theme addressed by seven women (25.9%) was that developing informal connections to men in the field is a challenge that limits the participation of women:

At some conferences, men do not like to discuss research with me; and instead seem to prefer to discuss small-talk items (the weather, children, food, etc). There are very few women, which makes for very uncomfortable situations…The gender bias is so ingrained it's really hard to feel a part of the organizations.

Another woman pointed out what women are missing when excluded from these informal connections:

There are fewer women in the field, and…the "good old boy" network is alive and well. Getting invitations, let alone acceptance, to the golf outings, happy hours, etc. where research directions are explored and decided upon is a challenge.

One woman discusses how these experiences influence her decisions about which research organizations to join (the organization names were removed to maintain confidentiality):
I continue to participate in these organizations, but I am more committed to [Organization 1] than [Organization 2] because I think the former has more capacity to be beneficial for me (and I feel that I can more effectively participate in the organization with fewer microaggressions) than the latter.

In many male-dominated organizations, women are more likely to be younger, less experienced members. Two women discussed the intersection of these demographics. One of these women stated:

There are certain professional organizations…that have a boys' club that limits presentations/participation of many younger faculty (and these tend to be women). This may be an age bias or friend bias, but it comes across as gender bias at many conferences. It has caused me to stop going to some smaller conferences because the opportunities do not exist to present my work to the appropriate audience with any sort of response that is helpful to scientific discourse.

Three out of the four men in social sciences, where women are becoming a predominant presence (NSF, 2013), reported that they face a significant gender bias. One man stated, “In our discipline, women control professional organizations and they feel free to discriminate against men as an expression of ‘equality.’”

Involvement

There were a large number of different organizations named first by faculty. In the hard sciences, women identified 11 different organizations and men identified 15. Women identified 47 and men identified 45 organizations in the life sciences. Women identified 42
organizations and men identified 33 organizations in the social sciences. In TEM, women identified 31 and men identified 22 organizations.

Only participants who attended at least one conference in the past two years were asked about their involvement within the organization they identified. There were a similar number of men and women in each academic category who did not attend any research-related events in hard sciences (women = 4, men = 8), life sciences (women = 19, men = 20), social sciences (women = 23, men = 18), and TEM (women = 11, men = 10), indicating the following analyses were not skewed because of a disproportionate number of male or female participants identifying organizations in which they were not involved.

**Presentations.** Table 9 shows the percent of faculty involved in each category along with the average number of presentations or submissions by gender. There was no significant gender difference in the average number of submissions or presentations given when controlling for rank in any academic category. Comparing the proportion of women and men involved in each category resulted in only one significant difference; more women in TEM submitted posters compared to men, \( \chi^2(1) = 7.83, p = .005. \)

To determine whether the lack of gender differences in involvement was a result of only analyzing the first organization identified by participants, post-hoc analyses using the second organization were also performed. The results of these analyses confirmed the initial findings. There were no significant gender differences in the average number of submissions or presentations given and no difference in the proportion of women and men involved in each category for the second organization identified (data not shown). There were a similar number of women and men who had not attended any research-related events sponsored by
the second organization they identified in the survey. This was true for those in hard sciences (women = 20, men = 20), life sciences (women = 42, men = 48), social sciences (women = 42, men = 42), and TEM (women = 28, men = 25).

Committees. All participants reporting the number of committees they served on were included in the following chi-square tests of independence with Yates’ correction to determine whether serving on a committee was related to gender. In hard sciences, 22 women served on at least one committee and 14 women served on no committees, whereas 14 men served on at least one committee and 16 served on no committees; the relationship between gender and serving on a committee in the hard sciences was not significant, \( \chi^2(1) = 0.86, p = .35 \). In life sciences, 24 women served on a committee and 41 did not as compared to 29 men who served on a committee and 36 who did not; this relationship was not significant, \( \chi^2(1) = 0.51, p = .48 \). Fifty-one women in the social sciences served on at least one committee and 65 served on no committees, whereas 29 men served on at least one committee and 63 did not serve on any; there was no relationship between gender and serving on a committee, \( \chi^2(1) = 2.85, p = .09 \). Finally, there was no significant relationship in TEM, where 20 women served on a committee and 21 did not as compared to the 18 men serving on committees and 26 not serving on zero committees, \( \chi^2(1) = 0.26, p = .61 \).

Table 10 shows the counts of individuals from each academic category who named the committees they served on. Fisher’s exact test was used because the count for those serving on committees was very low. No significant difference in the probability of women compared to men serving on committees in the five predetermined categories (Executive/Council, Program, Awards, Editorial, and Student/Minority) were found in the hard sciences (mid-\( p = \)
.31), life sciences (mid-\(p = .37\)), or TEM (mid-\(p = .36\); see Table 9). Probabilities of serving on these committee types were significantly related to gender in the social sciences (mid-\(p = .037\)), where women accounted for a higher proportion of those serving on executive committees and minority/student committees.

**DISCUSSION**

There were few differences in how women and men rated the importance of benefits provided by research organizations in hard sciences, life sciences, and TEM. Women in the social sciences rated several benefits as more important than did men, including mentoring, career services, having access to funding through the organization, and being involved in special interest groups or committees. Access to and actual use of these benefits was not measured directly in this study, but many of the benefits rated as more important by women in social sciences involve social interactions. Women are represented almost equally in social science tenure-track faculty positions in the U.S. (44.2%) as of 2010 (NSF, 2013). The proportion of women in social science faculty positions is much higher than in the life sciences (37.2%), hard sciences (21.8%), and TEM (19.2%), which may result in a more inclusive and equitable climate for women. Mentoring, networking, and serving on committees require hierarchical and peer interactions that oftentimes are easier for those not in an underrepresented group. An environment where there is a critical mass of women predicts increased perceptions of gender equity, inclusion, productivity (Maranto & Griffin, 2011), and overall well-being (Miner-Rubino & Cortina, 2004). Sanders, Willemsen, and Millar (2009) also found that women in departments with a higher percentage of women had
an easier promotion experience. Women in social science likely have an easier time using and therefore benefitting from these interactions, which may explain the higher ratings of importance. This finding indicates that reaching a critical mass of women in other disciplines may result in similar benefits.

The benefit rated most important by both women and men across all academic categories was attending research events. This was followed closely by receiving recognition from peers and networking opportunities, which generally take place during organization-sponsored meetings. The high rating of importance attributed to these benefits signifies that involvement in these organizations is valuable to faculty, especially involvement that leads to interacting with other professionals. Factors disproportionately limiting the access to these benefits for one group of individuals would result in the accumulation of potentially serious career disadvantages. Fortunately, there were few differences in perceived limitations between women and men. The factors rated as most limiting by both women and men across all academic categories were work obligations and cost. Challenges with traveling were listed as a close third and, for faculty with children, childcare responsibilities were rated relatively high as well. In the social sciences, the childcare responsibilities reported as more limiting by women than men did not reach statistical significance, but there was a gender difference in the other academic categories and this was a consistent trend among women in this sample. Women who rate childcare responsibilities as more limiting to their professional involvement in research organizations likely shoulder more of these responsibilities at home, too (U.S. Department of Labor, 2013).
The benefit of having childcare options available at organization-sponsored events was deemed as more important by women compared to men in social and life sciences but not hard science or TEM. This finding does not indicate that women in hard science and TEM would not benefit from having this resource available at conferences. Instead, both women and men in these academic areas would find the availability of childcare equally beneficial. Overall, the importance of having childcare services available during organization events was rated low in comparison to the other benefits. Some parents may not wish to use on-site childcare provided by the research organizations or may find traveling with children an undesirable way to balance their family responsibilities. The moderate importance of childcare as a resource does indicate that the greater limitation of family responsibilities for women in STEM would be at least partially reduced if this resource was made available at all conferences. Many research organizations have started to offer childcare options during events (see STEMFamilyTravel.org), but the lack of use and low relative ratings of importance by faculty with children indicate additional solutions should be explored. Additionally, continuing to raise awareness about the availability of these resources may increase their use more quickly.

Another limitation examined in this study was hypothesized to disproportionately impact women. In hard science and TEM, where women are most underrepresented, women were hypothesized to view gender bias as significantly limiting their participation in research organizations. This hypothesis was supported but not restricted to these fields. Women in all academic categories examined viewed gender bias as a more significant limitation compared to men. However, gender bias and discrimination was rated in the lower half of limiting
factors across all academic categories. Many studies show that women report gender biased
treatment when asked specific questions about their experiences (e.g., Carr et al., 2000;
Wright et al., 2003). The relatively low reports of gender bias and discriminative treatment
limiting participation within research organizations does not indicate women are always
treated equitably. Specific questions about interactions with organization members, invitations
to be involved formally or informally, and whether procedures used for evaluating fund
distribution or other awards are equitable should be posed. The women who left feedback
about the biases they faced revealed gender biases are a concern for at least some women in
research organizations. Any bias or discrimination based on gender needs to be addressed and
women recognizing these issues emphasizes the need for continued efforts to ensure unbiased
practices are employed in research organizations.

Personal perceptions of equity provide an individual-level understanding of how
inequity may impact women in STEM. Measuring objective outcomes provides additional
information and another way to test whether involvement levels differ by gender and thus
may be unequally restricted. There was no evidence in the current study that the participation
of women was disproportionately limited. Previous studies have shown that women are less
likely to be represented in the most prestigious presentation categories: invited and plenary
talks (Casadevall & Handelsman, 2014; Isbell et al., 2012; see Chapter 3). However, women
across all academic categories were equally represented in most types of involvement. In fact,
women in social science were more likely than men to serve as executive committee
members. Women were also more likely to serve on committees focused on minorities or
students as hypothesized, but this was only true for women in social science and was not a
consistent finding across academic categories. The current results provide an overview of participant involvement and indicate that women and men are approximately equally involved in research organizations.

There is a distinct discrepancy in the current findings compared to the clear underrepresentation of women in prestigious conference roles presented in the Chapter 3 case study. It is important to note that participants in the current study were prompted to identify any organization in their field. Many organizations were identified by women and men in each academic category. As indicated by a participant in the current study, individuals faced with barriers in one organization may be more likely to join an organization where their involvement is less restricted. Participants may have chosen organizations in which they were most highly involved or committed and excluded individual research organizations where they experienced or perceived biased practices that hinder the participation of underrepresented members. In the current study, the same involvement trends were seen when examining the second organization named by participants in the survey. The consistency of equal participation between women and men for both organizations identified indicates that the drop in involvement related to the second organization did not differ by gender. An examination incorporating a greater number of organizations in each academic category should be undertaken to determine whether STEM research organizations make involvement for women more challenging and whether women use avoidance to overcome any issues barring their full participation.

Women in STEM may also have to work harder or longer to achieve the same recognition and advancements as men (e.g., Lincoln et al., 2012; National Research Council,
2006; van den Brink & Benschop, 2011), and this trend may also be true in research organizations. Lower quality ratings are assigned to the work and abilities of women when all other factors are equal (e.g., Knobloch-Westerwick, Glynn, & Huge, 2013; Moss-Racusin et al., 2012). Therefore, the work women are submitting to present at research conferences may necessitate higher quality before being accepted. Considerations about the ease of involvement and the effort it takes to reach the equality found in the current study should be incorporated into future studies.

Barriers that may be contributing to the persistent underrepresentation of women in STEM need to be evaluated from multiple directions and this study assessed faculty experiences in a largely overlooked area. This study provides the first general overview of the similarity among women’s and men’s experiences and involvement in research organizations. A majority of the benefits associated with belonging to research organizations were rated quite high by women and men alike and underscore the importance of these experiences for faculty. The lack of any substantial gender differences may indicate that research organizations provide an environment where biases have a lesser impact on underrepresented women. Research organizations may provide environments where barriers limiting women’s involvement are reduced compared to the barriers faculty face in their academic institutions. However, future studies should examine specific experiences and interactions among members and organization leaders to ensure access to the benefits viewed as so important by women and men are not limited based on gender. Regardless, research organizations warrant further study and provide a new direction from which to understand and address the underrepresentation of women in STEM.
Table 1

Zero-Order Correlation Coefficients, Means, and Standard Deviations among Hard Science Faculty Importance Ratings of Benefits

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<td>.56**</td>
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<td>.32*</td>
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<td>.56**</td>
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<td>.54**</td>
<td>.68**</td>
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<td>.46**</td>
<td>.40**</td>
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<td>.57**</td>
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<td>.59**</td>
<td>.50**</td>
<td>.38**</td>
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Note. Pooled standard deviations are along the diagonal.
* p ≤ .05; ** p ≤ .001; n = 79 after list-wise deletion.
Table 2

Zero-Order Correlation Coefficients, Means, and Standard Deviations among Life Science Faculty Importance Ratings of Benefits

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<td>.31**</td>
<td>4.8 (1.6)</td>
<td>5.0 (1.3)</td>
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Note. Pooled standard deviations are along the diagonal.
* p ≤ .05; ** p ≤ .001; n = 169 after list-wise deletion.
### Table 3

Zero-Order Correlation Coefficients, Means, and Standard Deviations among Social Science Faculty Importance Ratings of Benefits

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<th>12.</th>
<th>13.</th>
<th>Women M (SD)</th>
<th>Men M (SD)</th>
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*Note.* Pooled standard deviations are along the diagonal. Univariate ANOVAs were used following a significant MANOVA to determine significant gender differences in ratings of importance, controlling for academic rank.

* p ≤ .05; ** p ≤ .001; n = 260 after list-wise deletion.

*a* p ≤ .05; *b* p ≤ .01; denotes a significant gender difference in mean importance rating.
Table 4

Zero-Order Correlation Coefficients, Means, and Standard Deviations among Technology, Engineering, and Mathematics Faculty Importance Ratings of Benefits

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Note. Pooled standard deviations are along the diagonal.  
* p ≤ .05; ** p ≤ .001; n = 112 after list-wise deletion.
Table 5

Zero-Order Correlation Coefficients, Means, and Standard Deviations among Hard Science Faculty Ratings of Limitations

|                | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. |
|----------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Cost           |    | 1.7|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Work           |    | .39**|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Health         |    | -.02|    | .08|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Language       |    | .17|    | .22|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Dependents     |    | .17|    | .18|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Race Bias      |    | .20|    | .25*|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Outdated Topics|    | .17|    | .02|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Travel Time/Distance | .20| .43**|    | .16|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Rejected Submissions | .08| .02|    | .10|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Nothing to Present | .14| .17|    | .04|    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

Note. Pooled standard deviations are along the diagonal.
* p ≤ .05; ** p ≤ .001; n = 77 after list-wise deletion.
Table 6

Zero-Order Correlation Coefficients, Means, and Standard Deviations among Life Science Faculty Ratings of Limitations

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Note. Pooled standard deviations are along the diagonal.
Univariate ANOVAs were used following a significant MANOVA to determine significant gender differences in ratings of importance, controlling for academic rank.

* p ≤ .05; ** p ≤ .001; n = 173 after list-wise deletion.
Table 7

Zero-Order Correlation Coefficients, Means, and Standard Deviations among Social Science Faculty Ratings of Limitations

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<td>2.8 (2.0)</td>
</tr>
<tr>
<td>10. Nothing to Present</td>
<td>.23**</td>
<td>.19*</td>
<td>.11</td>
<td>.19*</td>
<td>.14*</td>
<td>.19*</td>
<td>.19*</td>
<td>.28**</td>
<td>.57**</td>
<td>2.0</td>
<td>3.2 (2.0)</td>
<td>2.8 (1.9)</td>
</tr>
</tbody>
</table>

Note. Pooled standard deviations are along the diagonal

Univariate ANOVAs were used following a significant MANOVA to determine significant gender differences in ratings of importance, controlling for academic rank.

* p ≤ .05; ** p ≤ .001; n = 252 after list-wise deletion.

*a p ≤ .01; denotes a significant gender difference in mean importance rating.
Table 8

Zero-Order Correlation Coefficients, Means, and Standard Deviations among Technology, Engineering, and Mathematics Faculty Ratings of Limitations

<table>
<thead>
<tr>
<th></th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
<th>7.</th>
<th>8.</th>
<th>9.</th>
<th>10.</th>
<th>Women M (SD)</th>
<th>Men M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cost</td>
<td>1.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.3 (1.8)</td>
<td>5.1 (1.8)</td>
</tr>
<tr>
<td>2.</td>
<td>Work</td>
<td>.45**</td>
<td>1.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.9 (1.9)</td>
<td>4.8 (1.8)</td>
</tr>
<tr>
<td>3.</td>
<td>Health</td>
<td>.14</td>
<td>.28*</td>
<td>1.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.4 (1.6)</td>
<td>2.0 (1.2)</td>
</tr>
<tr>
<td>4.</td>
<td>Language</td>
<td>.15</td>
<td>.29*</td>
<td>.70**</td>
<td>1.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.0 (1.2)</td>
<td>1.8 (1.0)</td>
</tr>
<tr>
<td>5.</td>
<td>Dependents</td>
<td>.08</td>
<td>.26*</td>
<td>.58**</td>
<td>.54**</td>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.3 (1.7)</td>
<td>2.2 (1.6)</td>
</tr>
<tr>
<td>6.</td>
<td>Race Bias</td>
<td>.04</td>
<td>.20*</td>
<td>.53**</td>
<td>.64**</td>
<td>.47**</td>
<td>1.1</td>
<td></td>
<td></td>
<td></td>
<td>2.0 (1.2)</td>
<td>1.6 (0.9)</td>
</tr>
<tr>
<td>7.</td>
<td>Outdated Topics</td>
<td>.22*</td>
<td>.24*</td>
<td>.17</td>
<td>.31**</td>
<td>.27*</td>
<td>.37**</td>
<td>1.8</td>
<td></td>
<td></td>
<td>2.5 (1.6)</td>
<td>2.9 (1.9)</td>
</tr>
<tr>
<td>8.</td>
<td>Travel Time/Distance</td>
<td>.32**</td>
<td>.48**</td>
<td>.17</td>
<td>.11</td>
<td>.16</td>
<td>.11</td>
<td>.32**</td>
<td>1.7</td>
<td></td>
<td>4.9 (1.7)</td>
<td>4.2 (1.6)</td>
</tr>
<tr>
<td>9.</td>
<td>Rejected Submissions</td>
<td>.19*</td>
<td>.21*</td>
<td>.22*</td>
<td>.21*</td>
<td>.13</td>
<td>.22*</td>
<td>.29*</td>
<td>.27*</td>
<td>2.0</td>
<td>4.0 (1.9)</td>
<td>3.4 (2.0)</td>
</tr>
<tr>
<td>10.</td>
<td>Nothing to Present</td>
<td>.32**</td>
<td>.36**</td>
<td>.25*</td>
<td>.19*</td>
<td>.17</td>
<td>.19*</td>
<td>.31**</td>
<td>.35**</td>
<td>.72**</td>
<td>4.2 (1.8)</td>
<td>3.4 (2.0)</td>
</tr>
</tbody>
</table>

Note. Pooled standard deviations are along the diagonal.

* $p \leq .05$; ** $p \leq .001$; n = 112 after list-wise deletion.
### Mean Involvement and Percent of Faculty Involved by Type of Involvement, Academic Category, and Gender

<table>
<thead>
<tr>
<th>Type of Involvement</th>
<th>Hard Sciences</th>
<th>Life Sciences</th>
<th>Social Sciences</th>
<th>TEM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Women</td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
</tr>
<tr>
<td>Attended Conference</td>
<td>90.0%</td>
<td>80.0%</td>
<td>78.6%</td>
<td>78.7%</td>
</tr>
<tr>
<td></td>
<td>2.1 (1.4)</td>
<td>1.6 (1.1)</td>
<td>1.7 (0.8)</td>
<td>1.8 (0.9)</td>
</tr>
<tr>
<td>Submitted Poster</td>
<td>46.9%</td>
<td>60.7%</td>
<td>71.4%</td>
<td>71.0%</td>
</tr>
<tr>
<td></td>
<td>1.9 (3.1)</td>
<td>2.4 (3.1)</td>
<td>2.4 (3.2)</td>
<td>2.1 (2.4)</td>
</tr>
<tr>
<td>Submitted Oral Talk</td>
<td>74.3%</td>
<td>71.9%</td>
<td>56.3%</td>
<td>66.2%</td>
</tr>
<tr>
<td></td>
<td>2.2 (2.9)</td>
<td>1.9 (3.5)</td>
<td>1.2 (1.7)</td>
<td>1.2 (1.6)</td>
</tr>
<tr>
<td>Invited to Give Oral Talk</td>
<td>73.5%</td>
<td>53.3%</td>
<td>51.6%</td>
<td>48.4%</td>
</tr>
<tr>
<td></td>
<td>1.7 (2.1)</td>
<td>1.4 (3.6)</td>
<td>0.8 (0.9)</td>
<td>0.9 (1.5)</td>
</tr>
<tr>
<td>Gave Oral Talk</td>
<td>88.6%</td>
<td>77.4%</td>
<td>66.7%</td>
<td>72.1%</td>
</tr>
<tr>
<td></td>
<td>2.1 (1.8)</td>
<td>1.9 (2.7)</td>
<td>1.4 (1.7)</td>
<td>1.5 (2.0)</td>
</tr>
<tr>
<td>Invited to Give Plenary</td>
<td>15.2%</td>
<td>20.7%</td>
<td>9.5%</td>
<td>7.9%</td>
</tr>
<tr>
<td></td>
<td>0.3 (0.8)</td>
<td>0.3 (0.6)</td>
<td>0.1 (0.5)</td>
<td>0.1 (0.4)</td>
</tr>
<tr>
<td>Gave Plenary</td>
<td>15.2%</td>
<td>13.8%</td>
<td>9.5%</td>
<td>7.9%</td>
</tr>
<tr>
<td></td>
<td>0.3 (0.8)</td>
<td>0.1 (0.4)</td>
<td>0.1 (0.5)</td>
<td>0.1 (0.4)</td>
</tr>
</tbody>
</table>

*Note.* Faculty attending at least one conference in their first specified research organization over the past two years were asked to report their involvement in that organization. Missing data were excluded from percent calculations in each involvement type (totals by gender and type of involvement used for calculations can be found in Appendix B). Bold indicates significance at \( p \leq .01 \).

*The percentage of participants attending at least one conference was calculated from those identified as current members: Hard Sciences (HS; women = 40, men = 40); Life Sciences (LS; women = 84, men = 80); Social Sciences (SS; women = 126, men = 115); TEM (women = 55, men = 53). TEM = Technology, Engineering, and Mathematics.*
Table 10

Counts of Faculty Committee Involvement Since 2012

<table>
<thead>
<tr>
<th></th>
<th>Hard Sciences</th>
<th>Life Sciences</th>
<th>Social Sciences</th>
<th>TEM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Women</td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
</tr>
<tr>
<td>Executive/Council</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Program</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Award</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Editorial</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Minority/Student</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
<td>7</td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>N</td>
<td>15</td>
<td>10</td>
<td>18</td>
<td>24</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>1.6 (0.8)</td>
<td>1.3 (0.7)</td>
<td>1.4 (0.6)</td>
<td>1.6 (0.8)</td>
</tr>
</tbody>
</table>

Note. Faculty attending at least one conference in their first specified research organization over the past two years were asked to report their involvement in organization committees. There was a significant gender difference in the social sciences. TEM = Technology, Engineering, and Mathematics.
Figure 1. Importance rating of having childcare available at organization-sponsored events. Bars indicate standard error. Independent samples t-tests were calculated comparing women and men in each academic category. TEM = Technology, engineering, and mathematics.

*p < .05
Figure 2. Rating of childcare responsibilities limiting participation in research organizations for participants with children under the age of 18. TEM = Technology, engineering, and mathematics.

* $p < .05$
Figure 3. Level of agreement that gender bias or discrimination limits participation in research organizations. TEM = Technology, engineering, and mathematics.

* $p < .05$; ** $p < .01$
CHAPTER FIVE
PERCEPTIONS OF GENDER EQUITY IN RESEARCH ORGANIZATIONS

The number of women earning doctorate degrees in science has increased dramatically over the past 30 years, and in some STEM disciplines (e.g., Biology, Neuroscience) the number of doctoral degrees awarded to women is comparable to that of men (National Science Foundation [NSF], 2013). However, more women than men are lost at each juncture along the tenure path in STEM and this trend has raised concerns about the future of these fields in the United States (Bystydzienski & Bird, 2006; Long, 2001; National Academy of Sciences [NAS] et al., 2006; Preston, 2004). Many factors contributing to the persistent inequality have been identified (e.g., NAS et al., 2006), but there is still much left to accomplish before attaining an equal representation of women and men in STEM, particularly in faculty positions.

Solutions to address this inequality have been proposed and are currently being implemented across the country, in part as a result of several NSF funding programs. In 1997, NSF initiated a funding program called The Professional Opportunities for Women in Research and Education (POWRE) to provide another avenue of funding support for women in STEM. This program was replaced in 2001 with the ADVANCE program which shifted the focus from individual support to making changes at all levels of academic institutions in order to increase women’s representation in STEM and prevent faculty attrition. Programs were initiated across the individual, supervisory, department, and administrative levels. Substantial changes in hiring and promotion policies, training of leaders in academic departments and administrative roles, and policies addressing work-family conflict have been implemented
because of these programs (Bilimoria, Joy, & Liang, 2008; Bonnekessen, 2011; Laursen & Rocque, 2009; NAS et al., 2006; Preston, 2004; Ross, 2004b).

Creating change within academic institutions tends to be a challenging and lengthy process. Morimoto, Zajicek, Hunt, and Lisnic (2013) reviewed 37 universities across the U.S. that were awarded NSF ADVANCE grants from 2001 to 2008. Many of the policies and practices initiated were evaluated based on change in the representation of women across various levels within the institution. Concrete outcomes provide a straightforward measure of policy impact, but Morimoto et al. also discuss the importance of understanding which programs did not work and whether the changes implemented are having a conceptually different impact on the experiences of women and men. In line with this reasoning, Timmers, Willemsen, and Tijdens (2010) found that policies targeting cultural change and formal evaluations of how policies may differentially impact women and men led to the most significant increase of female professors, graduate students, and staff across 14 academic institutions. Policies implemented at academic institutions are beginning to have a positive impact for women in STEM, and now these successes need to be extended to other facets of researchers’ careers.

One especially visible facet is professional research organizations. The actions these organizations take are publicized to members and other research professionals. Frehill and Ivie (2013) reviewed the data collected and dispersed by professional research organizations. They noted that the involvement of women and other underrepresented individuals within these organizations may serve as a better gauge of their presence in a field compared to using the proportion at various academic ranks. The actions publicized by research organizations
and the change, or lack thereof, occurring within them are being incorporated into discussions about improving the general climate for women in STEM. Three prominent women chemists recently petitioned for scientists to boycott conferences showcasing only male speakers (Carter, Gagliardi, & Krylov, 2014). Their voices were quickly heard and the underrepresentation of women in prestigious positions at research conferences became a popular topic of discussion in the science community (e.g., Benderly, 2014; Flaherty, 2014; Gibney, 2014; Kase, 2014). Similar petitions have been initiated in the past (e.g., Rosen, 2013; Schliesser, 2012), resulting in a clear demand for research organizations to examine their practices and policies. Several research organizations in STEM have a history of disproportionately recognizing men and have been scrutinized for their use of potentially gender biased practices (Casadevall & Handelsman, 2014; Isbell, Young, & Harcourt, 2012; see Chapter 3), yet there has been virtually no research examining the actual policies and practices used within these organizations. A main goal of the current study was to determine what policies and practices, if any, are currently being implemented within research organizations to address issues contributing to gender disparity.

Strategies used to reduce inequalities based on gender should also reduce members’ perceptions of gender inequity. Perceptions of gender equity have been measured within academic institutions and women consistently report less gender equity than their male colleagues (Greene, Stockard, Lewis, & Richmond, 2010; Institute for Research on Women and Gender, 2002; Settles, Cortina, Malley, & Stewart, 2006). Improving the general climate and increasing perceptions of equity are some of the most challenging obstacles organizations face when attempting to increase the number of women in STEM (Bilimoria & Liang, 2012;
NAS et al., 2006). One proposed way to improve climate and perceptions of equity is to increase the number of women overall, especially women in leadership positions. A critical mass of women, reaching approximately 30% of the population, results in greater equity of resource allocation, reductions in feelings of isolation, as well as more women serving as mentors and in leadership positions (Carrigan, Quinn, & Riskin, 2011; Chesterman & Ross-Smith, 2006; de Wit, 2010; Joecks, Pull, & Vetter, 2013; Konrad, Kramer, & Erkut, 2008; Lagesen, 2007; Sanders, Willemsen, & Millar, 2009). The representation of women also increases more quickly within larger organizations, where there is often more pressure to conform to social pressures (Hillman, Shropshire, & Cannella, 2007). These same trends were hypothesized to hold within research organizations in the following ways:

**Hypothesis 1:** Women will perceive less gender equity in professional STEM research organizations compared to men.

**Hypothesis 2:** A greater number of policies and practices addressing potential gender disparities will relate to higher perceptions of gender equity.

**Hypothesis 3:** A greater proportion of women as leaders, speakers, and councilors in a research organization will predict higher perceptions of gender equity.

**Hypothesis 4:** Larger organizations will be viewed as more gender equitable than smaller organizations.
METHOD

Participants

Faculty members were sampled from 41 doctoral/research universities across the U.S. \((N = 645; \text{women} = 334, \text{men} = 311)\). See Chapter 2 for complete participant information. The full sample of participants was used to test invariance across gender for the measure of perceptions of gender equity. Data from a smaller sample of these participants was used once organizational characteristics were included in the analyses in the current study. Participants were asked to identify two professional research organizations in their discipline and data on 21 of these organizations were collected (see Organization Level Measures for details about selection criteria). Only participants who provided information about one of these 21 organizations were included in this study \((n = 408; \text{women} = 195, \text{men} = 213)\). Participants ranged in age from 27 to 89 \((M = 49.2, SD = 12.4)\). Over half were in social or life science disciplines (67.4\%) and the remaining 32.6\% were in hard science or technology, engineering, or mathematics (TEM). They identified as 3.4\% Asian, 3.4\% Black, 2.7\% Hispanic/Latina/o, 2.7\% multiracial/ethnic, 86.0\% White, 0.7\% Other, and 1.1\% did not respond. The majority of participants were married (77.7\%), followed by single/committed (13.0\%), and separated/divorced/widowed (7.8\%), and 1.5\% did not respond. In terms of academic rank, 27.3\% were assistant, 27.9\% were associate, 35.0\% were full, and 9.8\% were distinguished professors.

Individual Level Measures

As part of a larger survey (see Chapter 2), participants were asked to report their sex \((1 = \text{female})\), rank (assistant professor = 0), discipline \((0 = \text{hard science or TEM}; 1 = \text{life})\).
Maranto and Griffin’s (2011) scale, developed to measure perceptions of gender equity in an academic department, was modified to relate to a research organization (e.g., “Taken as a whole, there is gender equity in this [organization] for leadership and workload responsibilities”). One item (“I feel that the climate and opportunities for women faculty in my department are at least as good as those for men”) was added to this scale due to its relevance in this study (Rhode et al., 2010). Two items related to teaching course load were excluded. Each of the four remaining items were rated on a scale from 1 (strongly disagree) to 7 (strongly agree) and had high internal consistency ($\alpha = .89$).

Organizations

Participants identified a total of 358 professional research organizations in STEM. There were 27 academic, unidentifiable, or government institutions (e.g., Harvard, National Science Foundation, Department of Energy) identified that were excluded from analysis. The most popular organization was identified by 71 individuals and 267 organizations were identified by only one individual. Sixty-one organizations were identified by at least five people and leaders from those organizations were contacted for additional information.

Survey of leaders. The contact information for individuals listed as council members or executive leaders (e.g., executive director, president, etc.) were gathered from the organization webpage or the individual’s institution of employment. An email explaining the study was sent with a survey link to a selection of leaders from each organization totaling 287 invitations. The survey asked leaders to identify strategies used in their organization to
encourage or support the involvement of women. Leaders from 21 of the organizations responded. Executive directors provided the majority of responses (n = 12), followed by organization presidents (n = 6), and other council members (n = 3). Seven organizations had more than one leader respond. Feedback from the highest ranking leader was used in those cases (e.g., President over a council member).

All participants identifying one of these 21 organizations were included in the analyses. Some participants named one of these organizations for both of their selections (n = 58; 14.2%). In these cases, only one of their choices was selected for analysis by balancing organizations identified first and second; the majority of participants named one of the 21 organizations first (n = 304), so there were fewer participants with data for organizations named second in the sample (n = 104). There was a range from 6 to 68 participants answering questions about each organization (M = 19.9, SD = 16.6). Research organizations are often highly interdisciplinary, and one-third of the organizations (n = 7) were identified by individuals in the hard sciences or TEM as well as individuals in social sciences or life sciences.

**Organization Level Measures**

**Policies and practices.** For the purpose of this study, formal strategies (i.e., policies or practices found in writing about an organization) that may be used to encourage or support the involvement of women in a research organization were identified. Websites of membership organizations, academic institutions, and businesses were searched to create a comprehensive list of potential strategies. Policies not relevant in research organizations
where membership is voluntary were excluded (e.g., hiring, salary, etc.). A list of 18 policies and practices fitting these criteria were identified:

1. Stated declaration of being inclusive to all genders
2. Policy preventing gender discrimination
3. Policy to prevent harassment based on gender
4. Policy aimed at increasing the number of early-career women as members
5. Policy to increase the number of women as leaders within your organization (e.g., gender-alternating president)
6. Policy aimed at increasing the number of women submitting presentations
7. Policy to increase the number of women speakers at conferences/events
8. Clear guidelines about how to properly implement policies regarding gender
9. Training/resources for members and/or leaders regarding gender issues
10. Training or workshops for women to increase their competitiveness or success in their career
11. Committee/group focusing on women
12. Awards specifically for women
13. Awards recognizing individuals who strive for gender equity
14. Funding specifically for women
15. Mentoring opportunities specifically for women
16. Networking opportunities specifically for women
17. Support/social groups specifically for women
18. Childcare options available during conferences/events

The surveys sent to organizational leaders asked them to indicate whether each of these policies or practices was currently used in their organization (Yes/No). The number of policies or practices identified was summed for each organization to create a total policy
count. Leaders were asked to rate the importance of each policy implemented within their organization on a scale from 1 (*not at all important*) to 7 (*extremely important*). Those without the policy were asked to rate the importance of adding the policy in the future on the same scale. Leaders were asked to rate how effective the policies currently being implemented were at increasing the involvement of women in their organization on a scale from 1 (*not at all effective*) to 7 (*extremely effective*). There was also an open-ended question asking whether they wanted to add information about the policy or how it was implemented in their organization along with space at the end of the survey for more general feedback. A descriptive summary of this feedback is included in the results.

**Organization characteristics.** Additional characteristics of the 21 organizations with policy count information were gathered. These characteristics included organization size and the proportion of women speaking at events, represented on the council, and represented in leadership roles.

**Organization size.** The organization leaders surveyed were also asked to report the number of members currently in their organization. The number reported was verified on the respective organization webpages. One organization leader did not report the size of their organization, but the membership size was found on the webpage.

**Speakers.** Lists of plenary or main speakers featured at the research conference or event in 2013 for each organization were found by searching organization webpages. The proportion of women speaking in 2013 was used to provide the most accurate view of current organizational characteristics. When possible, the gender of the speakers was determined by viewing a photograph of them on the organization site. Not all organizations had photos of
their main speakers for past events. The gender of all other speakers was identified by searching their personal webpages through their affiliation. The proportion of women featured as plenary or invited speakers was used for this measure.

**Leaders.** Leaders included individuals listed as president, president-elect, vice president, secretary, or treasurer. Depending on the organization, past presidents remained part of the leadership for one or more years after the end of their term and were included in the leadership count. Additionally, six out of 21 organizations had multiple vice presidents listed and all were included in the total leadership count. The proportion of women serving in these leadership positions was used as the measure of leaders for each organization.

**Councilors.** Council members or members of the governing board were identified on the organization webpages and their gender was determined either through photographs or by searching their personal webpages. In many organizations, leaders were also listed as members of the council. Any individuals identified previously as leaders of the organization were excluded from the count for councilors. The proportion of women serving as councilors or governing board members was calculated for this measure.

**Analysis**

**Measurement invariance.** Mplus 7.2 software was used to examine the measure for perceptions of gender equity (Muthén, & Muthén, 2012). Invariance of latent measures across groups should be established before mean differences or structural relationships can be tested (Meredith & Teresi, 2006; Vandenberg & Lance, 2000; Wang & Wang, 2012; Widaman & Reise, 1997). A Satorra–Bentler scaled chi-square statistic ($\text{SB}_\chi^2$) was used to measure invariance as constraints were imposed, where a significant change in $\text{SB}_\chi^2$ would indicate
noninvariance across groups (Satorra & Bentler, 2001). A decrease in $\text{CFI} \leq .01$ was also used as an indication of invariance (Cheung & Rensvold, 2002).

When testing differences between groups and relationships among latent factors, it is important to first determine whether the measures used are invariant across groups (Vandenberg & Lance, 2000; Wang & Wang, 2012; Widaman & Reise, 1997). The *configural model* was estimated first to examine whether men and women had the same underlying factor structure, where each of the four items were associated with perceptions of gender equity for women and men. Next, *metric invariance* was tested by constraining factor loadings to be equal across gender. Metric invariance indicates that each item on the scale contributes to the same magnitude of change in the measure of gender equity for women and men. The factor loadings remained constrained across gender when moving to the test for *scalar invariance*. Scalar invariance was tested by constraining item intercepts to be equal across gender and invariance at this stage would indicate that scale items have a similar value for women as they do for men.

**Multilevel analysis.** The measure for perceptions of gender equity was transformed into a z-score and analyzed using multilevel robust estimation techniques in Mplus 7.2 (Muthén, & Muthén, 2012). A nested data structure (participants in organizations) requires the use of multilevel analysis techniques rather than ordinary least squares (OLS), which assumes independence of observations (Hox, 2010). The organization-level (level 2) predictors were of interest in this study, so grand mean centering was performed on level 1 predictors as suggested by Enders and Tofighi (2007). Grand mean centering level 1 predictors makes them a composite of both the within- and between-level variability which cannot be unambiguously
interpreted. The correlated level 1 and level 2 predictors allows for clearer interpretation of the organization-level predictors (level 2) since they become partial correlations parsing out the variability in level 1 predictors. Level 2 predictors were entered as z-scores and were thus already grand mean centered. In a multilevel random intercept model, the level 1 (individuals) regression equation is as follows:

\[ Y_{ij} = \beta_{0j} + \beta_{1j}X_{1ij} + \ldots + \beta_{nj}X_{nij} + r_{ij} \]

\( Y_{ij} \) represents the dependent variable score (i.e., perceptions of gender equity) at level 1 for person \( i \) in organization \( j \). \( \beta_{0j} \) is the random intercept for organization \( j \) adjusting for deviations from the grand mean in each cluster. \( \beta_{nj} \) represents the regression coefficient for level 1 predictor \((1 \ldots n)\) for participant \( i \) in organization \( j \), and is comprised of variability from both levels. The residual error at level 1 is depicted as \( r_{ij} \) and becomes \( \sigma^2_w \) once level 2 is included in the equation. Intercepts were allowed to vary in the current analysis:

\[ \beta_{0j} = \gamma_{00} + \gamma_{01}W_{1j} + \ldots + \gamma_{0n}W_{nj} + \sigma^2_B, \]

where \( \gamma_{00} \) represents the grand mean intercept of the dependent variable, \( \gamma_{01} \) to \( \gamma_{0n} \) represent the level 2 coefficients for \( W_{1j} \) to \( W_{nj} \) level 2 predictors, and \( \sigma^2_B \) is the level 2 residual variance for the random intercept.

To determine the amount of variance accounted for at each level, three multilevel models were analyzed. First, perceptions of gender equity was analyzed without any predictors to determine level 1 (within participants; \( \sigma^2_{W1} \)) and level 2 (between organizations; \( \sigma^2_{B1} \)) variability. These were used to calculate the intraclass correlation (ICC) as follows:
\[
\frac{\sigma_{B1}^2}{\sigma_{B1}^2 + \sigma_{W1}^2}
\]

Next, level 1 predictors were added to the model, which provided a measure of residual variability in the dependent variable at level 1 (\(\sigma_{W2}^2\)) and level 2 (\(\sigma_{B2}^2\)). The within variability accounted for by these predictors was calculated as follows:

\[
\frac{\sigma_{W1}^2 - \sigma_{W2}^2}{\sigma_{W1}^2}
\]

Finally, level 2 predictors were added to the model, where the remaining variance not accounted for in between variability of the dependent variable was obtained (\(\sigma_{B3}^2\)). The percent of variance around the intercepts accounted for by level 2 predictors was calculated as follows:

\[
\frac{\sigma_{B2}^2 - \sigma_{B3}^2}{\sigma_{B2}^2}
\]

**RESULTS**

**Organization Descriptive Characteristics**

The characteristics of the 21 organizations examined varied greatly. Organization size ranged from those with fewer than 3,000 to those exceeding 150,000 members (\(M = 34,347, SD = 41,683\)). The number of speakers highlighted within each organization varied greatly, ranging from a single plenary speaker to 22 invited speakers (\(M = 8.81, SD = 5.67\)). The proportion of women speaking ranged from 0% women to 100% women (\(M = 34.1\%, SD = 21.6\%\)). The proportion of women in leadership positions ranged from 0% to 87.5% (\(M = 41.9\%, SD = 20.9\%\)). One organization had as few as three leaders and two organizations had
as many as nine ($M = 6.33$, $SD = 1.80$). The number of councilors also varied greatly ranging from three to more than 50 ($M = 14.33$, $SD = 11.69$). Women were relatively well represented as councilors ($M = 49.9\%$, $SD = 21.9\%$) and their proportion ranged from $14.3\%$ to $100\%$.

**Policies and Strategies Identified**

The most commonly identified strategy to increase the involvement of women in research organizations was an anti-discrimination policy (see Table 1). This was followed closely by a general declaration of inclusiveness, having a committee regarding women in the organization or discipline, and providing childcare for organization-sponsored events. The policies identified least often were public recognition of individuals who strive for gender equity within the organization or discipline, as well as strategies to increase the number of presentations submitted by women and the number of female speakers overall. The popularity of the strategies identified closely matched the ratings of importance with the exception of awards for women. Having awards specifically for women was identified in $66.7\%$ of the organizations but was in the bottom three for ratings of importance by organization leaders. These awards were also rated as the least important strategy to add by leaders whose organizations did not currently use them. Providing childcare for organization-sponsored events and offering mentoring for women were rated as most important to add to organizations not currently providing these services.

Ratings of effectiveness matched ratings of importance for most of the strategies identified, where the most effective strategies were also rated as the most important. There were a few exceptions upon closer examination. Repeated samples t-tests were used to determine whether leaders rated the strategies currently used by their organization as less
effective compared to the magnitude of their ratings of perceived importance. The policy prohibiting discrimination based on gender was viewed as highly important but not as effective, $t(16) = 2.75, p = .014, d = .66$. A declaration of inclusion was rated as one of the top most important policies but its effectiveness at increasing the involvement of women was perceived to be substantially lower, $t(15) = 2.97, p = .010, d = .74$. The effectiveness of strategies used to increase the involvement of early-career members was rated lower compared to its perceived importance, $t(8) = 2.83, p = .022, d = .93$; and so were the workshops developed to increase the professional competitiveness of women, $t(13) = 2.89, p = .014, d = .81$.

**Descriptive feedback from leaders.** Leaders provided a total of 124 open-ended remarks about the 18 strategies listed. There were more male leaders ($n = 16$) than female leaders ($n = 5$) and four men (25%) provided no remarks about the policies and practices used in their organization. The comments fell into three main categories. First, 14.5% of the comments indicated that there were no issues in the organization that required the specific strategy identified. Another 11.3% of the comments regarded utilizing the strategies listed but without a specific focus on women. This same number of comments (11.3%) mentioned the use of informal versions of these strategies and three leaders contemplated creating formal policies throughout the survey (e.g., “Writing down something that we already do/exhibit/project is probably a good idea”). There was also one strategy identified by seven leaders that was not on the original list of 18: seeking nominations of women for awards and fellowships offered through the organization.
There were several comments referencing resistance toward these strategies. For example, when asked about a policy to increase the representation of women as speakers at their conference, one female leader stated:

There is often pushback against this in the Program Committee. Having a written policy allows the grumbling to happen and then to have the issue of representation addressed at every committee meeting.

Five others indicated that judgments within their organization were based on quality and gender was not incorporated into decisions on who is recognized. Another person discussed the possibility that biases still exist within their organization, but displayed a seemingly low sense of responsibility to address these issues:

I suspect there are [gender biases], but these are not conscious choices. We aim to correct imbalances where we are aware of them, but there are many practices embedded in our society (and here I mean the U.S. as well as our scientific society) that may have detrimental effects without individuals necessarily being aware of them.

One male leader identified the existence of a hostile climate and harassment as a major issue still facing members in their organization and general discipline. They also emphasized the need for research organizations to raise awareness about these issues beyond their organization, fostering changes within the broader discipline and academic institutions in order to better serve their members. The feedback from leaders was mixed, but an overarching theme was that strategies addressing gender disparity were only instigated and supported when issues were apparent. Leaders also revealed an uncertainty about how to approach certain issues and contemplated whether some of these strategies would benefit their members.
(e.g., “I have heard that some groups consider that awards just for women may marginalize both the award and the winner”).

It was of additional interest to determine whether the organizations not implementing these strategies differed in regard to their representation of women. Policies targeted at increasing the representation of women as leaders and speakers could be tested directly with the information gathered about the proportion of women represented in these categories within each of the 21 organizations. Albeit a small sample, independent samples t-tests were used to evaluate potential differences between organizations that utilize a formal policy compared to those that do not. The proportion of women as leaders in organizations with a formal policy regarding leadership ($M = 0.470, SD = 0.169$) did not significantly differ from the proportion of women as leaders in organizations without these policies ($M = 0.413, SD = 0.257$), $t(19) = 0.555, p = .59, d = .26$. The proportion of women serving as councilors did not differ between organizations with a formal leadership policy ($M = 0.549, SD = 0.279$) compared to those without a formal policy ($M = 0.485, SD = 0.211$), $t(19) = 0.594, p = .56, d = .26$. Finally, there was no significance difference in the proportion of women speaking at conferences in organizations with a formal policy aimed at increasing these numbers ($M = 0.281, SD = 0.061$) compared to those without a policy ($M = 0.366, SD = 0.251$), $t(19) = 0.808, p = .43, d = .47$.

**Measure of Gender Equity**

Women and men were first tested separately and met the criteria for acceptable fit where CFI > .90, RMSEA < .08, and SRMR < .08 (see Table 2). The *configural model* using both women and men was estimated to use as the baseline comparison for further invariance
testing. Next, metric invariance was tested by constraining the factor loadings to be equal across women and men. The metric invariance test held, which indicates the relationship between each indicator and the latent factor was similar between women and men (Meredith & Teresi, 2006). Scalar invariance was tested by constraining item intercepts in addition to the factor loadings but was significantly different across groups. The SB$_{\chi}^2$ change was significant and the decrease in CFI was greater than 0.08. This indicates that women and men responded systematically differently in their responses and precludes further group comparisons. To examine these differences more closely, each item intercept was constrained individually and tested against the metric invariance model (see Table 2). The factor loadings and item means are displayed in Table 3 and show that women reported less gender equity on each of the 4 items compared to men. The similar factor loadings shown in Table 3 corroborate the metric invariance already examined. Perceptions of gender equity were compared separately for the following multilevel analyses.

**Multilevel Regression Analysis**

The ICC for perceptions of gender equity was .122 for women and .015 for men. The variability in perceptions of gender equity was significant for individuals but not between organizations. As shown in Table 4, only years of membership was a significant level 1 predictor of gender equity perceptions, where more years as a member was associated with greater perceptions of gender equity for both women and men. Rank and discipline were not significantly associated with perceptions of gender equity for men or women. Together, the level 1 predictors accounted for 7.4% of the within variability for women and 8.8% for men.
Level 2 predictors were added to the model, Table 4 displays the final model with all predictors for women and men. The level 2 predictors accounted for 87.5% of the variance in perceptions of gender equity between organizations for men and 70.9% for women. Counter to the original hypothesis, the number of strategies identified by organization leaders predicted a significant decrease in perceptions of gender equity across organizations for women. The number of policies was also negatively associated with perceptions of gender equity for men, but this relationship did not reach statistical significance ($p = .11$). There was no support for the hypothesis that a higher proportion of women as leaders, councilors, or speakers would relate to higher gender equity perceptions for women; however, a greater proportion of women in leadership positions and speaking at conferences was associated with greater perceptions of gender equity for men. Larger organizations were associated with lower perceptions of gender equity for men, but there was no relationship between organization size and gender equity perceptions for women.

**DISCUSSION**

Women and men in the current study conceptualized gender equity differently. Personal perceptions of climate and equity have a significant impact on career outcomes above measures of actual climate factors and the presence of equitable processes (Carr, Schmidt, Ford, & DeShon, 2003; Schulte, Ostroff, & Kinicki, 2006). Perceptions of gender equity are important for women and men (Maranto & Griffin, 2011; Miner-Rubino & Cortina, 2004; Riffle et al., 2013; Settles, Cortina, Buchanan, & Miner, 2012), but the significant difference in how equity is conceptualized must be considered when examining how to
change these perceptions and improve the gender climate within an organization. Many policies are developed with the aim of increasing women’s representation in STEM and target the elimination of discriminatory processes that may result in unequal access to opportunities. The underlying idea being that once discriminatory processes are abolished, career progression will be equally attainable for men and women. However, removing discriminatory processes must be paired with a better understanding of how the experiences of women and men may differ and how these differences also contribute to the persistent underrepresentation of women. Reeves and Baden (2000) discuss the term gender equity and define it as the “equivalence in life outcomes for women and men, recognizing their different needs and interests, and requiring a redistribution of power and resources” (p. 10). They emphasize the importance of considering the potentially different impact organizational policies and changes will have on women and men.

Approaches used to achieve gender equity can be quite different from approaches developed to achieve an equal representation of women. The impact of attaining a critical mass of women in organizations is associated with improvements in the gender climate and productivity (Carrigan et al., 2011; Chesterman & Ross-Smith, 2006; Konrad et al., 2008) and should not be discounted, but there is debate over whether these improvements have a lasting effect (Kurtulus & Tomaskovic-Devey, 2012). In the current study, a greater number of women in the most visible positions of a research organization did not relate to higher perceptions of gender equity for women. In contrast, greater proportions of women as leaders and speakers at conferences were associated with higher perceptions of gender equity for men in STEM organizations. These findings further emphasize that men and women may be
conceptualizing what it means for an organization to be gender equitable differently, where
men are taking their cues from an equality-in-numbers standpoint. Sanders and colleagues
(2009) found that the percent of women in an academic department was not related to
perceptions of it being a woman-friendly environment. Striving for an equal representation of
women in STEM is a worthy goal, but these data confirm the need to acknowledge the
differences in how women and men view equity in order to change their perceptions in a
positive direction.

There was an inverse relationship between organization size and perceptions of gender
equity for men. Organization size did not relate to equity perceptions for women in a
statistically significant manner, but the inverse relationship was consistent. It was
hypothesized that larger organizations would be viewed as more gender equitable, but
changing the processes used within larger organizations may take longer to implement than
within small organizations (Stewart & Drakich, 1995). Organization leaders were not asked
how long the strategies they identified were in place prior to taking the survey. Change
requires time and newly developed strategies may not have significantly altered member
experiences at the time of the survey. Another explanation is that networking and socializing
with others is easier or more comfortable in smaller organizations. There may be a heightened
sense of connectedness among all members, especially for men in organizations that are male-
dominated.

An encouraging finding was that organization leaders appear to be aware of gender
issues and are taking steps to address them. This push for the development of strategies to
address gender issues in STEM research organizations was apparent from the number of
strategies currently being employed across the 21 organizations examined. All of the
described strategies listed were identified by at least four organizations and the strategies put to use
were rated as at least somewhat important for the organization by their leaders. Effectiveness
ratings of these strategies to increase the involvement of women mirrored most of the ratings
of importance. In contrast, the importance of adding strategies not currently in use was rated
as much less important overall. For many of the strategies listed, organization leaders
indicated that the issues the strategies would address did not exist in their organization,
making the implementation of such strategies irrelevant. Another common response was that
informal strategies were a sufficient alternative in their organization and rendered formal
policies unnecessary. Upon closer examination, there was no indication that the presence of a
formal policy aimed at increasing the number of women in leadership positions or as speakers
was related to a greater proportion of women in these positions. However, these data are
cross-sectional, so the proportion of women may have increased over time since the policies
were implemented and are now matching organizations that began with a more proportionate
representation of women. Evaluating the full impact of these policies requires a longitudinal
study to capture changes occurring across time.

The total number of policies identified within research organizations was negatively
associated with perceptions of gender equity for women but not men. More strategies used by
organizations to encourage the involvement of women were associated with lower ratings of
gender equity, which further supports the necessity of considering how changes within an
organization may impact women and men differently. These findings were contrary to the
hypothesized direction of association; however, the development of a policy is generally
linked with the presence of an issue requiring change. This reactive, rather than preemptive, process is common and helps explain the negative association between policies and perceptions of equity for women. Leaders within these STEM organizations discussed the importance of addressing issues if they arose, which indicates that the strategies currently used were likely initiated because of existing gender-related issues within the organization.

The organizational characteristics used in the current study accounted for a large amount of the between-level variability in perceptions of gender equity. However, the amount of variability accounted for was 16.6% lower for women than men and further corroborates the need to identify alternative organization-level characteristics that better explain gender equity perceptions for women. It is also important to note that the between-level variability in perceptions of gender equity was low and did not reach statistical significance in the current study. Factors accounting for the large proportion of variability between individuals should be characterized in future studies because less than 9% of the individual-level variability was accounted for by rank, discipline, and membership tenure.

Though it is encouraging that research organizations in STEM are beginning to formulate formal policies and strategies to address gender-related issues that may be limiting the involvement of women, fewer than half of the organizations identified having clear guidelines about how to implement those changes. Implementing these strategies effectively is a challenge that requires considerable effort to overcome. In a guide written for individuals funded by ADVANCE grants, Rosser and Chameau (2006) pose several important questions to consider when developing strategies for change to increase their effectiveness and sustainability. Having support for the proposed changes at all levels of the organization is an
emphasized necessity (Morimoto et al., 2013; Rosser & Chameau, 2006). Before any change is put in motion, an individual or group of people invested in the process should also be put in charge of implementing and monitoring the change.

Family-friendly policies are becoming more and more common where women are employed as a way to reduce their underrepresentation, but these policies are often mismanaged or misunderstood once developed. Responsibilities may fall on supervisors or administrators who were not well informed about the policy and are left to navigate the personal and professional impacts related to implementation (Todd & Binns, 2013). Raising awareness about these policies and how to properly access and manage them helps alleviate issues surrounding implementation and results in greater policy utilization (Villablanca, Beckett, Nettiksimmons, & Howell, 2013). These same strategies for implementing successful and sustainable change should be considered by leaders within STEM research organizations and the current lack of clear guidelines underscores this necessity.

Changes are being made within STEM organizations, specifically to address issues that may be negatively affecting female members. Leaders within these organizations appeared generally aware of many of the issues facing their members but were often unsure about the best approach to overcoming them. Part of this uncertainty may stem from the fact that many organizational characteristics may be related to perceptions of gender equity for men but not women. These differences likely lead to mixed reviews from members and add to the ambiguity about which strategies are most effective. The strategies currently in use need to be evaluated more critically. Acknowledging that any changes made within an organization may result in a different outcome for women and men will also help uncover changes to
implement that will be most useful for the entire membership. Improving the general climate for women in STEM research organizations will strengthen the changes being made in academic institutions. Change must be implemented across all facets of STEM careers for the number of women represented to continue rising and to ensure the experiences of all individuals in STEM are equitable.
### Table 1

**Importance and Effectiveness Rating of Policies Identified by Research Organization Leaders**

<table>
<thead>
<tr>
<th>Policy</th>
<th>Count</th>
<th>Importance</th>
<th>Effectiveness</th>
<th>Add Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender Discrimination</td>
<td>17</td>
<td>6.4 (0.7)</td>
<td>5.9 (0.7)</td>
<td>4.3 (1.2)</td>
</tr>
<tr>
<td>Gender/Sexual Harassment</td>
<td>14</td>
<td>6.4 (0.9)</td>
<td>5.9 (1.0)</td>
<td>5.0 (1.1)</td>
</tr>
<tr>
<td>Declaration of Inclusion</td>
<td>16</td>
<td>6.3 (1.4)</td>
<td>5.1 (1.3)</td>
<td>4.3 (1.7)</td>
</tr>
<tr>
<td>Committee on Women</td>
<td>15</td>
<td>6.3 (0.8)</td>
<td>5.7 (1.2)</td>
<td>3.7 (0.6)</td>
</tr>
<tr>
<td>Implementation Guidelines</td>
<td>9</td>
<td>6.3 (0.7)</td>
<td>5.9 (0.6)</td>
<td>4.0 (1.2)</td>
</tr>
<tr>
<td>Early-Career Involvement</td>
<td>9</td>
<td>6.2 (0.8)</td>
<td>5.6 (0.7)</td>
<td>4.0 (1.7)</td>
</tr>
<tr>
<td>Training about Gender Issues</td>
<td>9</td>
<td>6.2 (0.7)</td>
<td>5.7 (0.7)</td>
<td>4.3 (0.7)</td>
</tr>
<tr>
<td>Workshops for Women</td>
<td>13</td>
<td>6.1 (0.5)</td>
<td>5.5 (0.7)</td>
<td>5.0 (1.1)</td>
</tr>
<tr>
<td>Networking for Women</td>
<td>11</td>
<td>5.9 (0.7)</td>
<td>5.9 (0.7)</td>
<td>3.9 (0.4)</td>
</tr>
<tr>
<td>Increase Women as Leaders</td>
<td>8</td>
<td>5.9 (1.0)</td>
<td>6.0 (0.6)</td>
<td>3.6 (1.5)</td>
</tr>
<tr>
<td>Funding for Women</td>
<td>8</td>
<td>5.9 (0.6)</td>
<td>5.8 (0.7)</td>
<td>3.4 (1.4)</td>
</tr>
<tr>
<td>Childcare</td>
<td>15</td>
<td>5.8 (1.4)</td>
<td>5.4 (1.0)</td>
<td>4.8 (0.4)</td>
</tr>
<tr>
<td>Mentoring for Women</td>
<td>13</td>
<td>5.8 (0.7)</td>
<td>5.5 (1.0)</td>
<td>4.8 (0.5)</td>
</tr>
<tr>
<td>Support/Socials for Women</td>
<td>9</td>
<td>5.8 (0.9)</td>
<td>5.6 (0.7)</td>
<td>4.1 (1.4)</td>
</tr>
<tr>
<td>Increase Women as Speakers</td>
<td>6</td>
<td>5.5 (1.9)</td>
<td>6.0 (0.9)</td>
<td>3.7 (1.4)</td>
</tr>
<tr>
<td>Awards for Women</td>
<td>14</td>
<td>5.4 (1.2)</td>
<td>5.1 (1.6)</td>
<td>3.0 (1.6)</td>
</tr>
<tr>
<td>Increase Submissions by Women</td>
<td>4</td>
<td>5.3 (1.3)</td>
<td>4.8 (1.0)</td>
<td>3.1 (1.3)</td>
</tr>
<tr>
<td>Award Striving for Equity</td>
<td>4</td>
<td>5.3 (1.0)</td>
<td>4.5 (0.6)</td>
<td>3.9 (0.5)</td>
</tr>
</tbody>
</table>

*Note. A total of 21 organizations were included in these analyses. Add policy refers to the ratings of perceived importance to implement the strategy identified within organizations not currently using that strategy. Bold indicates difference in magnitude between importance and effectiveness rating in organizations currently implementing the strategy listed, p < .05.*
Table 2

<table>
<thead>
<tr>
<th>Model and Level of Invariance</th>
<th>Overall Fit Indices</th>
<th>Comparative Fit Indices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SBχ²</td>
<td>df</td>
</tr>
<tr>
<td>Women</td>
<td>5.99*</td>
<td>2</td>
</tr>
<tr>
<td>Men</td>
<td>3.46</td>
<td>2</td>
</tr>
<tr>
<td>1. Configural</td>
<td>9.86*</td>
<td>4</td>
</tr>
<tr>
<td>2. Metric</td>
<td>12.21</td>
<td>7</td>
</tr>
<tr>
<td>3. Scalar</td>
<td>67.03**</td>
<td>11</td>
</tr>
<tr>
<td>3a. Item 1</td>
<td>41.31*</td>
<td>8</td>
</tr>
<tr>
<td>3b. Item 2</td>
<td>38.13*</td>
<td>8</td>
</tr>
<tr>
<td>3c. Item 3</td>
<td>44.59*</td>
<td>8</td>
</tr>
<tr>
<td>3d. Item 4</td>
<td>62.93*</td>
<td>8</td>
</tr>
</tbody>
</table>

Note. Measurement invariance for perceptions of gender equity was tested between women (N = 334) and men (N = 311). STEM = science, technology, engineering, and mathematics; SBχ² = Satorra–Bentler scaled chi-square statistic; df = degrees of freedom; CFI = robust comparative fit index; SRMR = robust standardized root mean square residual; RMSEA = robust root mean square error of approximation; Δ = change between comparison models. *p ≤ .05; **p < .001
Table 3

**Standardized Factor Loadings and Item Intercepts for Perceptions of Gender Equity Scale**

<table>
<thead>
<tr>
<th>Item Prompt</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Taken as a whole, there is gender equity in this organization for</td>
<td>0.898</td>
<td>0.813</td>
</tr>
<tr>
<td>leadership and workload responsibilities</td>
<td>(4.722 ± 0.09)</td>
<td>(5.363 ± 0.08)</td>
</tr>
<tr>
<td>2. Women have equal access to committees and powerful leadership</td>
<td>0.930</td>
<td>0.927</td>
</tr>
<tr>
<td>positions in this organization, relative to their numbers and rank</td>
<td>(4.986 ± 0.09)</td>
<td>(5.568 ± 0.07)</td>
</tr>
<tr>
<td>3. I feel that the climate and opportunities for women in this organization</td>
<td>0.891</td>
<td>0.942</td>
</tr>
<tr>
<td>are at least as good as those for men</td>
<td>(4.802 ± 0.09)</td>
<td>(5.469 ± 0.07)</td>
</tr>
<tr>
<td>4. In this organization, research by men is valued more than research by</td>
<td>0.733</td>
<td>0.632</td>
</tr>
<tr>
<td>women (R)</td>
<td>(4.461 ± 0.09)</td>
<td>(5.373 ± 0.09)</td>
</tr>
</tbody>
</table>

*Note.* Standardized factor loadings are followed by item means in parentheses with ± standard error. (R) = prompt was reverse coded. All factor loadings for women and men were significant at $p < .001$. 

Table 4

*Multilevel Regression for Perceptions of Gender Equity in Research Organizations*

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>S.E.</th>
<th>Coefficient</th>
<th>S.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\gamma_{00}$</td>
<td>-0.218 (0.090)</td>
<td>0.281 (0.040)</td>
<td></td>
</tr>
<tr>
<td>Level 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associate</td>
<td>0.182 (0.202)</td>
<td>0.130 (0.140)</td>
<td></td>
</tr>
<tr>
<td>Full/Distinguished</td>
<td>-0.003 (0.218)</td>
<td>0.293 (0.193)</td>
<td></td>
</tr>
<tr>
<td>Life/SS</td>
<td>-0.228 (0.225)</td>
<td>-0.211 (0.115)</td>
<td></td>
</tr>
<tr>
<td>Years as Member</td>
<td>0.279* (0.131)</td>
<td>0.142* (0.068)</td>
<td></td>
</tr>
<tr>
<td>Level 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Policies</td>
<td>-0.209* (0.106)</td>
<td>-0.076 (0.047)</td>
<td></td>
</tr>
<tr>
<td>Percent Speakers</td>
<td>0.094 (0.064)</td>
<td>0.078* (0.035)</td>
<td></td>
</tr>
<tr>
<td>Percent Leaders</td>
<td>0.142 (0.090)</td>
<td>0.177* (0.076)</td>
<td></td>
</tr>
<tr>
<td>Percent Council</td>
<td>0.058 (0.135)</td>
<td>-0.161 (0.084)</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>-0.087 (0.058)</td>
<td>-0.111* (0.050)</td>
<td></td>
</tr>
<tr>
<td>$\sigma_W^2$</td>
<td>0.836** (0.086)</td>
<td>0.676** (0.060)</td>
<td></td>
</tr>
<tr>
<td>$\sigma_B^2$</td>
<td>0.032 (0.021)</td>
<td>0.001 (0.007)</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Level 2 predictors were z-scores and level 1 predictors were centered at their grand mean. All coefficients are left unstandardized. Women ($N = 195$) and men ($N = 213$) were analyzed separately. Full/Distinguished = full or distinguished faculty rank; Life/SS = life science or social science.

* $p < .05$; ** $p < .001$
CHAPTER SIX
GENERAL DISCUSSION AND CONCLUSION

Women leave science, technology, engineering, and mathematics (STEM) positions in the United States at a higher rate than men, resulting in women being progressively more underrepresented at each level of advancement from post-doctoral researcher to full professor (National Science Foundation [NSF], 2013). Efforts directed at identifying and attempting to address issues causing this disproportionate rate of attrition have been growing over the past several decades, especially within academic institutions (Bystydzienski & Bird, 2006; Institute for Research on Women, 2002; National Academy of Sciences [NAS] et al., 2007). The issues being identified are complex and seem stubbornly engrained in STEM departments and careers in general. Career experiences of STEM researchers extend beyond the academic institution at which they are employed, but most external experiences are given little attention. For example, professional research organizations provide a number of career benefits and events for academics but have been largely ignored in regard to their contribution to the higher attrition of women. Solutions created to overcome the challenges women in STEM face must be comprehensive and multifaceted. The primary goal of this dissertation was to establish a comprehensive set of data regarding women’s experiences within research organizations. These data further characterize the ongoing issues that impede women in STEM and provide a new direction from which to develop and implement solutions.

Involvement in research organizations is an expected activity for research professionals but the relationship to the careers of STEM professors has never been established. Chapter 2 outlined the importance of affective commitment to professional
research organizations as it relates to the overall career satisfaction of STEM faculty. This relationship was significant and similar for women and men. Unfortunately, women are underrepresented in the most prestigious and recognized roles at research conferences, as demonstrated by the case study in Chapter 3. A more general view of women’s experiences and involvement in research organizations in Chapter 4 revealed that, overall, women surveyed were involved at the same level as men but identified that some gender-related issues may create additional obstacles for women. In Chapter 5, characteristics of research organizations and the actions they take to address issues disproportionately impacting women were examined and were shown to alter the perceptions of gender equity differently for women and men.

Participating in professional research organizations is an integral part of being a professor at a research university. Most organizations sponsor one major conference each year, but attending this conference was rated as a highly important membership benefit by faculty across all disciplines examined. The opportunities for networking and gaining recognition for research were rated as a close second in importance. The importance of research organizations for faculty was corroborated by the positive relationship observed between affective commitment to these organizations and overall career satisfaction. This positive relationship was significant even after controlling for affective commitment to the academic institution where faculty were currently employed, signifying that experiences within research organizations are a unique and significant component of STEM faculty careers.
After establishing the importance of belonging and commitment to research organizations, the experiences of women and men were more closely examined to determine whether women’s experiences in research organizations were hindered or differed substantially from the experiences of men. The importance of research organizations was similar for women and men, as measured by ratings of importance and the relationship to career satisfaction. However, women were more likely than men to recognize gender bias and discrimination as limiting their participation in research organizations. Feedback left by women who indicated gender bias and discrimination limited their participation emphasized the disproportionate recognition of men at research events. Their concerns were validated when reviewing the representation of women at meetings held by the International Association for the Study of Pain (IASP). Women in IASP have been underrepresented as plenary speakers and workshop chairs in relation to their membership and proportion employed in the field with no substantial improvement over the past 30 years. A similar underrepresentation of women in the most revered conference roles has been reported by members of several other research organizations (Casadevall & Handelsman, 2014; Isbell, Young, & Harcourt, 2012).

The evidence within specific research organizations clearly relays the need to identify potential causes of the underrepresentation of women, but the average ratings of bias and discrimination were markedly low when participants were asked to think about research organizations in general. Women did identify gender bias and discrimination as a greater limitation compared to men, but most women across all academic categories examined did not agree that bias and discrimination was a substantial limitation. The explicit use of the terms
bias and discrimination in the faculty survey may have been too blatant to accurately gauge this limitation, especially when considering there was only a moderate level of gender equity perceived using a more subtle multi-item scale (Chapter 5). These terms carry with them a negative connotation and may have deterred women from identifying them as issues when asked directly. Women who pursue and maintain a position in STEM have a tendency to distance themselves from women who portray more feminine characteristics or appear to struggle with the masculine expectations associated with careers in STEM (Rhoton, 2011). Bevan and Learmonth (2012) also found that women employed in research laboratories rarely challenged the biases engrained in their work environments and expressed by colleagues and supervisors. These studies reveal that women in STEM are hesitant to acknowledge gender discrimination as negatively impacting them. Subtler questions about how women are viewed and treated within research organizations in future studies may provide a more accurate reflection of the climate for women and whether a person’s gender influences their experience.

Another explanation of the low perception of gender bias and discrimination is that these issues are not significantly prevalent within research organizations. When examining involvement across multiple research organizations, a similar proportion of women and men surveyed reported being involved by attending conferences, presenting posters, and receiving invitations to speak. Men and women also submitted and gave a similar average number of presentations at conferences in general. However, the overall response rate for the survey was low (8.9%). Respondents may not be representative of the full spectrum of faculty in STEM and may represent more involved faculty members in general; however, the demographic
characteristics of the respondents closely match the current demographics found across STEM faculty in the United States (NSF, 2013). A review of surveys with differing response rates revealed that nonrespondent bias is often minimal, especially when the demographics of respondents are similar to those in the population (e.g., Holbrook, Krosnick, & Pfent, 2008; Keeter, Miller, Kohut, Groves, & Presser, 2000). Therefore, the current reports are likely representative but should be reexamined for consistency in future studies.

The results of the faculty survey indicate that the level of involvement in research organizations is not contingent on an individual’s gender. Serving in leadership roles in research organizations and presenting at conferences are used as measures of productivity and career engagement for research professors. Equal involvement across gender in regard to these measures of productivity is similar to several recent studies examining other measures of productivity in STEM. Many studies have shown that women and men publish an equivalent number of articles after controlling for factors such as the length of time in their career (e.g., Carr et al., 1998; DesRoches, Zinner, Rao, Iezzoni, & Campbell, 2010). Publication productivity is a predictor of promotion success in academia (e.g., van Dijk, Manor, & Carey, 2014), and a discrepancy in productivity across gender has been used to explain the persistent underrepresentation of women in STEM (e.g., Hancock, Baum, & Breuning, 2013; West, Jacquet, King, Correll, & Bergstrom, 2013). Unclear guidelines and expectations associated with promotions in academia have been cited as a barrier to earning a higher tenure rank (Fox & Colatrella, 2006; Roth & Sonnert, 2011). Information reducing the ambiguity in the evaluative processes required for rising in rank would help address this issue. In the current study, affective commitment to a research organization did not uniquely relate
to publication productivity, but the link between involvement in these organizations and promotion rates should be examined more directly in the future.

Relatively equal involvement in research organizations across gender was not consistent across all studies in this dissertation. The involvement of women in IASP and what was reported by women about their average involvement in research organizations is contradictory. Women are underrepresented in IASP but equally involved compared to men when multiple organizations identified by participants were analyzed. Women may be finding ways to be as involved as their male colleagues regardless of any existing constraints within specific organizations. For example, women in technology, engineering, and mathematics (TEM) fields identified a greater number of research organizations compared to men but also most strongly agreed that gender bias and discrimination limited their participation compared to women in academic categories where there is a more equal gender distribution. Women identifying a wider range of research organizations may indicate that women avoid the most biased organizations. One woman surveyed specifically stated that she felt more committed to the organization where she experienced fewer microaggressions. She felt her involvement in that organization was more effective and thus more beneficial. Joining organizations that impose the fewest limitations on participation is one potential solution, but there are no data examining what influences membership decisions and whether membership tenure is related to involvement.

Cancelling membership to a research organization may not be a practical way to avoid unfair treatment. On average, membership tenure in the research organizations identified exceeded 13 years for men and women. Long membership tenure indicates that switching
between organizations is likely an uncommon strategy used to increase involvement, so alternative strategies used by individuals to overcome any issues within specific organizations should be explored in future studies. Future studies should also attempt to identify factors that more specifically predict engagement in a professional organization, rather than membership tenure.

Members may be able to avoid or reduce the issues limiting their involvement on an individual level, but eradicating these issues for all members within an organization will require implementing broader organizational changes. Fortunately, strategies to improve the experiences of members are being developed at the organization level, specifically in regard to addressing issues that have the potential to disproportionately impact women. Policies prohibiting discrimination and harassment based on gender appear to be standard practice, and over 70% of the organizations examined had a committee focused on women’s experiences in that organization or related discipline. The existence of these policies conveys that organization leaders are taking action, but the number of policies in an organization was inversely related to perceptions of gender equity for women. Perceptions of equity are directly related to climate, which has been established as one of the most challenging but influential issues left to solve in regard to increasing the representation of women in STEM (e.g., August & Waltman, 2004; Callister, 2006; Gallaher & Pearson, 2000; Greene, Stockard, Lewis, & Richmond, 2010; Maranto & Griffin, 2011; Riffle et al., 2013; Settles, Cortina, Malley, & Stewart, 2006).

These data provided novel insights about why changing the more negative climate for women in STEM is proving difficult. First, women were more likely to acknowledge issues
regarding gender bias, discrimination, and inequities but these perceptions did not always match the objective outcomes like general involvement. The apparent disconnect between personal experiences of organization members and outcomes increases the challenge encountered by organizations when attempting to implement constructive change in policy or practice. Leaders of research organizations must be aware of their members’ experiences regardless of the objective measures used to gauge equality. The measure used for perceptions of gender equity was conceptualized differently by men and women and poses a second challenge to improving climate. Altering these perceptions will require different approaches for women compared to men. For male members, greater equality in the number of women represented as leaders and speakers within the organization related positively to their perceptions of equity. The perceptions of women were not affected by the presence of a greater proportion of women in these roles. Leaders will need to expend greater efforts to understand their organizational climate and what factors can be changed to increase the perceptions of equity for their female members.

Conclusion

The current studies provide the first overview of experiences in professional STEM research organizations. The positive relationship between affective commitment to a research organization and overall career satisfaction demonstrates that these organizations are important to the professional lives of professors. The fact that women are underrepresented in at least some STEM research organizations and perceive less gender equity within these organizations indicates that there are issues limiting the career development of women in these fields. The potential impact these limitations have on the careers of women need to be
more clearly defined in the future. Regardless, these findings underscore the necessity of developing multifaceted solutions that reach beyond academic institutions. Strategies identified by organizational leaders as currently being implemented are not effectively impacting perceptions of gender equity. In order to begin more rapidly increasing the number of women in STEM and retaining those who are currently in faculty positions, improvements must be widespread. In addition to the growing focus on implementing change within academic institutions across the United States, the current studies highlight the need to also initiate purposeful and informed changes within professional research organizations.
REFERENCES


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146


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National Academy of Sciences, National Academy of Engineering, and Institute of Medicine; Committee on Science, Engineering, and Public Policy; & Committee on Maximizing the Potential of Women in Academic Science and Engineering. (2006). *Beyond bias*


APPENDIX A

FACULTY SURVEY
Consent Form

Research Study Consent Form
Washington State University Psychology Department
Study Title: Understanding Faculty Membership in Science Organizations
Researcher: Kimber Saville

You are being asked to take part in a research study to better understand faculty perceptions of professional organizations.

The following survey should take you approximately 20-30 minutes to complete. You will be asked a series of questions about professional organizations in your field and your career. Please read each question carefully and answer thoughtfully.

There are no foreseeable risks to take part in this study and you may choose to exit the survey at any time without penalty. The link you used to access this survey is connected to your e-mail address; however, data gathered from this survey will be separated from your e-mail address when stored and analyzed and will in no way be linked back to you.

If you have questions about this study or the information in this form, please contact Kimber Saville: kimber.saville@wsu.edu or mail to Washington State University Vancouver, Psychology Department, 14204 NE Salmon Creek Avenue, Vancouver, WA 98686.

Selecting I agree below means that you understand the following:
· Participation in this study is voluntary
· There is no penalty for not taking part in this study
· You may discontinue participation at any time during this study without penalty

If you would like a copy of this consent form, please print this page now or contact Kimber Saville (kimber.saville@wsu.edu).

**Statement of Consent:**
“I hereby certify that I am 18 years of age or older. I understand the information in this form and give my voluntary consent to take part in this survey."
○ I agree
○ I disagree
Degree

What is the highest degree you have earned?
○ Less than a bachelor's degree
○ Bachelor's degree
○ Master's degree
○ Doctoral/professional degree
○ Other ___________________

Career Satisfaction

There are similarities among questions you will read over the next few pages. Please read all questions carefully because each one is important.

Thinking about your career in academia, please rate how much you agree or disagree with the following statements:

<table>
<thead>
<tr>
<th>When thinking about your current academic position, please rate how much you agree or disagree with each of the following statements:</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am satisfied with the success I have achieved at this point in my career</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am satisfied with the progress I have made toward meeting my goals for advancement at this point in my career</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am satisfied with the progress I have made toward meeting my goals for the development of new skills at this point in my career</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am satisfied with the progress I have made toward meeting my goals for income at this point in my career</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>At this point in my career, I am satisfied with the progress I have made toward meeting my overall career goals</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
### Turnover Intentions

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I often think about quitting academia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I will probably look for a new job outside academia in the next year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please rate how likely you are to do the following:

<table>
<thead>
<tr>
<th>Very Unlikely</th>
<th>Unlikely</th>
<th>Somewhat Unlikely</th>
<th>Undecided</th>
<th>Somewhat Likely</th>
<th>Likely</th>
<th>Very Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>How likely is it that you will actively look for a job at a different institution in the next year?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How likely is it that you will actively look for a job outside of academia in the next year?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Affective Commitment and Turnover Intentions

Thinking about the academic institution where you are currently employed, please rate how much you agree or disagree with each of the following statements:

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would be very happy to spend the rest of my career at this institution</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I enjoy discussing my institution with people outside it</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I really feel as if this institution's problems are my own</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I think that I could easily become as attached to another institution as I am to this one</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I do NOT feel like 'part of the family' at this institution</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I do NOT feel 'emotionally attached' to this institution</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>This institution has a great deal of personal meaning for me</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I feel a strong sense of belonging to my institution</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I will probably look for a job at a different academic institution in the next year</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I often think about quitting my current institution</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
Organization Identification

You will now be asked questions about organizations in your discipline. Please think only about professional organizations that hold research-focused conferences or events (i.e., research is presented and discussed). Please write the full name of TWO research-focused professional organizations in your discipline (please do NOT abbreviate).

First Organization (full name) ____________________________
Second Organization (full name) ____________________________

How many total research-focused professional organizations are you currently a member of?
Dropdown [None (0) - 50 or more (50)]

How familiar are you with [Organization 1]?
○ Very Unfamiliar
○ Unfamiliar
○ Somewhat Unfamiliar
○ Neutral
○ Somewhat Familiar
○ Familiar
○ Very Familiar

How relevant is the research discussed in [Organization 1] compared to your specific research area?
○ Not at all relevant
○ Not relevant
○ Somewhat not relevant
○ Neutral
○ Somewhat relevant
○ Relevant
○ Very Relevant

How familiar are you with [Organization 2]?
○ Very Unfamiliar
○ Unfamiliar
○ Somewhat Unfamiliar
○ Neutral
○ Somewhat Familiar
○ Familiar
○ Very Familiar

169
How relevant is the research discussed in [Organization 2] compared to your specific research area?
○ Not at all relevant
○ Not relevant
○ Somewhat not relevant
○ Neutral
○ Somewhat relevant
○ Relevant
○ Very Relevant

Organization 1

Have you EVER been a member of [Organization 1]?
○ Yes
○ No

How many TOTAL years have you been a member of [Organization 1]?
Please round to the nearest whole year. ___________

Are you currently a member of [Organization 1]?
○ Yes
○ No

When your current membership expires, how likely are you to renew your membership in this organization?
○ Very Unlikely
○ Unlikely
○ Somewhat Unlikely
○ Undecided
○ Somewhat Likely
○ Likely
○ Very Likely
How likely are you to become a member of this organization within the next year?
○ Very Unlikely
○ Unlikely
○ Somewhat Unlikely
○ Undecided
○ Somewhat Likely
○ Likely
○ Very Likely
**Involvement in Organization**

Over the past 2 YEARS, how many RESEARCH-FOCUSED conferences or events sponsored by [Organization 1] have you attended?
Dropdown [None (0) - 40 or more (40); There are no research-focused events sponsored by this organization]

Please fill out the following table regarding your activities at the conference(s)/event(s) sponsored by [Organization 1] in the past 2 YEARS.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Please enter the number associated with each activity below (enter a '0' if appropriate).</th>
<th>Please select 'Not Applicable' if the activity listed is NOT offered at the events sponsored by this organization.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of POSTER presentations SUBMITTED</td>
<td>_____</td>
<td>□</td>
</tr>
<tr>
<td>Number of POSTERS PRESENTED</td>
<td>_____</td>
<td>□</td>
</tr>
<tr>
<td>Number of ORAL presentations SUBMITTED (e.g., symposium, workshop, etc.)</td>
<td>_____</td>
<td>□</td>
</tr>
<tr>
<td>Number of INVITATIONS from other organization members for you to give an ORAL presentation (one you did not apply for)</td>
<td>_____</td>
<td>□</td>
</tr>
<tr>
<td>Number of ORAL presentations GIVEN (e.g., symposium, workshop, etc.)</td>
<td>_____</td>
<td>□</td>
</tr>
<tr>
<td>Number of INVITATIONS to give a PLENARY lecture (i.e., an oral lecture attended by most members at the event)</td>
<td>_____</td>
<td>□</td>
</tr>
<tr>
<td>Number of PLENARY lectures GIVEN</td>
<td>_____</td>
<td>□</td>
</tr>
<tr>
<td>Number of COMMITTEES you serve(d) on</td>
<td>_____</td>
<td>□</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>_____</td>
<td>□</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>_____</td>
<td>□</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>_____</td>
<td>□</td>
</tr>
</tbody>
</table>
**Committee Involvement**

Please specify which committees you have served on in [Organization 1], what your position was, and how long you held that position:

<table>
<thead>
<tr>
<th></th>
<th>Committee Information</th>
<th>Time in Position</th>
<th>Check box if you are CURRENTLY serving on this committee</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Committee Name</td>
<td>Your Position</td>
<td>Starting YEAR</td>
</tr>
<tr>
<td>2.</td>
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<td>3.</td>
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<td>4.</td>
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<td>5.</td>
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<td>9.</td>
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<tr>
<td>10.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Event Attendance**

When did you most recently attend a research-focused conference/event sponsored by [Organization 1]?

Dropdown [Month/Year]
## Perceptions of Organization

Please rate how much you agree or disagree with the following statements about *Organization 1*:

Please rate the following statements using what you know about the organization (even if you are not a member).

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would be very happy to spend the rest of my career as a member of this organization</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I enjoy discussing this organization with people outside it</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I really feel as if this organization's problems are my own</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I think that I could easily become as attached to another organization as I am to this one</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I do NOT feel 'part of the family' in this organization</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I do NOT feel 'emotionally attached' to this organization</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>This organization has a great deal of personal meaning for me</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I feel a strong sense of belonging to this organization</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I feel opportunities and support for my personal advancement have been at least as good in this organization as they would in other organizations</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Other members of this organization value my research/scholarship</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I am satisfied with opportunities to collaborate with other members in this organization</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
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<td>---</td>
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<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Other members of this organization solicit my opinions about their research ideas and problems</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I feel respected by other members of this organization</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Taken as a whole, there is gender equity in this organization for leadership and workload responsibilities</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Women have equal access to committees and powerful leadership positions in this organization, relative to their numbers and rank</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I feel that the climate and opportunities for women in this organization are at least as good as those for men</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>In this organization, research by men is valued more than research by women</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Being a member of this organization is a benefit for me (or would be)</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I have a voice in the decision-making that affects the direction of this organization</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I feel I have adequate access to the resources available from this organization</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
**Leadership Positions**

Have you EVER held a LEADERSHIP position within *Organization 1*?  
○ Yes  
○ No

Please write ALL the leadership position(s) you have held in *Organization 1* and the year(s) you served in that position.

<table>
<thead>
<tr>
<th>Name of Leadership Position</th>
<th>Starting Year</th>
<th>Ending Year</th>
<th>Select box if CURRENTLY in position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Leadership Position</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Leadership Position</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Leadership Position</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Leadership Position</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Leadership Position</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Leadership Position</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Leadership Position</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Leadership Position</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Leadership Position</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Leadership Position</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Primary Organization**

Would you consider [*Organization 1*] the PRIMARY (i.e., most relevant/popular) research-focused professional organization in your discipline?
○ Yes
○ No

Would you consider [*Organization 2*] the PRIMARY (i.e., most relevant/popular) research-focused professional organization in your discipline?
○ Yes
○ No

What research-focused professional organization would you consider the PRIMARY (i.e., most relevant/popular) in your discipline? _________________

**Second Organization**

All questions asked about the first organization identified were repeated for Organization 2.
General Research Organization Feedback

Thank you so much for your feedback about [Organization 1] and [Organization 2]. For the next few questions, please think about research-focused professional organizations IN GENERAL.

Thinking about the benefits associated with being a member of research-focused professional organizations in general, how important is each of the following benefits for YOU?

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Not at all Important</th>
<th>Very Unimportant</th>
<th>Somewhat Unimportant</th>
<th>Neither Important nor Unimportant</th>
<th>Somewhat Important</th>
<th>Very Important</th>
<th>Extremely Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opportunity to attend research-focused conferences or events</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Discounts offered (e.g., event registration, subscriptions, etc.)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Access to journal/published materials</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Access to career services (e.g., continuing education credits, webinars, etc.)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Access to mentoring programs</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Access to member directory</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Ability to network or collaborate with other members</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Opportunity to have input regarding organization decisions</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Opportunity to get involved in education or advocacy events</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Gaining recognition for your research/scholarship</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Access to grants/fellowships through the organization</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Belonging to special interest groups or committees</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Opportunity to travel to conference locations</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Access to childcare during organization conferences/events</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
Please rate how much you agree or disagree that the following factors LIMIT how much YOU can participate in research-focused professional organizations:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Somewhat Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Somewhat Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Work obligations</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Health issues</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Language barriers</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Childcare responsibilities</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Caring for dependents (NOT including children)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Biases/discrimination based on my gender</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Biases/discrimination based on my race/ethnicity</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Research topics are irrelevant or outdated</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Time or distance required to travel</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Other (please specify)</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Not having submissions accepted for presentation</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Not having data to present</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Please briefly describe why you think your gender limits your participation in research-focused professional organizations in your discipline? __________________________

Please briefly describe why you think your race/ethnicity limits your participation in research-focused professional organizations in your discipline? __________________________
**Personal Demographic Information**

You are almost done! This next section includes demographic questions and questions related to your academic position. It is very important these data are collected, so please answer each question carefully and thoughtfully.

Are you...
○ Male
○ Female
○ Other (please specify) ____________________

Please enter your current age.

What is your race/ethnicity? Please select all that apply.
○ African American/Black
○ Asian
○ Caucasian/White
○ Hispanic/Latino
○ Native American/American Indian
○ Pacific Islander
○ Other (please specify) ____________________

What is your current relationship status?
○ Single, never married
○ Never married, but in a committed relationship
○ Married/Civil Union
○ Separated
○ Divorced
○ Widowed

How many children do you have?
Dropdown [0 - 11 or more]

How many children under the age of 18 do you have living in your household?
Dropdown [None - 11 or more]

In what state do you currently live?
Dropdown [All 50 states in alphabetical order and District of Columbia; I do not live in the United States]
Career Information

With which of the following academic institutions are you currently affiliated? Dropdown [Unlisted to protect participant identities]

In what year did you earn your highest degree? Dropdown [2013 - 1940]

What is your current faculty rank?
○ Non-tenure track
○ Tenure-track Assistant professor
○ Tenure-track Associate professor
○ Tenure-track Full professor
○ Tenure-track Distinguished/Endowed/Emeritus/Regents professor

What is your current [Non-tenure track] position?
○ Instructor/Lecturer
○ Adjunct professor
○ Clinical faculty
○ Research faculty
○ Other (please specify) ____________________

In what year were you first hired into a tenure-track position? Dropdown [2013 – 1940]

In what year were you most recently promoted? Dropdown [2013 – 1940]

Approximately what is your annual salary before taxes? Dropdown [$20,000 or less - $340,001-$350,000 by increments of 10,000 increments; $350,001 or more]
Which of the following would you consider your primary field of study?
○ Agricultural sciences
○ Biological/Life sciences
○ Computer/Information sciences
○ Environmental sciences
○ Engineering
○ Health sciences
○ Mathematics/Statistics
○ Neuroscience
○ Physical sciences
○ Psychology
○ Sociology
○ Other social sciences/Humanities
○ Other (please specify) ____________________

Which of the following best describes your specific field of study within BIOLOGICAL/LIFE SCIENCES?
○ Biochemistry or biophysics
○ Botany
○ Cell or molecular biology
○ Ecology
○ General biology
○ Genetics
○ Microbiology or immunology
○ Nutritional sciences
○ Pharmacology
○ Physiology or pathology
○ Zoology
○ Other (please specify) ____________________
Which of the following best describes your specific field of study within ENGINEERING?
- Aerospace
- Agricultural
- Architectural
- Bioengineering
- Chemical
- Civil
- Computer and systems
- Electrical
- Environmental
- Geophysical
- Mechanical
- Other (please specify) ________________

Which of the following best describes your specific field of study within HEALTH SCIENCES?
- Audiology
- Health services
- Health/Medical technologies
- Medical preparation programs
- Medicine (e.g., dentistry, optometry, osteopathic, etc.)
- Veterinary
- Nursing
- Pharmacy
- Other (please specify) ________________

Which of the following best describes your specific field of study within PHYSICAL SCIENCES?
- Astronomy
- Atmospheric or meteorology
- Biochemistry or biophysics
- Chemistry
- Earth sciences
- Geology
- Oceanography
- Physics
- Other (please specify) ________________
Which of the following best describes your specific field of study within PSYCHOLOGY?
○ Clinical
○ Cognitive
○ Counseling
○ Educational
○ Experimental
○ General
○ Industrial/Organizational
○ Social
○ Social Work
○ Other (please specify) ________________

Which of the following best describes your specific field of study within SOCIAL SCIENCES?
○ Anthropology
○ Economics
○ Ethnic studies
○ Geography
○ History
○ History of science
○ International relations
○ Political science
○ Social work
○ Other (please specify) ________________

How many tenure-track faculty are in your department (including yourself if appropriate)?

How many of these tenure-track faculty in your department are FEMALE (including yourself if appropriate)?
Productivity

On average, how many hours do you work as part of your academic job each WEEK?

Please move the horizontal bars to indicate what percentage of your WORK-RELATED time is spent doing the following activities:
(Please be sure your time spent adds up to 100%)
_____ Research
_____ Teaching
_____ Administrative tasks
_____ Service to University
_____ Community Outreach
_____ Other (please specify)

Over the past 2 YEARS, how many PEER-REVIEWED articles reporting original research results have you SUBMITTED for publication?
Please do NOT count revisions or re-submissions as separate papers.
Dropdown [None - 60 or more]

How many of the [# articles submitted] peer-reviewed articles submitted over the past 2 YEARS were PUBLISHED or ACCEPTED for publication?

Over the past 2 YEARS, how many articles NOT reporting your original research results did you PUBLISH (e.g., reviews, theoretical articles, book chapters, reports, etc.)?
Dropdown [None - 50 or more]

Over the past 2 YEARS, how many books (including textbooks) have you PUBLISHED?
Dropdown [None - 30 or more]

Over the past 2 YEARS, how many active grants have you had for research purposes from EXTERNAL funding sources (i.e., funds awarded from outside your primary academic institution)?
Dropdown [None - 40 or more]

Over the past 2 YEARS, what is the total amount of money for direct-costs you have had access to from EXTERNAL grant funding sources (i.e., funds awarded from outside your primary institution)?

Over the past 2 YEARS, what is the total amount of money for direct-costs you have had access to from INTERNAL grant funding sources for research purposes (i.e., from your academic institution)?
Over the past 2 YEARS, how many patents have you applied for?
Dropdown [None - 50 or more]

How many of these patents have you been GRANTED over the past 2 years?
Dropdown [None - 50 or more]

Over the past 2 YEARS, how many total credit hours have you taught (please include summer sessions)?
Dropdown [None - 175 or more]

Were these credits...
○ Quarter credits
○ Semester credits

How many of the [# credits selected] credits you taught over the past 2 years were graduate-level

How many of the [# credits selected] credits you taught over the past 2 years were taught in a summer session?

On average, how many students are in one of your undergraduate-level classes?

Over the past 2 YEARS, how many UNDERGRADUATE students have you mentored in research-related activities?

Over the past 2 YEARS, how many GRADUATE students would call you their primary mentor/advisor?

Over the past 2 YEARS, how many student committees (e.g., thesis committees, preliminary/qualifying exam committees, etc.) have you served on?

Have you ever served as the chair/head of your current department?
○ Yes
○ No

Are you currently serving as the chair/head of your department?
○ Yes
○ No
APPENDIX B

STANDARDIZED FACTOR LOADINGS AND RELIABILITY FOR CAREER SATISFACTION AND AFFECTIVE COMMITMENT MEASURES
### Standardized Factor Loadings and Reliability for Career Satisfaction and Affective Commitment Measures

<table>
<thead>
<tr>
<th>Latent Factor</th>
<th>Loading</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Career Satisfaction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am satisfied with the success I have achieved</td>
<td>.881</td>
<td>[.849 - .889]</td>
</tr>
<tr>
<td>I am satisfied with the progress I have made toward meeting my goals for advancement</td>
<td>.811</td>
<td></td>
</tr>
<tr>
<td>I am satisfied with the progress I have made toward meeting my goals for the development of new skills</td>
<td>.620</td>
<td></td>
</tr>
<tr>
<td>I am satisfied with the progress I have made toward meeting my goals for income</td>
<td>.573</td>
<td></td>
</tr>
<tr>
<td>I am satisfied with the progress I have made toward meeting my overall career goals</td>
<td>.913</td>
<td></td>
</tr>
<tr>
<td><strong>Affective Commitment to Academic Institution</strong></td>
<td>.897</td>
<td>[.884 - .908]</td>
</tr>
<tr>
<td>I would be very happy to spend the rest of my career at this institution</td>
<td>.686</td>
<td></td>
</tr>
<tr>
<td>I enjoy discussing my institution with people outside it</td>
<td>.682</td>
<td></td>
</tr>
<tr>
<td>I really feel as if this institution’s problems are my own</td>
<td>.460</td>
<td></td>
</tr>
<tr>
<td>I think that I could easily become as attached to another institution as I am to this one</td>
<td>.502</td>
<td></td>
</tr>
<tr>
<td>I do NOT feel like ‘part of the family’ at this institution</td>
<td>.779</td>
<td></td>
</tr>
<tr>
<td>I do NOT feel ‘emotionally attached’ to this institution</td>
<td>.834</td>
<td></td>
</tr>
<tr>
<td>This institution has a great deal of personal meaning for me</td>
<td>.820</td>
<td></td>
</tr>
<tr>
<td>I feel a strong sense of belonging to my institution</td>
<td>.883</td>
<td></td>
</tr>
<tr>
<td><strong>Affective Commitment to Research Organization</strong></td>
<td>.922</td>
<td>[.911 - .930]</td>
</tr>
<tr>
<td>I would be very happy to spend the rest of my career as a member of this organization</td>
<td>.716</td>
<td></td>
</tr>
<tr>
<td>I enjoy discussing this organization with people outside it</td>
<td>.732</td>
<td></td>
</tr>
<tr>
<td>I really feel as if this organization’s problems are my own</td>
<td>.715</td>
<td></td>
</tr>
<tr>
<td>I think that I could easily become as attached to another organization as I am to this one</td>
<td>.505</td>
<td></td>
</tr>
<tr>
<td>I do NOT feel like ‘part of the family’ at this organization</td>
<td>.819</td>
<td></td>
</tr>
<tr>
<td>I do NOT feel ‘emotionally attached’ to this organization</td>
<td>.837</td>
<td></td>
</tr>
<tr>
<td>This organization has a great deal of personal meaning for me</td>
<td>.874</td>
<td></td>
</tr>
<tr>
<td>I feel a strong sense of belonging to this organization</td>
<td>.893</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Career satisfaction prompts each had “at this point in my career” incorporated.
APPENDIX C

SAMPLE SIZE FOR CELLS IN TABLE 4.9
### Number of Participants Used to Calculate Percentages Reported in Table 4.9

<table>
<thead>
<tr>
<th></th>
<th>Hard Sciences</th>
<th></th>
<th>Life Sciences</th>
<th></th>
<th>Social Sciences</th>
<th></th>
<th>TEM</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Women</td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
</tr>
<tr>
<td>Attended Conference</td>
<td>40</td>
<td>40</td>
<td>84</td>
<td>80</td>
<td>126</td>
<td>115</td>
<td>55</td>
<td>53</td>
</tr>
<tr>
<td>Submitted Poster</td>
<td>32</td>
<td>28</td>
<td>63</td>
<td>62</td>
<td>105</td>
<td>92</td>
<td>43</td>
<td>40</td>
</tr>
<tr>
<td>Submitted Oral Talk</td>
<td>35</td>
<td>32</td>
<td>64</td>
<td>68</td>
<td>113</td>
<td>98</td>
<td>44</td>
<td>47</td>
</tr>
<tr>
<td>Invited to Give Oral Talk</td>
<td>34</td>
<td>30</td>
<td>62</td>
<td>64</td>
<td>107</td>
<td>90</td>
<td>43</td>
<td>46</td>
</tr>
<tr>
<td>Gave Oral Talk</td>
<td>35</td>
<td>31</td>
<td>66</td>
<td>68</td>
<td>114</td>
<td>98</td>
<td>47</td>
<td>47</td>
</tr>
<tr>
<td>Invited to Give Plenary</td>
<td>33</td>
<td>29</td>
<td>63</td>
<td>63</td>
<td>108</td>
<td>91</td>
<td>42</td>
<td>44</td>
</tr>
<tr>
<td>Gave Plenary&lt;sup&gt;a&lt;/sup&gt;</td>
<td>33</td>
<td>28</td>
<td>63</td>
<td>63</td>
<td>108</td>
<td>90</td>
<td>41</td>
<td>43</td>
</tr>
</tbody>
</table>

*Note.*<sup>a</sup> Calculations for the percent of plenary talks given were taken from the totals of those invited to give a plenary talk.