The purpose of this manuscript is to gather together a large amount of source material pertaining to women in mathematics, from studies of girls in elementary school through data on females winning prizes for mathematical research. Along the way, we have also gathered a large amount of material from the psychology and sociology literature on implicit biases more generally, particularly pertaining to gender. This source material was then used to support the writing of the article [55]. We have tried to refer to primary research literature whenever possible, although we have also included well-written blog posts, organizational web sites, self-published articles by research organizations, and even a YouTube video.

Each bibliography entry is accompanied by some remarks summarizing its content and representative quotes from the articles themselves. We have followed standard practice when including these quotes, with the following exception: where the original quote has included citations to other work, or supporting statistics such as \( p \)-values, we have omitted these annotations to enhance the clarity of the quote. Nevertheless, much of the work in this bibliography contains a large number of further references to the relevant research literature.

The annotated bibliography is thus reasonable for browsing; but for those looking to find source material for particular aspects of this issue, we hope the following categories will be of some use:

- Hypotheses on the causes of underrepresentation of women in science: [7], [23], [34], [48], [54], [85]
- Declining gender gap in math achievement by girls and boys: [4], [23], [34], [42], [43], [48], [66]
- Overemphasis of, and problems with, standardized tests: [1], [23], [42], [64]
- Children with extremely high math achievement: [4], [34], [42], [64]
- Role of culture’s gender inequity in math achievement by girls and boys: [23], [34], [43], [48]
- Biases in primary school classrooms: [11], [41], [64], [65], [91]
- Intelligence as fixed trait vs. intelligence as malleable quality: [32], [60], [87]
- Explicit sexism: [7], [28], [39], [85], [94]
- Implicit biases: [6], [9], [12], [19], [20], [30], [31], [33], [38], [57], [58], [70], [73], [82], [83], [86], [94], [95]
- Incognizance of our biases, and the illusion of meritocracy: [5], [30], [51], [69], [73], [80], [83]
- Broader societal gender-based problems: [1], [4], [6], [7], [9], [10], [22], [24], [31], [36], [51], [54], [72]
- Gender-based personality expectations: [5], [10], [16], [19], [22], [24], [31], [62], [71], [79]
- Gender-based differential in self-concept: [64], [70], [78], [86]
- Effect of parenting, childcare, flexible schedules on one’s career: [11], [13], [19], [25], [53], [59], [75], [76]
- Impostor phenomenon: [16], [49]
- Stereotype threat: [26], [32], [54], [64], [80]
- Different standards for women and men regarding leadership, persuasion, and negotiation: [5], [10], [12], [13], [19], [22], [24], [87], [71]
- Female speakers at conferences: [21], [31], [15], [19], [25], [26], [27], [28], [30], [36], [45], [47], [65], [68], [73], [74], [81], [83], [89]
- Gender-based differential in teaching evaluations: [50], [62], [78]
- Gender-based differential in award winners, grants, promotion/tenure: [14], [17], [38], [51], [77], [82], [94]
- Gender-based biases in evaluation and selection processes: [11], [14], [21], [31], [36], [37], [45], [50], [51], [57], [58], [59], [70], [77], [78], [79], [84], [90], [92], [95]
- Action items and recommendations for addressing underrepresentation of women: [1], [4], [14], [15], [19], [25], [26], [28], [29], [44], [45], [47], [53], [61], [65], [74], [81], [89], [91], [94], [95]
This manuscript also includes an appendix containing tables of data from the 2014 ICM and the 2014 Joint Meetings of the AMS and MAA, listing the various sessions and the numbers of female speakers and total speakers (and the same for organizers, where given). Some data from mathematics prizes will also be included.

As we write in [55]: “We have made the conscious choice to include only initials and last names in the bibliography and in both manuscripts. We have observed a tendency to be curious about the gender of the authors of the research referred to herein, and perhaps to involuntarily wonder how the authors’ gender should affect our evaluation of their conclusions. These reflexive speculations, we believe, tellingly illuminate the depth to which these implicit biases about gender are ingrained in us, even though we rationally know that possessing one gender or another does not affect a person’s objectivity. Being socialized to have biases is not our fault; but preventing our biases from negatively affecting the world around us is nonetheless our responsibility.”

ACKNOWLEDGMENTS

We thank W. Miao for gathering the data appearing in the appendix, as well as for locating copies of several of the papers in this bibliography; we also thank J. Bryan for performing the statistical analysis described in the appendix.

REFERENCES

[1] American Association of University Women, How schools shortchange girls: executive summary, The AAUW Report, 1992. [http://www.aauw.org/files/2013/02/how-schools-shortchange-girls-executive-summary.pdf] (accessed September 15, 2014)

This report documents the many ways in which inequity is (unintentionally) demonstrated, and bias demonstrated and transmitted, in primary and secondary school classrooms in the united states.

“Girls receive significantly less attention from classroom teachers than do boys.”

“African American girls have fewer interactions with teachers than do white girls, despite evidence that they attempt to initiate interactions more frequently.”

“The contributions and experiences of girls and women are still marginalized or ignored in many of the textbooks used in our nation’s schools.”

“Incest, rape, and other physical violence severely compromise the lives of girls and women all across the country. These realities are rarely, if ever, discussed in schools.”

“Test scores can provide an inaccurate picture of girls’ and boys’ abilities. Other factors such as grades, portfolios of student work, and out-of-school achievements must be considered in addition to test scores when making judgments about girls’ and boys’ skills and abilities.”

The report includes forty Recommendations: Actions for Change, as well as several references to the AAUW Gender Equity Library.

[2] American Mathematical Association, Annual survey of the mathematical sciences: full reports. [http://www.ams.org/profession/data/annual-survey/survey-reports] (accessed September 5, 2014)

This report contains data on PhDs earned in mathematics in the United States, broken down by gender (and ethnicity and employment and starting salary), from 1957–2010.

For some information about PhDs earned in other countries, see: [http://www.scientificamerican.com/article/how-nations-fare-in-phds-by-sex-interactive]
This web site announces a funding program by the AWM to support the travel of female mathematicians.

“Enabling women mathematicians to attend conferences in their fields provides them a valuable opportunity to advance their research activities and their visibility in the research community. Having more women attend such meetings also increases the size of the pool from which speakers at subsequent meetings may be drawn and thus addresses the persistent problem of the absence of women speakers at some research conferences. The Mathematics Travel Grants provide full or partial support for travel and subsistence for a meeting or conference in the applicant’s field of specialization.”

T. Andreescu, J. Gallian, J. M. Kane, and J. E. Mertz, Cross-cultural analysis of students with exceptional talent in mathematical problem solving, Notices of the AMS 55 (2008), 1248–1260.

This article details the authors’ study of American children who demonstrate extreme mathematical ability. It includes data on high achievement on the Putnam contest and the International Mathematics Olympiad, as well as enrollment in summer mathematics training programs and mathematics degree programs; the data is sorted by gender and also by national and ethnic background.

“[T]he ratio of boys to girls identified in the [Study of Mathematically Precocious Youth] has dramatically declined during the past quarter century from the high of 13:1 originally reported in 1983 to 2.8:1 in a 2005 report. The fact that 29% of Ph.D.’s awarded to USA citizens in the mathematical sciences went to women in the 2006–2007 academic year supports the idea that this latter ratio is a more accurate reflection of current interest and ability in mathematics among USA females. This dramatic change likely reflects in part increased educational opportunities available to USA girls since enactment in 1972 of Title IX that banned sex discrimination in schools.”

“While the USA has been producing many more women mathematicians in recent years, they remain poorly represented among tenured professors at the very top-ranked USA research universities and people identified as profoundly gifted in the field. This article presents for the first time a comprehensive compilation of data, including cross-cultural comparisons, regarding young people identified during the past twenty years as possessing profound aptitude for mathematics based upon their performances in extremely difficult examinations in mathematical problem solving. We show that many girls exist who possess such extremely high aptitude for mathematics. The frequency with which they are identified is due, at least in part, to a variety of socio-cultural, educational, or other environmental factors that differ significantly among countries and ethnic groups and can change over time. Girls were found to be 12%–24% of the children identified as having profound mathematical ability when raised under some conditions; under others, they were 30-fold or more underrepresented.”

“[I]t is deemed uncool within the social context of USA middle and high schools to do mathematics for fun; doing so can lead to social ostracism. Consequently, gifted girls, even more so than boys, usually camouflage their mathematical talent to fit in well with their peers. This peer group social problem has been noted in interviews with top Putnam students and USA female Olympians. The overwhelming preponderance of foreign-born and Asian–American students in high school mathematics clubs is a nationwide phenomenon. Almost all of the girls who have achieved USAMO Award Winner or Honorable Mention (that is, top twenty-five) in this examination’s thirty-five-year history were foreign-born, Asian–American, or home-schooled. Thus, we hypothesize that the extreme scarcity of USA-born non-Asian girls among the top scorers in the AIME, USAMO, and Putnam is not due to a lack of girls with profound intrinsic aptitude for mathematics; rather, it is due to their choosing to spend their free time on nonmathematical pursuits. The substantial overrepresentation of Asian–American and foreign-born boys indicates that USA-born non-Asian boys are also being adversely affected by the social stigma associated with doing mathematics, although not to the extreme extent it is affecting girls.”

“1. First and foremost, the myth that females cannot excel in mathematics must be put to rest. Teachers, guidance counselors, parents, principals, university presidents, the lay public, and, most importantly, girls themselves need to be informed about the fact that females can excel in mathematics, even at the very highest level. When people believe they cannot do something, it becomes a self-fulfilling prophecy. To quote Henry Ford, ‘If you think you can or can’t, you are right.’
“2. We need to improve greatly the lay public’s perception of mathematicians via the news media, movies, and TV shows such as Numb3rs so preteens and teenagers of both genders will feel it is socially acceptable to study and to enjoy doing mathematics.”

[5] L. Babcock, S. Laschever, M. Gelfand, and D. Small, Nice girls don’t ask, Harvard Business Review 81 (2003), no. 10, 14–16.

“Woman are less likely than men to negotiate for themselves for several reasons. First, they often are socialized from an early age not to promote their own interests and to focus instead on the needs of others. . . Second, many companies’ cultures penalize women when the do ask—further discouraging them from doing so. Women who assertively pursue their own ambitions and promote their own interests may be labeled as bitchy or pushy.”

[6] L. Bacon, Once and for all: tech is not a meritocracy, Quartz, March 27, 2013. http://qz.com/66866/once-and-for-all-tech-is-not-a-meritocracy (accessed July 27, 2014)

This blog post examines the myth that success in the tech sector is based solely on merit; it points out many ways in which judgment of merit is impaired by implicit biases, causing inequity in outcomes. It contains references to many studies in the literature supporting its assertions.

“Just about every time diversity comes up in tech-sector conversations, there is a chorus of protests that tech is a meritocracy where anyone who's talented and hardworking will advance smoothly and quickly. The problem with that belief system is that it assumes that there are no external or internal forces contributing to some groups being underrepresented in tech. I would argue that there are both. While it’s a wonderful and important ideal, ‘meritocratic’ is a long way from being an accurate description of our current state of affairs, thanks to human foibles of various kinds. Those foibles can be broken down roughly into two types: biases (both conscious and unconscious) that limit people with qualifications from advancing, and barriers (personal, social, and systemic) that prevent people from attaining the qualifications, support, and mentorship necessary to succeed.”

“Here’s the thing: The defining feature of a blind spot is that we don’t know it’s there. And it’s hard to notice it until we’re challenged on it. We see this again and again with all-male speaker lineups at tech conferences. I certainly don’t believe the organizers of those conferences are rabid misogynists; they just have a blind spot when it comes to gender, and frequently don’t notice the lack of women until it’s pointed out to them.”

[7] B. A. Barres, Does gender matter? Nature 442 (2006), 133–136.

The author reports upon his personal experiences in mathematics, first as a women, and then as a transgendered man, emphasizing the differences in the amount of respect his instructors and peers demonstrated.

“As an undergrad at the Massachusetts Institute of Technology (MIT), I was the only person in a large class of nearly all men to solve a hard maths problem, only to be told by the professor that my boyfriend must have solved it for me. I was not given any credit. I am still disappointed about the prestigious fellowship competition I later lost to a male contemporary when I was a PhD student, even though the Harvard dean who had read both applications assured me that my application was much stronger (I had published six high-impact papers whereas my male competitor had published only one). Shortly after I changed sex, a faculty member was heard to say ‘Ben Barres gave a great seminar today, but then his work is much better than his sister’s.’”

“[P]eople who don’t know I am transgendered treat me with much more respect: I can even complete a whole sentence without being interrupted by a man.”

One can compare this experience to that of J. Roughgarden, who transitioned from a man to a woman and saw an analogous degradation of the way she was treated: http://www.nytimes.com/2000/10/17/science/scientist-work-joan-roughgarden-theorist-with-personal-experience-divide-between.html

[8] S. L. Beilock, E. A. Gunderson, G. Ramirez, and S. C. Levine, Female teachers’ math anxiety affects girls’ math achievement, Proceedings of the National Academy of Sciences of the USA 107 (2010), no. 5, 1860–1863.

From the abstract: “There was no relation between a teacher’s math anxiety and her students’ math achievement at the beginning of the school year. By the school year’s end, however, the more anxious teachers were about math, the more likely girls (but not boys) were to endorse the commonly held stereotype that ‘boys are good at math, and girls are good at reading’ and the lower these girls’ math achievement. Indeed, by the end of the school
year, girls who endorsed this stereotype had significantly worse math achievement than girls who did not and than boys overall. In early elementary school, where the teachers are almost all female, teachers' math anxiety carries consequences for girls' math achievement by influencing girls' beliefs about who is good at math.”

[9] M. Biernat, M. Manis, and T. E. Nelson, Stereotypes and standards of judgment, Journal of Personality and Social Psychology 60 (1991), no. 4, 485–499.

From the abstract: “In 3 studies, subjects judged a series of targets with respect to a number of gender-relevant attributes (e.g., height, weight, and income), using either either subjective (Likert-type) or objective response scales (e.g., inches, pounds, and dollars). Objective judgments were consistently influenced by sex stereotypes; subjective judgments were not. Results were also consistent with the expectation that when a judgment attribute is unrelated to gender, male and female targets evoke the same judgment standards.”

There was also an intermediate result when respondents were explicitly asked to subjectively judge with respect to the “average person”.

“The results we obtained when targets’ financial success was evaluated present a particularly striking example of respondents’ inadvertent use of different subjective standards for assessing women and men. . . . Whereas the male targets were thought to earn more money per year than the female targets, these same men were regarded as being less successful than women when rated on a subjective scale.”

[10] H. R. Bowles, L. Babcock, and L. Lai, Social incentives for gender differences in the propensity to initiate negotiations: sometimes it does hurt to ask, Organizational Behavior and Human Decision Processes 103 (2007), 84–103.

Abstract: “Four experiments show that gender differences in the propensity to initiate negotiations may be explained by differential treatment of men and women when they attempt to negotiate. In Experiments 1 and 2, participants evaluated written accounts of candidates who did or did not initiate negotiations for higher compensation. Evaluators penalized female candidates more than male candidates for initiating negotiations. In Experiment 3, participants evaluated videotapes of candidates who accepted compensation offers or initiated negotiations. Male evaluators penalized female candidates more than male candidates for initiating negotiations; female evaluators penalized all candidates for initiating negotiations. Perceptions of niceness and demandingness explained resistance to female negotiators. In Experiment 4, participants adopted the candidate’s perspective and assessed whether to initiate negotiations in same scenario used in Experiment 3. With male evaluators, women were less inclined than men to negotiate, and nervousness explained this effect. There was no gender difference when evaluator was female.”

[11] V. L. Brescoll, J. Glass, and A. Sedlovskaya, Ask and ye shall receive? the dynamics of employer-provided flexible work options and the need for public policy, Journal of Social Issues 69 (2013), no. 2, 367–388.

From the abstract: “[M]anagers were most likely to grant flextime to high-status men seeking flexible schedules in order to advance their careers. In contrast, flexible scheduling requests from women were unlikely to be granted irrespective of their job status or reason.”

[12] A. W. Brooks, L. Huang, S. W. Kearney, and F. E. Murray, Investors prefer entrepreneurial ventures pitched by attractive men, Proceedings of the National Academy of Science of the USA 111 (2014), no. 12, 4427–4431.

Abstract: “We identify a profound and consistent gender gap in entrepreneurship, a central path to job creation, economic growth, and prosperity. Across a field setting (three entrepreneurial pitch competitions in the United States) and two controlled experiments, we find that investors prefer entrepreneurial pitches presented by male entrepreneurs compared with pitches presented by female entrepreneurs, even when the content of the pitch is the same. This effect is moderated by male physical attractiveness: attractive males are particularly persuasive, whereas physical attractiveness does not matter among female entrepreneurs . . . .”

[13] L. L. Carli and A. H. Eagly, Gender, hierarchy, and leadership: an introduction, Journal of Social Issues 57 (2001), no. 4, 629–636.

From the abstract: “The articles included in the issue provide evidence of bias in the evaluation of women, discuss effects of gender stereotypes on women’s influence and leadership behaviors, and evaluate strategies for change.
This introductory article provides a brief summary of changes in women’s status and power in employment and education and the absence of change at the upper echelons of power in organizations. Also included is an outline of the contributions of the other articles in the issue.”

[14] M. Carnes, S. Geller, E. Fine, J. Sheridan, and J. Handelsman, NIH Director’s Pioneer Awards: could the selection process be biased against women?, J. Women’s Health 14 (2005), no. 8, 684–691.

From the abstract: “Nine excellent scientists were chosen as NIH Pioneers, but the selection of all men is at odds with the percentage of women receiving doctoral degrees for the past three decades, serving as principal investigators on NIH research grants, and achieving recognition as scientific innovators in non-NIH award competitions. The absence of women Pioneers provokes the following question: In the context of extant research on the impact of gender-based assumptions on evaluation of men and women in traditionally male fields, such as science, were there aspects about the process of nomination, evaluation, and selection that inadvertently favored men? We present evidence to suggest that women scientists would be disadvantaged by the following components of the NIH Director’s Pioneer Award initiative: (1) time pressure placed on evaluators, (2) absence of face-to-face discussion about applicants, (3) ambiguity of performance criteria, given the novelty of the award, combined with an emphasis on subjective assessment of leadership, potential achievements rather than actual accomplishments, and risk taking, (4) emphasis on self-promotion, (5) weight given to letters of recommendation, and (6) the need for finalists to make a formal, in-person presentation in which the individual and not his or her science was the focus of evaluation. We offer an analysis of this process to encourage the NIH to embark on self-study and to educate all reviewers regarding an evidence-based approach to gender and evaluation.”

The article discusses in detail how each component disadvantages female applicants in our current society. For example, “Multiple studies, largely from cognitive and social psychology, find that whenever ambiguity or uncertainty exists in evaluating performance in a traditionally male gendered job, men are consistently evaluated as being more competent and possessing more achievement-related characteristics than women performing the same work.”

[15] A. Casadevall and J. Handelsman, The presence of female conveners correlates with a higher proportion of female speakers at scientific symposia, mBio 5 (2014), no. 1, e00846-13.

From the abstract: “Analysis of 460 symposia involving 1,845 speakers in two large meetings sponsored by the American Society for Microbiology revealed that having at least one woman member of the convening team correlated with a significantly higher proportion of invited female speakers and reduced the likelihood of an all-male symposium roster.”

“The proportion of women entering scientific careers has increased substantially, but women remain underrepresented in academic ranks. Participation in meetings as a speaker is a factor of great importance for academic advancement. We found that having a woman as a convener greatly increased women’s participation in symposia, suggesting that one mechanism for achieving gender balance at scientific meetings is to involve more women as conveners.”

[16] P. R. Clance and S. Imes, The impostor phenomenon in high achieving women: dynamics and therapeutic intervention, Psychotherapy: Theory, Research, and Practice 15 (1978), no. 3, 241–247.

Abstract: “The term impostor phenomenon is used to designate an internal experience of intellectual phonies [sic], which appears to be particularly prevalent and intense among a select sample of high achieving women. Certain early family dynamics and later introjection of societal sex-role stereotyping appear to contribute significantly to the development of the impostor phenomenon. Despite outstanding academic and professional accomplishments, women who experience the impostor phenomenon persists [sic] in believing that they are really not bright and have fooled anyone who thinks otherwise. Numerous achievements, which one might expect to provide ample object evidence of superior intellectual functioning, do not appear to affect the impostor belief. Four factors, which contribute to the maintenance of impostor feelings over time, are explored. Therapeutic approaches found to be effective in helping women change the impostor self-concept are described.”

“The question has been raised as to whether or not men experience this phenomenon. In our clinical experience, we have found that the phenomenon occurs with much less frequency in men and that when it does occur, it is with much less intensity.”
The findings of the research cited by Deaux are consistent with the following principals: 1) An unexpected performance outcome will be attributed to a temporary cause. 2) An expected performance outcome will be attributed to a stable cause. In line with their lower expectancies, women tend to attribute their successes to temporary causes, such as luck or effort, in contrast to men who are much more likely to attribute their successes to the internal, stable factor of ability. Conversely, women tend to explain failure with lack of ability, whereas men more often attribute failure to luck or task difficulty. Given the lower expectancies women have for their own (and other women’s) performances, they have apparently internalized into a self-stereotype the societal sex-role stereotype that they are not considered competent.

[17] R. Cleary, J. W. Maxwell, and C. Rose, Fall 2012 departmental profile report, Notices of the AMS 61 (2014), no. 2, 158–167.

Included in the survey data in this report are several statistics about the proportion of members (from sessional instructors to full professors) of mathematics departments (from small colleges to prestigious PhD-granting departments) who are female. In summary: the better the job, the lower the percentage of women.

Females account for 29–31% of full-time doctoral faculty—in all departmental groupings except “Doctoral Math”, where they are only 18% of full-time doctoral faculty.

“Females account for 53% of full-time nondoctoral faculty in all mathematics groups combined (down from 54% last year), compared to females accounting for 24% of all doctoral full-time faculty and 29% of all full-time faculty.”

“For the combined mathematics departments (Math Public, Math Private, Applied Math, Masters and Bachelors), women comprised 29% (6,482 with a standard error of 83) of the full-time faculty (22,219) in fall 2012. For the doctoral mathematics departments combined (Math Public, Math Private and Applied Math), women comprised 14% of the combined doctoral-holding tenured and tenure-track faculty and 27% of the doctoral-holding non-tenure-track (including postdocs) faculty in fall 2012. For Masters faculty these same percentages are 28 and 39, and for Bachelors faculty they are 29 and 33, respectively. Among the nondoctoral full-time faculty in all math departments combined, women comprise 53%. Females account for 41% of all part-time faculty in mathematics departments combined.”

“Females hold 12% of full-time tenured and 24% of fulltime untenured/tenure-track positions in all doctoral mathematics departments combined.”

“Masters departments reported the highest percentage of fulltime female faculty (35%), while Math Private Large reported the lowest (14%).”

[18] S. J. Correll, S. Benard, and I. Paik, Getting a job: is there a motherhood penalty?, American Journal of Sociology 112 (2007), no. 5, 1297–1339.

Abstract: “Survey research finds that mothers suffer a substantial wage penalty, although the causal mechanism producing it remains elusive. The authors employed a laboratory experiment to evaluate the hypothesis that status-based discrimination plays an important role and an audit study of actual employers to assess its real-world implications. In both studies, participants evaluated application materials for a pair of same-gender equally qualified job candidates who differed on parental status. The laboratory experiment found that mothers were penalized on a host of measures, including perceived competence and recommended starting salary. Men were not penalized for, and sometimes benefited from, being a parent. The audit study showed that actual employers discriminate against mothers, but not against fathers.”

[19] D. J. Dean and J. B. Koster, Equitable Solutions for Retaining a Robust STEM Workforce: Beyond best practices, Academic Press, 2014.

This book discusses the causes of underrepresentation of women in STEM fields and goes into great detail about how to correct the inequities in the system. For example, Chapters 5 and 6 describe case studies of conferences that offered provision for child care, including funding for family or caretaker travel; Chapter 8 discusses implicit bias, the dissonance between success and likability for women, and the shortage of female conference speakers.

Table of contents:
1. Envisioning the STEM workplace of the future: the need for work/life programs and family-friendly practices
2. Work/life integration challenges are worldwide
3. Addressing work/life issues
4. Dual careers and strategic decision making
5. Child care and dependent care in professional contexts
6. Promoting family-friendly policies
7. Mentoring and networking
8. Implicit bias and the workplace
9. Government policy implications for addressing family-related issues

[20] P. G. Devine, E. A. Plant, D. M. Amodio, E. Harmon–Jones, and S. L. Vance, The regulation of explicit and implicit race bias the role of motivations to respond without prejudice, Journal of Personality and Social Psychology 82 (2002), no. 5, 835–848.

From the abstract: “[E]xplicit race bias was moderated by internal motivation to respond without prejudice, whereas implicit race bias was moderated by the interaction of internal and external motivation to respond without prejudice. Specifically, high internal, low external participants exhibited lower levels of implicit race bias than did all other participants. Implications for the development of effective self-regulation of race bias are discussed.”

The following quotes refer to the Internal and External Motivation to Respond Without Prejudice Scales (IMS and EMS), which are instruments for measuring people’s motivations for their responses and actions.

“The IMS assesses personal motivation to respond without prejudice and includes items such as ‘I attempt to act in nonprejudiced ways toward Black people because it is personally important to me’ and ‘Being nonprejudiced toward Black people is important to my self-concept.’ The EMS focuses instead on external pressure to respond without prejudice and includes items such as ‘If I acted prejudiced toward Black people, I would be concerned that others would be angry with me’ and ‘I attempt to appear nonprejudiced toward Black people in order to avoid disapproval from others.’”

“When responses are easy to control [EMS], those with high levels of personal motivation to respond without prejudice are able to do so. Also consistent with our previous findings, highly externally motivated individuals reported slightly higher levels of explicit race bias than did their low external counterparts.”

“We expected that participants who reported high levels of internal motivation and low levels of external motivation and, thus, were theoretically highly autonomous would be the most effective at regulating expressions of race bias, even on difficult-to-control responses [IMS]. Consistent with our expectations, these individuals responded with lower levels of implicit race bias than did all other participants.”

[21] T. A. DiPrete and G. M. Eirich, Cumulative advantage as a mechanism for inequality: a review of theoretical and empirical developments, Annual Review of Sociology 32 (2006), 271–297.

This article delves into a theoretical, even somewhat axiomatic, explanation for the “leaky pipeline” problem and related inequities (not all gender-based) in scientific recognition.

“Merton started with three premises. The first was that resources in the scientific world were limited. The second was that scientific talent was difficult to observe directly. The third was that allocation of resources in science was governed by the norms of universalism (recognition should be granted based on the quality of scientific work) and communism (resources should be allocated in order to maximize the overall productivity of the scientific community). Scientific resources were therefore not simply a ‘reward’ for past productivity, but were given in order to stimulate future productivity. With limited ability to evaluate the great mass of ongoing scientific work, and with limited ability to measure future productivity ex ante, the scientific community favored those who had been most successful in the past with additional resources and attention. One consequence of this mechanism was that the gap in rewards between a more able and a less able scientist would grow over time. A second consequence was that chance events (e.g., unequal luck in the draw of reviewers upon submitting a grant proposal for funding would produce a relative advantage for one of two individuals of identical talent, and this relative advantage could persist and increase over time. A third consequence (Merton’s so-called Matthew effect) was that scientists with
greater reputations would gain greater rewards from work of a given quantity and quality than would scientists with lesser reputations.”

“[W]omen’s disadvantage grows during the early career as a result of CA processes that magnify their early disadvantages, though Long and Fox evaluate this evidence as more tentative than conclusive.” Several references to the relevant literature are given.

[22] A. H. Eagly and S. J. Karau, Role congruity theory of prejudice toward female leaders, Psychological Review 109 (2002), no. 3, 573–598.

This article summarizes and analyzes dozens of studies that demonstrate biases against women in wages, evaluation, suitability for leadership roles, and so on. The authors also put forward a theoretical psychological framework for explaining the source of our biases against female leaders.

“[T]here is general agreement that such studies have demonstrated wage discrimination against women. Although Stanley and Jarrell’s meta-analysis of the results of 41 studies estimating wage discrimination showed an unequivocal decrease over time, other detailed analyses confirm that some wage discrimination against women remains in the United States.”

“A role congruity theory of prejudice toward female leaders proposes that perceived incongruity between the female gender role and leadership roles leads to 2 forms of prejudice: (a) perceiving women less favorably than men as potential occupants of leadership roles and (b) evaluating behavior that fulfills the prescriptions of a leader role less favorably when it is enacted by a woman. One consequence is that attitudes are less positive toward female than male leaders and potential leaders. Other consequences are that it is more difficult for women to become leaders and to achieve success in leadership roles. Evidence from varied research paradigms substantiates that these consequences occur, especially in situations that heighten perceptions of incongruity between the female gender role and leadership roles.”

“This method of examining potential bias against women has been labeled the Goldberg paradigm in honor of P. Goldberg’s (1968) initial experiment, in which identical articles ostensibly written by a woman or a man were given to students for evaluation. . . . The most extensive meta-analysis of the subset of Goldberg studies presenting job résumés or applications was based on information in 49 articles and dissertations. The results showed that men were preferred over women for jobs rated as male sex-typed and women over men for jobs rated as female sex-typed. Given that leadership roles are usually sex-typed as masculine, this research supports our theory’s prediction of bias against female candidates for such positions.”

[23] N. M. Else-Quest, J. S. Hyde, and M. C. Linn, Cross-national patterns of gender differences in mathematics: a meta-analysis, Psychological Bulletin 136 (2010), no. 1, 103–127.

This article compares many studies that investigate gender gaps in mathematics performance, overall and also among the highest achievers separately. They demonstrate a significant correlation between that gap and measures of gender inequality in the countries in question. This analysis provides evidence for the **gender stratification hypothesis**, that “cross-national patterns of gender differences in math achievement reflect gender inequities in educational and economic opportunities available in a given culture”, over the **greater male variability hypothesis**, “greater variance in test scores is displayed by males than females, so that, even if there is no average gender difference, there will still be more males among the very top performers”.

“Gender equity in school enrollment, women’s share of research jobs, and women’s parliamentary representation were the most powerful predictors of cross-national variability in gender gaps in math.” The authors include a table containing Composite and Domain-Specific Indicators of Societal Gender Equity.

The article includes a large number of references for statements like “mounting evidence of gender similarities in math achievement”, “stereotypes about female inferiority in mathematics”, “girls earn better grades in mathematics courses through the end of high school”, “girls tending to report higher anxiety and lower self-concept about their math abilities”, and “gender differences in mathematics performance are declining”.

The authors also provide a theoretical framework underlying the gender stratification hypothesis, relating it to cognitive social learning theory and social structure theory, for example.
From the abstract: “We conceptualize leadership development as identity work and show how subtle forms of gender bias in the culture and in organizations interfere with the identity work of women leaders. Based on this insight, we revisit traditional approaches to standard leadership topics … reinterpret them through the lens of women’s experiences in organizations; and revise them to meet the particular challenges women face when transitioning into senior leadership. By framing leadership development as identity work, we reveal the gender dynamics involved in becoming a leader…” Here, “identity work” refers to the process by which external perceptions of identity mediate between one’s self-identity and socially permissible roles.

“Organizational research on the causes of women’s persistent underrepresentation in leadership positions has thus shifted away from a focus on actors’ intentional efforts to exclude women to consideration of so-called second-generation forms of gender bias, the powerful yet often invisible barriers to women’s advancement that arise from cultural beliefs about gender, as well as workplace structures, practices, and patterns of interaction that inadvertently favor men. For example, organizational hierarchies in which men predominate, along with practices that equate leadership with behaviors believed to be more common or appropriate in men, powerfully if unwittingly communicate that women are ill-suited for leadership roles; people’s tendency to gravitate to those who are like them on salient dimensions such as gender leads powerful men to sponsor and advocate for other men when leadership opportunities arise. Such biases accumulate and in the aggregate can interfere in women’s ability to see themselves and be seen by others as leaders.”

“The mismatch between qualities attributed to women and qualities thought necessary for leadership places women leaders in a double bind and subjects them to a double standard. Women in positions of authority are thought too aggressive or not aggressive enough, and what appears assertive, self-confident, or entrepreneurial in a man often looks abrasive, arrogant, or self-promoting in a woman. African American women are especially vulnerable to such stereotypes and risk being seen as overly aggressive and confrontational. In experiment after experiment, women who achieve in distinctly male arenas are seen as competent but are less well-liked than equally successful men. Merely being a successful woman in a male domain can be regarded as a violation of gender norms, warranting sanctions. By the same token, when women performing traditionally male roles are seen as conforming to feminine stereotypes, they tend to be liked but not respected: They are judged too soft, emotional, and unassertive to make tough decisions and to come across as sufficiently authoritative. In short, women can face trade-offs between competence and likability in leadership roles.”

“The composition of one’s informal network can open doors to leadership opportunities, determine who will see and grant (or not) one’s leadership claims, and shape what one learns in the process. . . . In settings where men predominate in positions of power, women have a smaller pool of high-status, same-gender contacts on which to draw and fewer ties to powerful, high-status men. Both white women and women of color cite lack of access to influential colleagues with whom to network as a major barrier to advancement.”

The article contains a large number of references to studies supporting these quoted statements.
philosophy as they otherwise would. . . . We would like these harms to stop, and we think that a significant step toward achieving that is drawing people’s attention to some of their causes.”

The web site is nicely written in general and contains a good FAQ and a how-to page for balancing gender at conferences.

[27] Feministe, Female conference speaker bingo: a bingo card full of excuses for not having more female speakers at STEM conferences. http://www.feministe.us/blog/archives/2012/09/24/why-arent-there-more-women-at-stem-conferences-this-time-its-statistical/female-conference-speaker-bingo (accessed July 28, 2014)

[28] Geek Feminism, Conference anti-harassment/Policy. http://geekfeminism.wikia.com/wiki/Conference_antiharassment/Policy (accessed July 29, 2014)

“This is an example anti-harassment policy suitable for most open source, computing, or technology-related conferences. It may be adopted unchanged or tweaked to suit your conference.”

[29] Geek Feminism, Ten tips for getting more female speakers. August 11, 2009. http://geekfeminism.org/2009/08/11/ten-tips-for-getting-more-women-speaker (accessed July 29, 2014)

[30] A. Gheaus, Three cheers for the token woman, Social Science Research Network, March 5, 2013. http://ssrn.com/abstract=2228632 (accessed July 28, 2014)

This nuanced and extremely well-written essay deeply explores the questions: “Was I invited to speak at this conference just because I’m a woman? Should I accept the invitation?”

“If women were invited on the sole ground of their sex, this would indeed pose the threat of humiliation and of undermining women’s achievements. But nobody suggests including women on the sole ground of their sex; being a woman should be acknowledged as one of the legitimate reasons, alongside competence, for including women. Here I argue that in some contexts there are several legitimate grounds—indeed, independent from competence—for including people in positions of visibility and prestige and that sometimes sex can be such a legitimate reason. If this is true, there is nothing wrong with being a token woman—although a lot is wrong with what makes tokenism possible!—and it is important to overcome the ambivalence of those who may be, at some point, a token woman.”

“The gendered conference campaign (henceforth the GCC) is an initiative supported by growing number of philosophers who believe that the discipline of philosophy is overly dominated by men. Male domination is both expressed and perpetuated through the existence of too many male-only conference and edited volumes. This state of affairs is deemed to contribute to the (possibly unconscious) stereotype that philosophy is best done by men, a stereotype which the proponents of GCC think is detrimental to women in two ways. First, because it undermines the self-confidence of women who aspire to become professional philosophers, or to remain in this exceptionally competitive profession. Second, the stereotype feeds the conscious or unconscious biases against women of the people who decide the fate of those who aspire to become or remain in the profession. The GCC supporters believe that conference organisers and volume editors should strive to include women philosophers amongst the invited speakers and authors in order to fight the stereotype of philosophy as a male subject. Because the existence and scope of implicit bias is disputed, this paper does not assume it. If implicit bias is as pervasive and uncontrollable as the proponents of the GCC believe it is, this lends additional force to the reasoning I propose here. But even without believing in implicit bias, it is reasonable to think that more gender-balance within professional philosophy will contribute to fairer chances for existing and would-be female philosophers, by making sex a less salient characteristic and so by sending the general message that people of both sexes can be professional philosophers.”

“Anne Phillips—an advocate of female quotas in politics—encourages us to: ‘query the startling presumption that existing incumbents were chosen on merit. One of the points raised in the wider literature is that, even in the most seemingly meritocratic of systems—the selection of students for academic courses or the appointment of academics to university jobs—there is normally a cluster of vaguer characteristics which can override the stricter numerical hierarchy of grades or publications or degrees, always moderated by additional criteria. These more qualitative criteria [(‘personality’, ‘character’, whether the candidates will ‘fit in’) often favour those who are most like the people conducting the interview: more starkly, they often favour the men’].’”

11
This paper analyzes how a change in the process for auditioning prospective members of orchestras—namely, putting the auditionee behind a screen—resulted in significantly more women being selected.

“We find, using our audition sample in an individual fixed-effects framework, that the screen increases the probability a woman will be advanced out of a preliminary round when there is no semifinal round. The screen also greatly enhances the likelihood a female contestant will be the winner in a final round. Using both the roster and auditions samples, and reasonable assumptions, the switch to blind auditions can explain about one-third of the increase in the proportion [of] female[s] among new hires (whereas another one-third is the result of the increased pool of female candidates).”

The authors created a “sense of belonging in math” tool, which predicted “college students’ intent to pursue math in the future”. They used this tool to probe the effect of stereotypes on individuals’ opinions that they could succeed in future mathematics.

“[S]tudents’ perceptions of 2 factors in their math environment—the message that math ability is a fixed trait and the stereotype that women have less of this ability than men—worked together to erode women’s, but not men’s, sense of belonging in math. . . . [T]he message that math ability could be acquired protected women from negative stereotypes….”

The paper references stereotype threat: “ability-impugning stereotypes such as these can trigger psychological processes that can undermine the performance of stereotyped individuals, including females in math”. It also contains references for implicit theories of intelligence: believing math to be a “fixed trait” can “turn students away from challenges that might undermine their belief that they have high ability”, while believing math to be a “malleable quality” can make students “seek challenges that can result in better learning” and “remain highly strategic and effective in the face of setbacks, even showing enhanced motivation and performance”.

This web site implements implicit bias tests, which individuals can take for themselves to help see the implicit biases hidden inside their own minds.

This article analyzes the correlation between general measures of a country’s gender inequality and gaps in standardized test scores between girls and boys.

“(i) The World Economic Forum’s Gender Gap Index (GGI) reflects economic and political opportunities, education, and well-being for women (see chart). (ii) From the World Values Surveys (WVSs), we constructed an index of cultural attitudes toward women based on the average level of disagreement to such statements as: ‘When jobs are scarce, men should have more right to a job than women.’ (iii) The rate of female economic activity reflects the percentage of women age 15 and older who supply, or are available to supply, labor for the production of goods and services. (iv) The political empowerment index computed by the World Economic Forum measures women’s political participation, which is less dependent on math skills than labor force participation. These four measures are highly correlated.”

“We find a positive correlation between gender equality and gender gap in mathematics. . . . These results are true not only at the mean level, but also in the tail of the distribution.”

“This interaction between gender gap and GGI remains significant even when we insert an interaction between gender and log of GDP per capita, which suggests that the improvement in math scores is not just related to economic development, but to the improvement of the role of women in society.”

Reading scores are similarly affected by a country’s GGI index (although there the girls always outperform boys—but they do so more in countries with more gender equality).
The article also discusses genetically similar groups with different socio-political environments, showing that these correlations persist—thus providing evidence against the hypothesis that biological factors play a significant role.

“This evidence suggests that intra-gender performance differences in reading versus mathematics and in arithmetic versus geometry are not eliminated in a more gender-equal culture. By contrast, girls’ underperformance in math relative to boys is eliminated in more gender-equal cultures. In more gender-equal societies, girls perform as well as boys in mathematics and much better than them in reading. These findings shed some light on recent trends in girls’ educational achievements in the United States, where the math gender gap has been closing over time.”

[35] A. Hegewisch, C. Williams, H. Hartmann, and S. K. Hudiburg, The gender wage gap: 2013, Institute for Women’s Policy Research Fact Sheet #C423, September 2014. http://www.iwpr.org/publications/pubs/the-gender-wage-gap-2013 (accessed September 16, 2014)

This publication provides data on the wage gap between women and men in the United States; of particular note is that the numbers have been basically static for the past decade.

“The ratio of women’s and men’s median annual earnings was 78.3 percent for full-time/year-round workers in 2013. This means the gender wage gap for full-time/year-round workers is 21.7 percent.”

“An alternative measure of the wage gap, the ratio of women’s to men’s median weekly earnings for full-time workers—was 82.1 percent in 2013.”

[36] M. E. Heilman, The impact of situational factors on personnel decisions concerning women: varying the sex composition of the applicant pool, Organizational Behavior and Human Performance 26 (1980), 386–395.

Abstract: “One hundred male and female MBA students evaluated a woman applicant for a managerial position when the proportion of women in the applicant pool was varied. Results indicated that personnel decisions of both males and females were significantly more unfavorable when women represented 25% or less of the total pool. Additional findings suggest that this effect was mediated by the degree to which sex stereotypes predominated in forming impressions of applicants. The results were interpreted as supportive of the thesis that situational factors can function to reduce the adverse effects of sex stereotypes in employment settings.”

[37] M. E. Heilman, M. C. Simon, and D. P. Repper, Intentionally favored, unintentionally harmed? impact of sex-based preferential selection on self-perceptions and self-evaluations, Journal of Applied Psychology 72 (1987), no. 1, 62–68.

This paper describes experiments in which small groups of participants had a group leader selected; some were told that the selection was completely random, while others were told that the selection took gender into account. Women’s performance on subsequent tasks were lower in the latter groups.

“It had been proposed that sex-based preferential selection procedures would have negative consequences only for women because they, as a group, are unlikely to be confident about their ability to succeed in a leadership position, whereas men, as a group, are confident about their ability in this regard. Women’s performance apprehensions were therefore expected to be exacerbated by the ambiguity of [sex-based] preferential selection and alleviated by the reaffirmation of competence inherent in merit-based selection, giving rise to differential evaluations of self and performance. Our results are consistent with this idea and, indeed, lend support to it.”

“As predicted, the method of leader selection had effects only on women, not on men.”

“When selected on the basis of sex, women devalued their leadership performance, took less credit for successful outcomes, and reported less interest in persisting as leader; they also characterized themselves as more deficient in general leadership skills.”

[38] M. E. Heilman, A. S. Wallen, D. Fuchs, and M. M. Tamkins, Penalties for success: reactions to women who succeed at male gender-typed tasks, Journal of Applied Psychology 89 (2004), no. 3, 416–427.

From the abstract: “(a) When women are acknowledged to have been successful, they are less liked and more personally derogated than equivalently successful men; (b) these negative reactions occur only when the success is in an arena that is distinctly male in character; and (c) being disliked can have career-affecting outcomes,
both for overall evaluation and for recommendations concerning organizational reward allocation. These results were taken to support the idea that gender stereotypes can prompt bias in evaluative judgments of women even when these women have proved themselves to be successful and demonstrated their competence. The distinction between prescriptive and descriptive aspects of gender stereotypes is considered, as well as the implications of prescriptive gender norms for women in work settings.”

[39] A. Hess, Why women aren’t welcome on the internet, Pacific Standard 11 (Jan/Feb 2014), 36–47. http://www.psmag.com/navigation/health-and-behavior/women-arent-welcome-internet-72170 (accessed September 8, 2014)

This essay provides a thoroughly horrifying account of how women are treated online. (Trigger warning: rape threats, torture threats, death threats.)

"Accounts with feminine usernames incurred an average of 100 sexually explicit or threatening messages a day. Masculine names received 3.7.”

[40] D. E. Ho and M. G. Kelman, “Does class size affect the gender gap? a natural experiment in law”, Journal of Legal Studies 43 (2014), 291–321.

From the abstract: "We provide evidence that assignment to small sections closed a slight (but substantively and highly statistically significant) gender gap existing in large sections from 2001 to 2008; that reforms in 2008 that modified the grading system and instituted small graded writing and simulation-intensive courses eliminated the gap entirely; and that women, if anything, outperformed men in small simulation-based courses. Our evidence suggests that pedagogical policy—particularly small class sizes—can reduce, and even reverse, achievement gaps in post-graduate education.”

In an article about this research, C. B. Parker writes: “Kelman said that the study also refutes a common assumption that performance is predetermined by ‘fixed’ student traits. ‘Some naïve reactions are that if women get poorer grades at law school, women must be less capable,’ he said. Kelman added, ‘I think it’s surprising to many—and perhaps a confirmation of a more optimistic view that I have—that much of the inequality we observe in the world is mutable, and that the structures that we sometimes take for granted may work to the advantage of some and the disadvantage of others.’” http://news.stanford.edu/news/2014/november/gender-law-pedagogy-111014.html

[41] A. Hochschild and A. Machung, The Second Shift: Working families and the revolution at home, Penguin Books, 2012 (revised).

The “second shift” refers to the workload women have over and above what men have: childcare, home maintenance, and so on.

[42] J. S. Hyde, S. M. Lindberg, M. C. Linn, A. Ellis, and C. Williams, Gender similarities characterize math performance, Science 321 (2008), 494–495.

This article examines standardized test scores, reporting that girls’ scores and boys’ scores are essentially equal. “For whites, the ratios of boys:girls scoring above the 95th percentile and 99th percentile are 1.45 and 2.06, respectively, and are similar to predictions from theoretical models. For Asian Americans, ratios are 1.09 and 0.91, respectively. Even at the 99th percentile, the gender ratio favoring males is small for whites and is reversed for Asian Americans. If a particular specialty required mathematical skills at the 99th percentile, and the gender ratio is 2.0, we would expect 67% men in the occupation and 33% women. Yet today, for example, Ph.D. programs [sic] in engineering average only about 15% women.”

They categorized the test problems according to the following knowledge framework: Level 1 (recall), Level 2 (skill/concept), Level 3 (strategic thinking), Level 4 (extended thinking). The authors lamented the fact that tests associated with No Child Left Behind included essentially no Level 3 or 4 problems at all. They found some Level 3 problems on tests associated to National Assessment of Educational Progress data; gender differences on these problems were quite small.

“Conclusion. Our analysis shows that, for grades 2 to 11, the general population no longer shows a gender difference in math skills, consistent with the gender similarities hypothesis. There is evidence of slightly greater...
male variability in scores, although the causes remain unexplained. Gender differences in math performance, even among high scorers, are insufficient to explain lopsided gender patterns in participation in some STEM fields. An unexpected finding was that state assessments designed to meet NCLB requirements fail to test complex problem-solving of the kind needed for success in STEM careers, a lacuna that should be fixed.”

[43] J. S. Hyde and J. E. Mertz, Gender, culture, and mathematics performance, Proc. Nat. Acad. Sci. USA 106 (2009), 8801–8807.

From the abstract: “Using contemporary data from the U.S. and other nations, we address 3 questions: Do gender differences in mathematics performance exist in the general population? Do gender differences exist among the mathematically talented? Do females exist who possess profound mathematical talent? … [C]ontemporary data indicate that girls in the U.S. have reached parity with boys in mathematics performance, a pattern that is found in some other nations as well. … [S]tudies find more males than females scoring above the 95th or 99th percentile, but this gender gap has significantly narrowed over time in the U.S. and is not found among some ethnic groups and in some nations. Furthermore, data from several studies indicate that greater male variability with respect to mathematics is not ubiquitous. Rather, its presence correlates with several measures of gender inequality. Thus, it is largely an artifact of changeable sociocultural factors, not immutable, innate biological differences between the sexes. … [W]e document the existence of females who possess profound mathematical talent. Finally, we review mounting evidence that both the magnitude of mean math gender differences and the frequency of identification of gifted and profoundly gifted females significantly correlate with sociocultural factors, including measures of gender equality across nations.”

[44] Institute for Mathematics and its Applications, Diversity at IMA. https://www.ima.umn.edu/diversity (accessed October 12, 2014)

This web page gives information about some of the IMA’s diversity-related activities, including the Joint Math Institutes Expertise Database [61], Career Options for Underrepresented Groups in Mathematical Sciences, and the Girls in Mathematics Summer Day Program.

[45] L. A. Isbell, T. P. Young, and A. H. Harcourt, Stag parties linger: continued gender bias in a female-rich scientific discipline, PLOS ONE 7 (2012), no. 11, e49682.

Abstract: “Discussions about the underrepresentation of women in science are challenged by uncertainty over the relative effects of the lack of assertiveness by women and the lack of recognition of them by male colleagues because the two are often indistinguishable. They can be distinguished at professional meetings, however, by comparing symposia, which are largely by invitation, and posters and other talks, which are largely participant-initiated. Analysis of 21 annual meetings of the American Association of Physical Anthropologists reveals that within the subfield of primatology, women give more posters than talks, whereas men give more talks than posters. But most strikingly, among symposia the proportion of female participants differs dramatically by the gender of the organizer. Male-organized symposia have half the number of female first authors (29%) that symposia organized by women (64%) or by both men and women (58%) have, and half that of female participation in talks and posters (65%). We found a similar gender bias from men in symposia from the past 12 annual meetings of the American Society of Primatologists. The bias is surprising given that women are the numerical majority in primatology and have achieved substantial peer recognition in this discipline.”

The authors argue, among other things, that scientific conferences need more women on organizing committees.

[46] Joint Mathematics Meetings, Child care grants, 2015 Joint Mathematics Meetings (San Antonio, TX). http://jointmathematicsmeetings.org/meetings/national/jmm2015/2168_childcare (accessed September 16, 2014)

“The AMS and the MAA will provide approximately 40 reimbursement grants of US$250 per family to help with the cost of child care for a number of registered participants at 2015 JMM. The funds may be used for child care that frees a parent to participate more fully in the JMM.”

[47] JSConf EU 2012, Beating the odds—how we got 25% women speakers for JSConf EU 2012. http://2012.jsconf.eu/2012/09/17/beating-the-odds-how-we-got-25-percent-women-speakers.html (accessed October 12, 2014)
This post describes how the organizers adopted Stanton’s approach [81] to get many more women to submit talk proposals to their JavaScript conference.

“The ingredients are as simple as they are obvious: 1. Open an inviting call for presentations (CFP). 2. Select talks anonymously, and state in the CFP that you do so. [They emphasize later in the post how crucial this is for avoiding bias.] 3. Encourage people from under-represented groups to submit to the CFP.” The organizers also followed up energetically with women who dismissed their own worthiness to apply, brainstorming possible topics with them encouragingly; even so, only 13 of the 35 women they approached ended up submitting proposals (along with 5 other women).

Amazingly, even though 18 of the 180 (10%) proposers were women, the proposals (selected anonymously) included 10 of 40 (25%) by women. In other words, over half of the women who applied had proposals superior to the vast majority of men who applied.

[48] J. M. Kane and J. E. Mertz, Debunking myths about gender and mathematics performance, Notices of the AMS 59 (2012), no. 1, 10–21.

The authors define and investigate several hypotheses on gender gaps on mathematics tests, including the gender-stratified hypothesis: “boys and girls may be born similar in their innate intellectual potential but end up displaying differences due to a variety of sociocultural factors present in their environment”; the gap due to inequity hypothesis: “the gap between boys’ and girls’ mathematics performance is due to differences in opportunities available to males versus females”; and the greater male variability hypothesis: “variability in intellectual abilities is intrinsically greater among males”.

Part of their research was to compare gender gaps in test scores with measures of gender inequality in various countries. “The Gender Gap Index (GGI) is a composite, weighted measure of the gap between men and women with respect to economic participation, educational attainment, political empowerment, and health.” One difference between the GGI and the Social Watch Group’s similar GEI is that the GEI reflects overall wealth less, and “typically yielded slightly higher correlations with mathematics performance”.

“In support of the gender-stratified hypothesis, we show here that greater male variability and gender gap in mathematics performance, when present, are both largely artifacts of a complex variety of sociocultural factors rather than intrinsic differences, co-educational schooling, or specific religious following per se. Importantly, we document that mathematics performance for both boys and girls exhibits a strong positive correlation with some measures of gender equity, especially participation rates and salaries of women in the paid labor force relative to men.”

“[E]quity indexes and gender gap in mean mathematics performance do not reproducibly correlate; that is, while girls’ scores increase as equity indexes increase, boys’ scores do likewise.”

[49] K. Kaplan, Unmasking the impostor, Nature 459 (2009), 468–469.

This article provides a succinct but thorough description of what it’s like to experience the “impostor phenomenon”, how it affects people’s careers, and steps that may help in “purging that inner critic”. Included are several examples of, and quotes from, women who experience impostor phenomenon.

[50] E. Kaschak, Sex bias in student evaluations of college professors, Psychology of Women Quarterly 2 (1978), no. 3, 235–242.

“Sex, which would be an entirely irrelevant variable, seemed to be the crucial one on which faculty members were evaluated by male students. . . . The women students in this study rated female professors equally with male professors. . . . [M]ales, to a greater extent than females, are clearly biased by supposedly irrelevant information—the sex of the professor.”

On the same topic, see interactive charts at the New York Times: http://nyti.ms/1FgBON4

[51] S. Knobloch-Westercick, C. J. Glynn, and M. huge, The Matilda effect in science communication: an experiment on gender bias in publication quality perceptions and collaboration interest, Science Communication 35 (2013), no. 5, 603–625.
From the abstract: “Participants rated conference abstracts ostensibly authored by females or males, with author associations rotated. The abstracts fell into research areas perceived as gender-typed or gender-neutral to ascertain impacts from gender typing of topics. Publications from male authors were associated with greater scientific quality, in particular if the topic was male-typed. Collaboration interest was highest for male authors working on male-typed topics. Respondent sex did not influence these patterns.”

The following quote is reminiscent of Bacon’s post [6]: “Although ideally scientists would communicate with each other in unbiased fashion, living up to an ideal marketplace of ideas, patterns of stereotyping may still apply.”

“Rossiter introduced the term Matilda effect for a systematic underrecognition of female scientists. The term has been coined with reference to the well-known [to sociologists] ‘Matthew effect’—overrecognition of those at the top of the scientific profession, even credit misallocation to scientists who are already well known.”

“Compared with their male counterparts, [women] receive grants less often and receive smaller grant allocations, fewer citations, and fewer scientific awards—for example, ‘men were more than eight times more likely than women to win a scholarly award and almost three times more likely to win a young investigator award’. Furthermore, among recipients of career development grants, women are significantly less likely than men to obtain subsequent academic success for a number of criteria, such as receiving major grants, getting promoted, and holding academic leadership positions. Evaluation biases against women may play a role in this context. In fact, faculty recommendation letters have been found to differ in language use and praise by sex of the evaluated individual, favoring males. Yet women likely benefit from a blind peer review process, as it reduces gender biases through author anonymity. Taken together, the data suggest a pervasive culture of negative bias—whether conscious or unconscious—against women in academia.” This paragraph alone had nine citations to supporting research.

“A bias against female scholars extended further to young scholars’ interest in exchange and collaboration. Overall, male authors were perceived as more attractive for such interpersonal connections if they worked on male-typed topics compared to gender-neutral or female-typed topics. On the other hand, female authors fostered greater Collaboration Interest if they were associated with work on female-typed topics compared to gender-neutral topics.” The very fact that some fields are male-typed or female-typed [51, Table 1 on page 612] is thus a huge part of the problem. Note this extends to leadership, which is a male-typed activity.

[52] B. L. Keyfitz et al., Women mathematicians in the academic ranks: a call to action, BIRS Workshop on Women in Mathematics (September 2006), final report. [53] M. Lalin, Attending conferences with small children, What’s new, August 20, 2014.

This well-written blog post discusses issues faced by mothers with small children who wish to attend conferences, which it is easy for conference organizers to be ignorant of.

“The mother of a nursing infant that wishes to attend a conference has three options:
(a) Bring the infant and a relative/friend to help caring for the infant.
(b) Bring the infant and hire someone local (a nanny) to help caring for the infant.
(c) Travel without the infant and pump milk regularly.

“It is important to keep in mind that each option has its own set of challenges (even when expenses and facilities are all covered) and that different families may be restricted in their choice of options for a variety of reasons. It is therefore important that all these three options be facilitated.”

“Having to make choices about what to miss in the conference is very hard. While talks are important, so are the opportunities to meet people and discuss mathematics that happen during breaks and social events.”

The post includes a “Hall of Fame for those organizations that are already supporting nursing mothers’ travels in mathematics”, and ends with action items for conference organizers.
This literature analysis investigates various studies that measured a “gender gap” in mathematics ability between girls and boys. Averaged over all studies, this gender difference was negligible: the histogram of girls’ test scores was bell-curve-shaped, as was that of boys’ scores; each standard deviation was about 0.5 units on the scale they used, as compared to a difference in means of about 0.05.

“Mathematics and science are stereotyped as male domains. Stereotypes about female inferiority in mathematics are prominent among children and adolescents, parents, and teachers. Although children may view boys and girls as being equal in mathematical ability, they nonetheless view adult men as being better at mathematics than adult women. Implicit attitudes that link men and mathematics have been demonstrated repeatedly in studies of college students.

“Parents believe that their sons’ mathematical ability is higher than their daughters’. In one study, fathers estimated their sons’ mathematical IQ at 110 on average, and their daughters’ at 98; mothers estimated 110 for sons and 104 for daughters. Teachers, too, tend to stereotype mathematics as a male domain. In particular, they overrate boys’ ability relative to girls’.” [These last two paragraphs alone cite ten studies.]

“Stereotype threat effects have been found for women in mathematics. In the standard paradigm, half the participants (talented college students) are told that the math test they are about to take typically shows gender differences (threat condition), and the other half are told that the math test is gender fair and does not show gender differences (control). Studies have found that college women underperform compared with men in the threat condition but perform equal to men in the control condition, indicating that priming for gender differences in mathematics indeed impairs girls’ math performance. Stereotype threat effects have been found in children as early as kindergarten. Other research, measuring implicit stereotypes about gender and math, has found that these implicit stereotypes predict performance in a calculus course.”

One of the few effects that is still present: “Overall, we conclude that a small gender difference favoring boys in complex problem solving is still present in high school. Multiple factors may account for this gender gap. As noted earlier, girls are less likely to take physics than boys are, and complex problem solving is taught in physics classes, perhaps even more than in math classes. Gender differences in patterns of interest may play a role, although these patterns, too, are shaped by culture. Moreover, even in very recent studies, parents and teachers give higher ability estimates to boys than to girls, and the effects of parents’ and teachers’ expectations on children’s estimates of their own ability and their course choices are well documented.”

[54] G. Martin, Addressing the underrepresentation of women in mathematics conferences, preprint (2015). arXiv: 1502.06326

This is the article whose composition motivated the current annotated bibliography.

Abstract: “Despite significant improvements over the last few generations, our discipline of mathematics still counts a disproportionately small number of women among its practitioners. These women are underrepresented as conference speakers, even more so than the underrepresentation of women among PhD-earners as a whole. This underrepresentation is the result of implicit biases present within all of us, which cause us (on average) to perceive and treat women and men differently and unfairly. These mutually reinforcing biases begin in primary school, remain active through university study, and continue to oppose women’s careers through their effects on hiring, evaluation, awarding of prizes, and inclusion in journal editorial boards and conference organization committees. Underrepresentation of women as conference speakers is a symptom of these biases, but it also serves to perpetuate them; therefore, addressing this inequity at conferences is valuable and necessary. We describe in detail the biases against women in mathematics, knowing that greater awareness of them leads to a better ability to mitigate them. Finally, we make explicit suggestions for organizing conferences in a way that is equitable to female mathematicians.”

[55] H. A. Medina, Doctorate degrees in mathematics earned by blacks, Hispanics/Latinos, and Native Americans: a look at the numbers, Notices of the AMS 51 (2004), no. 7, 772–775.

This article collects data on the number of PhD degrees in mathematics earned by visible minorities in the United States from 1993 to 2002.
[57] K. L. Milkman, M. Akinola, and D. Chugh, What happens before? a field experiment exploring how pay and representation differentially shape bias on the pathway into organizations, preprint.

From the abstract: “In our experiment, professors were contacted by fictional prospective students seeking to discuss research opportunities before applying to a doctoral program. Students’ names were randomly assigned to signal gender and race, but messages were otherwise identical. Faculty ignored requests from women and minorities at a higher rate than requests from Caucasian males, particularly in higher-paying disciplines and private institutions.”

[58] C. A. Moss-Racusin, J. F. Dovidio, V. L. Brescoll, M. J. Graham, and J. Handelsman, Science faculty’s subtle gender biases favor male students, Proceedings of the National Academy of Science of the USA 109 (2012), no. 41, 16474–16479.

This article describes experiments where research faculty in science were given application materials ascribed to either a male or female name (but which were otherwise identical). Both male and female faculty rated the male applicant significantly more highly than the identical female applicant.

“[S]cience faculty from research-intensive universities rated the application materials of a student—who was randomly assigned either a male or female name—for a laboratory manager position. Faculty participants rated the male applicant as significantly more competent and hireable than the (identical) female applicant. These participants also selected a higher starting salary [14% on average] and offered more career mentoring to the male applicant. The gender of the faculty participants did not affect responses . . . .”

“[T]he female student was less likely to be hired than the identical male because she was viewed as less competent overall.”

“The fact that faculty members’ bias was independent of their gender, scientific discipline, age, and tenure status suggests that it is likely unintentional, generated from widespread cultural stereotypes rather than a conscious intention to harm women.”

[59] C. Munsch, Flexible work, flexible penalties: the effect of gender, childcare, and type of request on the flexibility bias, preprint.

From the press release by the American Sociological Association: “Among those who read the scenario in which a man requested to work from home for childcare related reasons, 69.7 percent said they would be ‘likely’ or ‘very likely’ to approve the request, compared to 56.7 percent of those who read the scenario in which a woman made the request. Almost a quarter—24.3 percent—found the man to be ‘extremely likeable’, compared to only 3 percent who found the woman to be ‘extremely likeable’. And, only 2.7 percent found the man ‘not at all’ or ‘not very’ committed, yet 15.5 percent found the woman ‘not at all’ or ‘not very’ committed.”

[60] M. C. Murphy and C. S. Dweck, A culture of genius: How an organization’s lay theories shape people’s cognition, affect, and behavior, Personality and Social Psychology Bulletin 36 (2010), 283–296.

This article discusses two theories of intelligence: “People who hold an entity theory of intelligence view it as a fixed quantity that cannot be changed very much by effort and learning, whereas people who hold an incremental theory believe intelligence is malleable and expandable.”

From the abstract: “In five studies, the authors examine how an organization’s fixed (entity) or malleable (incremental) theory of intelligence affects people’s inferences about what is valued, their self and social judgments, and their behavioral decisions. In Studies 1 and 2, the authors find that people systematically shift their self-presentations when motivated to join an entity or incremental organization. People present their ‘smarts’ to the entity environment and their ‘motivation’ to the incremental environment. In Studies 3a and 4, they show downstream consequences of these inferences for participants’ self-concepts and their hiring decisions. In Study 3b, they demonstrate that the effects are not due to simple priming.”

“[P]articipants judged the club endorsing a fixed view to be less appealing than the one endorsing a malleable view of intelligence.”

“[P]articipants expected to be more comfortable, to feel that they belonged more, and to believe that they would be more accepted and less likely to stick out in the organization that endorsed a malleable (vs. fixed) view of intelligence.”
“Participants who interviewed with a club that endorsed a fixed view of intelligence not only displayed their smarts during the interview but also enacted the fixed-view philosophy when choosing a candidate in an unrelated hiring task. In fact, participants chose the candidate who featured her smarts 78% of the time when they themselves had previously applied to the entity club. Similarly, participants who interviewed for membership to a club that espoused a malleable theory of intelligence showed a strong trend toward displaying more motivational characteristics and went on to hire the motivated candidate 92% of the time.”

Despite what we want our students to believe, our discipline has a strong view of mathematical research “power” as a fixed aspect of intelligence.

[61] National Science Foundation Mathematical Sciences Institutes, Joint math institutes expertise database. http://www.mathinstitutes.org/diversity_database (accessed September 15, 2014)

This web page describes a database of women and underrepresented minority mathematicians, for use by NSF-sponsored math institutes (currently AIM, IAS, ICERM, IMA, IPAM, MBI, MSRI, SAMSI). The website seems to be maintained by the IMA.

[62] I. Neath, How to improve your teaching evaluations without improving your teaching, Psychological Reports 78 (1996), 1363–1372.

This article discusses several ways (phrased as “tips”) in which teaching evaluations by students are affected by aspects of the course unrelated to the quality of the instruction.

“Tip 1: Be Male”

“The effects of instructors’ gender on evaluation ratings are complex and interact with a variety of other variables. Nonetheless, a preliminary conclusion appears to be that it is better to be male than female. Changing your gender, if female, can boost your effectiveness ratings. Students often expect more support from female faculty than from male faculty, and, when this extra effort is not forthcoming, students often downgrade their ratings of teaching effectiveness. If you are female, do not be very demanding of your students; students tend to be more critical, particularly on items measuring faculty’s availability and course stimulation when the instructor is female. This effect is compounded if you teach a technical course, particularly to liberal arts majors. If you do happen to be female and, for whatever reason, do not wish to become male, all is not lost. The Bem Sex-role Inventory is a scale that measures the preponderance of masculine and feminine traits in an individual [sic]. Study the scale and learn how to be less feminine and more androgynous; your ratings will improve.” This paragraph alone cites seven studies.

[63] J. L. Newsome, The Chemistry PhD: the impact on women’s retention, Royal Society of Chemistry/UK Resource Centre for Women in SET, 2008. http://www.biochemistry.org/Portals/0/SciencePolicy/Docs/Chemistry%20Report%20For%20Web.pdf

This report is linked from the web pages of the Department of Chemistry at Imperial College London. http://www3.imperial.ac.uk/chemistry/academicopportunities/chemacademicopps/reportsdocuments

“[T]he chemistry PhD programme and academic careers are modelled on masculine ways of thinking and doing, which leaves women neither supported as PhD students nor enthused to remain in research in the longer term. Cultural as well as procedural change is required to address this.”

The point is: assertions that women leave the field due to “their own choices” neglect the reality that external forces differentially shape those choices for women and men. See also the New York Times article “Academic science isn’t sexist” and the rebuttal by E. Willingham, “Academic science is sexist: we do have a problem here”. http://www.nytimes.com/2014/11/02/opinion/sunday/academic-science-isnt-sexist.html http://www.emilywillinghamphd.com/2014/11/academic-science-is-sexist-we-do-have.html

[64] M. Niederle and L. Vesterlund, Explaining the gender gap in math test scores: the role of competition, Journal of Economic Perspectives 24 (2010), no. 2, 129–144.

The authors examine the effect on competitive environments themselves on the performance of men and women on mathematics tests. “We will present results that suggest that the abundant and disturbing evidence of a large
gender gap in mathematics performance at high percentiles in part may be explained by the differential manner in which men and women respond to competitive test-taking environments.”

They also argue that men’s greater (over)confidence leads them to select more difficult and more math-intensive paths than women.

“Over the past 20 years, the fraction of males to females who score in the top five percent in high school math has remained constant at two to one (Xie and Shauman, 2003). Examining students who scored 800 on the math SAT in 2007, Ellison and Swanson (in this issue) also find a two to one male–female ratio. Furthermore, they find that the gender gap widens dramatically when examining the right tail of the performance distributions for students who participate in the American Mathematics Competitions.”

“Our results show that women shy away from competition while men embrace it and this difference is explained by gender differences in confidence and in attitudes toward competition. A consequence is that from a payoff-maximizing perspective, too few high-performing women and too many low-performing men enter the tournament.” [note: performance gap for mixed-sex tournaments far larger than for single-sex tournaments]

“Girls and boys with the same math test scores have very different assessments of their relative ability. Conditional on math performance, boys are more overconfident than girls, and this gender gap is greatest among gifted children. The strong gender stereotype that boys are better at math may help to explain this gender gap in confidence.”

“Dee and Carrell, Page, and West study the effect of a teacher’s gender on performance. Having a female math or science teacher improves the math and science performances by females, and the effect is particularly large for the gifted female students. Using the 1999–2000 Schools and Staffing Survey (SASS), Dee estimates that in 12th grade 44 percent of science teachers and 52 percent of math teachers are female, compared to 71 percent in reading. See Bettinger and Long for evidence on college instruction.”

“Stereotypes may not only influence a child’s confidence directly and the manner in which the child responds to competition, it may also influence the likelihood by which the child ‘chokes’ in any performance setting. Stereotype threat theory argues that a strong stereotype may harm the stereotyped individual’s performance on a task because they fear confirming it. Spencer, Steele, and Quinn show that the effect of stereotype threat may be removed if in describing a test it is stated that the ‘math test had revealed no gender difference in the past.’”

“The findings by Pope and Sydnor are very much in line with stereotypes influencing test performance at the tail. Looking at U.S. data, they find large variation in the gender ratios of 8th graders scoring in the top 75th and 95th percentiles of the National Assessment of Educational Progress (NAEP). The test is taken by a sample of children in public schools. Consistent with beliefs influencing behavior, they show that in regions where men and women are viewed as more equal there are smaller gender disparities in stereotypically male-dominated tests of math and science and in stereotypically female-dominated tests of reading.”

“Our study shows that when women are guaranteed equal representation among winners [via an affirmative-action tournament], more women and fewer men enter competitions and the change exceeds that predicted by the changes in the probability of winning that result from the introduction of affirmative action. The response causes the fraction of entrants who are women to increase from 29 to 64 percent. . . . [M]en are less overconfident and women less reluctant to compete in groups where their own gender is better represented.”

[65] O’Reilly Media, Conference diversity. http://cdn.oreillystatic.com/en/assets/1/eventprovider/1/ConfDiversity.pdf (accessed October 1, 2014)

This is a template for a diversity statement, intended for conference organizers to use as a blueprint for making their own diversity statements and including them on conference web sites and in conference materials. The statement is licensed under a Creative Commons license, meaning that others may freely adapt and share it for their own purposes, as long as they give attribution to the original.

[66] Organisation for Economic Co-operation and Development, How do girls compare to boys in mathematics skills?, PISA 2009 at a Glance, OECD Publishing, 2011.

This pamphlet contains data on boys’ and girls’ math scores on the 2009 Programme for International Student Assessment test.
A striking pattern among the respondents’ comments was the fear of making a mistake in public; this seems connected to the perception of mathematics ability as a fixed trait—why else would making a mistake be so feared?

T. Tao writes in his blog: “This article, submitted to the Newsletter of the European Mathematical Society, consists of personal contributions from ten different participants (at varying levels of stage of career, and intensity of participation) on their own experiences with the project, and some thoughts as to what lessons to draw for any subsequent Polymath projects.” https://terrytao.wordpress.com/2014/09/30/the-bounded-gaps-between-primes-polymath-project-a-retrospective/

This web site contains an app that shows the distribution function for the number of female speakers appearing among a total number (specified by the user) of speakers, assuming that each speaker’s gender is an independent random variable with a particular probability (also specified by the user). It also computes some summarizing statistics such as the probability of overrepresenting women and of having no women at all. The purpose is to make it easy to counter the argument that a lineup of speakers with few women should happen often by chance.

“I sometimes encounter the argument that speaker line-ups that fail to adequately represent women are not the product of systemic discrimination, but rather an inevitably frequent occurrence in an industry as male-dominated as ours…. [I]n an unbiased selection, you’re significantly more likely to see more than the expected number of women than none at all.”

This article contains research on how people (fail to) perceive implicit biases in themselves, even when they attribute them to others. Table 1, on pages 786–787, summarizes (with references to the original research) a large number of studies of particular biases and how the participants deny being affected by them.

“Studies calling for individuals to assess possible biasing influences on their own judgments and decisions have generally documented a failure to recognize such influence.”

“Participants overwhelmingly reported that they personally were less susceptible to each of these biases than the average American.”

“This asymmetry in attributions of bias, we have suggested, arises in part from the simple fact that people inhabit a world in which others hold opinions, make judgments, and undertake decisions that differ from their own. The attempt to account for this difference, and to do so while holding the conviction that one’s own responses to the world reflect the realities of that world, we have further suggested, is a proximate cause of the perceived asymmetry between self and others.”

“Our analysis further suggests that blindness to bias in the self is also produced and maintained by people’s willingness to take their introspections about the sources of their judgments and decisions at face value—that is, to treat the lack of introspective awareness of having been biased as evidence that one is innocent of such bias.”

Abstract: “Does discrimination contribute to the low percentage of women in mathematics and science careers? We designed an experiment to isolate discrimination’s potential effect. Without provision of information about candidates other than their appearance, men are twice more likely to be hired for a mathematical task than women. If ability is self-reported, women still are discriminated against, because employers do not fully account for men’s tendency to boast about performance. Providing full information about candidates’ past performance
reduces discrimination but does not eliminate it. We show that implicit stereotypes (as measured by the Implicit Association Test) predict not only the initial bias in beliefs but also the suboptimal updating of gender-related expectations when performance-related information comes from the subjects themselves.”

[71] C. L. Ridgeway, Gender, status, and leadership, Journal of Social Issues 57 (2001), no. 4, 637–655.

From the abstract: “In mixed-sex or gender-relevant contexts, gender status beliefs shape men’s and women’s assertiveness, the attention and evaluation their performances receive, ability attributed to them on the basis of performance, the influence they achieve, and the likelihood that they emerge as leaders. Gender status beliefs also create legitimacy reactions that penalize assertive women leaders for violating the expected status order and reduce their ability to gain compliance [sic] with directives.” These effects depend upon the perception of the task as male, female, or gender-neutral.

The original versions of the following quotes contain a large number of references to the research literature:

“Several studies show that, other things being equal, men in mixed-sex groups talk more, make more task suggestions, display more visual dominance and assertive gestures, use less tentative speech, and are more influential than women. . . . [M]en’s tendency to speak more and engage in more active task-related behaviors was mediated by status-based assumptions that men were more competent. When performance expectations for men and women in the situation were equalized, gender differences in task-related behavior disappeared.”

“As a result, the theory predicts that when a woman becomes a manager, the task-relevant implications of that role will significantly strengthen performance expectations for her, compared to other women. Because of the lingering, background effects of gender status, however, she will still be seen as less competent than a similar male manager. . . . The persisting effects of gender status mean that a woman manager’s efforts to assert authority over others is subtly undercut by continuing, implicit assumptions that she is not quite as competent in the role as a man would be.”

“[W]hen women in mixed-sex groups present their ideas in an assertive or self-directed style, they are disliked or perceived as untrustworthy and achieve less influence over men compared to similarly acting men or less assertive women. Similarly, studies have shown that self-promoting behavior that highlights competence produces positive outcomes for men but makes women appear less likeable and less hireable.”

[72] C. L. Ridgeway and S. J. Correll, Unpacking the gender system: a theoretical perspective on gender beliefs and social relations, Gender and Society 18 (2004), no. 4, 510–531.

From the abstract: “[C]ultural beliefs about gender function as part of the rules of the game, biasing the behaviors, performances, and evaluations of otherwise similar men and women in systematic ways that the authors specify. While the biasing impact of gender beliefs may be small in any one instance, the consequences cumulate over individuals’ lives and result in substantially different outcomes for men and women.”

“When hegemonic gender beliefs are effectively salient in a situation, hierarchical presumptions about men’s greater status and competence become salient for participants, along with assumptions about men’s and women’s different traits and skills. . . . The trouble with these status-shaped expectations for competence is that they affect people’s behaviors and evaluations in self-fulfilling ways.”

“What is interesting about the age old gender system in Western society is not that it never changes but that it sustains itself by continually redefining who man and women are and what they do while preserving the fundamental assumption that whatever the differences are, on balance, they imply that men are rightly more powerful. The essential form of gender hierarchy—that is, the cultural assumption that men have more status and authority than do women—has persisted during major economic transformations such as industrialization, the movement of women into the paid labor force, and more recently, the movement of women into male-dominated occupations such as law or medicine.”

[73] E. Ries, Why diversity matters (the meritocracy business), Startup Lessons Learned, February 22, 2010.
http://www.startuplessonslearned.com/2010/02/why-diversity-matter-meritocracy.html (accessed October 1, 2014)

This is a well-written article about the benefits of diversity and the disadvantages of homogeneity.
“So when a team lacks diversity, that’s a bad sign. What are the odds that the decisions that were made to create that team were really meritocratic? That’s why I care a lot about diversity: not for its own sake, but because it is a source of strength for teams that have it, and a symptom of dysfunction for those that don’t.”

“[S]tartups led by women are actually more successful, on average, than those led by men. This doesn’t surprise me at all, and you don’t have to support a biological determinism theory to see why. If women face structural barriers to becoming entrepreneurs, then those few who are able to overcome those barriers are probably exceptional to begin with.”

“Diversity benefits men, too. One of the most pernicious effects of groupthink is the sense of entitlement it breeds. Teams that are complacent are less likely to challenge their own assumptions, less likely to listen to feedback and, therefore, less likely to learn. . . . Outsiders are afraid to enter, let alone make a suggestion. The safety of the group becomes an impediment to dealing with reality.”

“Demographic diversity is an indicator. It’s a reasonable inference that a group that is homogeneous in appearance was probably chosen by a biased selector.”

“Even the fact that a startup is all-male can make it less likely that a women would want to join. Even worse, it might even affect her performance in an interview. And just solving the gender imbalance might not be helpful, if the solution involves yet more negative stereotypes. . . . But priming cuts both ways: when we go out of our way to affirm meritocracy, it actually improves everyone’s performance. In fact, explicitly making meritocracy a value is actually better than rejecting stereotypes—by calling attention to the stereotype, you’re still engaging in priming. Instead of focusing on programs designed to specifically benefit any one group, I think our focus should be on making our companies as meritocratic as possible.”

[74] E. Ries and S. Milstein, Seeking speakers, Startup Lessons Learned, August 8, 2012. http://www.startuplessonslearned.com/2012/08/seeking-speakers.html (accessed July 29, 2014)

This essay contains a lovely personal story, with lots of specificity, about how changing the way speakers were sought for a particular annual conference greatly improved the diversity of the eventual list of speakers.

[75] S. A. Rogier and M. Y. Padgett, The impact of utilizing a flexible work schedule on the perceived career advancement potential of women, Human Resource Development Quarterly 15 (2004), no. 1, 89–106.

From the abstract: “This study examined whether a woman working a flexible schedule would be perceived as having less career advancement potential than a woman on a regular schedule. Participants reviewed a packet of materials simulating the personnel file of a female employee in an accounting firm who was seeking promotion from manager to senior manager. Results indicated that participants perceived the female employee on the flexible schedule as having less job-career deduction and less advancement motivation; there was no difference in perceived capability.”

“This finding is consistent with prior research by Cohen and Single, who found that CPAs working flexible schedules were perceived as less desirable for an engagement, less likely to be promoted, and more likely to leave the firm.”

[76] E. Sander, AWM childcare statement, Association for Women in Mathematics, November 2010. http://sites.google.com/site/awmmath/awm-resources/policy-and-advocacy/awm-childcare-statement (accessed September 29, 2014)

“It is often critical to parents with young children that onsite childcare be made available at technical meet-

ings, but there is little uniformity in the practice of providing childcare. A list of principles supported by the Association for Women in Mathematics follows.”

[77] J. M. Sheltzer and J. C. Smith, Elite male faculty in the life sciences employ fewer women, Proceedings of the National Academy of Science of the USA 111 (2014), no. 28, 10107–10112.

“[M]ale faculty members tended to employ fewer female graduate students and postdoctoral researchers (post-
docs) than female faculty members did. Furthermore, elite male faculty—those whose research was funded by the Howard Hughes Medical Institute, who had been elected to the National Academy of Sciences, or who had won a major career award—trained significantly fewer women than other male faculty members. In contrast, elite
female faculty did not exhibit a gender bias in employment patterns. New assistant professors at the institutions that we surveyed were largely comprised of postdoctoral researchers from these prominent laboratories, and correspondingly, the laboratories that produced assistant professors had an overabundance of male postdocs. Thus, one cause of the leaky pipeline in biomedical research may be the exclusion of women, or their self-selected absence, from certain high-achieving laboratories.”

“[M]ale professors run laboratories that have about 22% fewer female postdocs and 11% fewer female graduate students than their female colleagues do.”

“For instance, male HHMI investigators ran laboratories that had, on average, 31% female postdocs, whereas men who were not HHMI investigators employed, on average, 38% female postdocs. This difference translates to a 19% deficit in the employment of female postdocs relative to their representation across all laboratories [led by males].”

[78] L. Sinclair and Z. Kunda, Motivated stereotyping of women: she’s fine if she praised me but incompetent if she criticized me, Personality and Social Psychology Bulletin 25 (2000), no. 11, 1329–1342.

Abstract: “Motivation may provoke stereotype use. In a field study of students’ evaluations of university instructors and in a controlled experiment, participants viewed women as less competent than men after receiving negative evaluations from them but not after receiving positive evaluations. As a result, the evaluation of women depended more on the favorability of the feedback they provided than was the case for men. Most likely, this occurred because the motivation of criticized participants to salvage their self-views by disparaging their evaluator led them to use a stereotype that they would otherwise not have used. The stereotype was not used by participants praised by a woman or by participants who observed someone else receive praise or criticism from a woman; all these participants rated the woman just as highly as participants rated a man delivering comparable feedback.”

[79] K. Snyder, The abrasiveness trap: high-achieving men and women are described differently in reviews, Fortune.com, August 26, 2014. http://fortune.com/2014/08/26/performance-review-gender-bias (accessed August 28, 2014)

“Words like bossy, abrasive, strident, and aggressive are used to describe women’s behaviors when they lead; words like emotional and irrational describe their behaviors when they object. All of these words show up at least twice in the women’s review text I reviewed, some much more often. Abrasive alone is used 17 times to describe 13 different women. Among these words, only aggressive shows up in men’s reviews at all. It shows up three times, twice with an exhortation to be more of it.”

“When breaking the reviews down by gender of the person evaluated, 58.9% of the reviews received by men contained critical feedback. 87.9% of the reviews received by women did. Men are given constructive suggestions. Women are given constructive suggestions—and told to pipe down.”

“This kind of negative personality criticism—watch your tone! step back! stop being so judgmental!—shows up twice in the 83 critical reviews received by men. It shows up in 71 of the 94 critical reviews received by women.”

See http://www.fastcompany.com/3034895/strong-female-lead/the-one-word-men-never-see-in-their-performance-reviews for a layperson’s writeup of this research, with a few colorful graphs added.

[80] S. J. Spencer, C. M. Steele, and D. M. Quinn, Stereotype threat and women’s math performance, Journal of Experimental Social Psychology 35 (1999), 4–28.

From the abstract: “When women perform math, unlike men, they risk being judged by the negative stereotype that women have weaker math ability. We call this predicament stereotype threat and hypothesize that the apprehension it causes may disrupt women’s math performance. In Study 1 we demonstrated that the pattern observed in the literature that women underperform on difficult (but not easy) math tests was observed among a highly selected sample of men and women. In Study 2 we demonstrated that this difference in performance could be eliminated when we lowered stereotype threat by describing the test as not producing gender differences. However, when the test was described as producing gender differences and stereotype threat was high, women performed substantially worse than equally qualified men did. A third experiment replicated this finding with a less highly selected population and explored the mediation of the effect.”
In an effort to organize a game developer conference, the author made a huge effort to solicit talk proposals from women. A stark pattern was observed in terms of the differences between how man and women reacted to the conference pitch:

“When I’d talk to men about the conference and ask if they felt like they had an idea to submit for a talk, they’d always start brainstorming on the spot. I’m not generalizing—every guy I talked to about speaking was able to come up with an idea, or multiple ideas, right away and yet, overwhelmingly the women I talked to with the same pitch deferred with a, ‘well, but I’m not an expert on anything,’ or ‘I wouldn’t know what to submit,’ or ‘yes but I’m not a lead [title], so you should talk to my boss and see if he’d want to present.’”

In the end, eight women and ten men submitted proposals, which were evaluated blind (without knowing the submitters’ names or genders); the chosen speakers turned out to be six women and six men.

Researchers took a real-life CV, made two copies of it that were identical except for the name (one a typical female name, the other a typical male name), and distributed it to people for evaluation. Evaluations were significantly better for the CV with the male name than for the identical CV with the female name.

“Both men and women were more likely to vote to hire a male job applicant than a female job applicant with an identical record. Similarly, both sexes reported that the male job applicant had done adequate teaching, research, and service experience compared to the female job applicant with an identical record. In contrast, when men and women examined the highly competitive curriculum vitae of the real-life scientist who had gotten early tenure, they were equally likely to tenure the male and female tenure candidates and there was no difference in their ratings of their teaching, research, and service experience.”

In a similar experiment, they took a stellar CV (of a real-life person who was awarded early tenure) and did the same; while evaluations were overwhelmingly positive no matter what, evaluators went out of their way to hedge their bets about the CV with the female name.

“The present findings did not indicate that potential female tenure candidates are evaluated more negatively than potential male tenure candidates, although participants were four times as likely to write cautionary comments in the margins of their questionnaire if they had reviewed a female tenure candidate than if they had reviewed the male tenure candidate. These cautionary comments include such comments as, ‘We would have to see her job talk,’ ‘It is impossible to make such a judgement without teaching evaluations,’ ‘I would need to see evidence that she had gotten these grants and publications on her own.’ Such cautionary comments on the male tenure candidate’s vitae were quite rare.”

This research studied the language and scope of actual letters of recommendation, finding differences in the letters that were correlated to the gender of the person being recommended.

“Letters written for female applicants were found to differ systematically from those written for male applicants in the extremes of length, in the percentages lacking in basic features, in the percentages with doubt raisers
(an extended category of negative language, often associated with apparent commendation), and in frequency of mention of status terms. Further, the most common semantically grouped possessive phrases referring to female and male applicants (‘her teaching,’ ‘his research’) reinforce gender schema that tend to portray women as teachers and students, and men as researchers and professionals.”

[85] N. D. Tyson, response to question during panel discussion, The Secular Society and its Enemies, Center for Inquiry, New York, 2007. response http://www.youtube.com/watch?v=z7ihNLEDiuM ; conference web site http://www.centerforinquiry.net/secularsociety (both accessed September 29, 2014)

An audience member’s question (with its sexist wording) prompted the moderator to ask whether any panelist wanted to address the hypothesis that there are biological differences between men and women that lead to men being overrepresented in science. Tyson’s response is excellent; the transcription at http://economixcomix.com/2014/04/20/neil-degrasse-tyson-on-gender-and-race-in-science-transcribed was done by M. Goodwin:

“I have never been female. But I have been black my whole life. And so, let me perhaps offer some insight from that perspective. Because there are many similar social issues related to access to equal opportunity that we find in the black community, as well as the community of women, in a male-dominated—a white-male-dominated—society.

“When I look at, throughout my life—I’ve known that I wanted to do astrophysics since I was nine years old, my first visit to the Hayden planetarium. So I got to see how the world around me reacted to my expression of these ambitions. And all I can say is, the fact that I wanted to be a scientist and astrophysicist was, hands down, the path of most resistance through the forces of society.

“Any time I expressed this interest teachers would say, ‘Don’t you want to be an athlete?’ I looked to become something that was outside the paradigms of expectation of the people in power. Fortunately, my depth of interest was so deep, and so fuel-enriched, that every one of these curveballs I was thrown, and fences built in front of me, and hills that I had to climb, I just reached for more fuel and I kept going.

“Now here I am, one—I think—one of the most visible scientists in the land, and I look behind me and say, ‘Where are the others who might have been this?’ And they’re not there. And I wonder how—who—what is the blood on the tracks that I happened to survive that others did not? Simply because of the forces of society that prevented, at every turn, at every turn, to the point that I have security guards following me as I go through department stores, presuming that I am a thief. I walked out of a store one time and the alarm went off, so they came running to me. I walked through the gate at the same time a white male walked through the gate. And that guy just walked off with the stolen goods, knowing that they would stop me and not him. That’s an interesting sort of exploitation of this; what a scam that was. I think people should do that more often. [laughter]

“So, my life experience tells me that when you don’t find blacks in the sciences, when you don’t find women in the sciences, I know that these forces are real, and I had to survive them in order to get where I am today.

“So before we start talking about genetic differences, you gotta come up with a system where there’s equal opportunity. Then we can have that conversation.”

[86] E. L. Uhlmann and G. L. Cohen, “‘I think it, therefore it’s true’: effects of self-perceived objectivity on hiring discrimination”, Organizational Behavior and Human Decision Processes 104 (2007), 207–223.

This article describes how our implicit biases are extremely invisible to us; consequently, the more we believe that we are unbiased, the more likely we are to act on our hidden biases and prejudices.

“This suggests that the conviction that one is objective (and by extension, that one’s beliefs and thoughts are as well) should increase the likelihood that an individual will act on his or her stereotypic beliefs and thoughts. Additionally, people confident in their own objectivity may overestimate their invulnerability to bias, and thus fail to correct for the influence of stereotypic biases that they might have otherwise been careful to monitor.”

“[A] sense of personal objectivity led people to act on group-based biases they might have otherwise suppressed or held with greater tentativeness.”

“[T]he rational actor ideal can exacerbate bias when it is applied descriptively. When people believe that they are objective, rational actors, they may be more likely to do what they think is correct, and at the same time less
likely to take into account alternative viewpoints. However, as Study 3 indicates, what people think is correct can arise not simply from stereotypic beliefs, but from incidental, environmentally primed concepts like ‘pink’ and ‘Barbie’.

“When people feel that they are objective, rational actors, they act on their group-based biases more rather than less. . . . Indeed, from the actor’s perspective, it may seem rational to act on stereotypic thoughts that, though they may arise from incidental environmental cues, subjectively feel like objective reflections of reality.”

[87] D. H. Uttal, Beliefs about genetic influences on mathematics achievement: A cross-cultural comparison, Genetica 99 (1997), 165–172.

From the abstract: “Contrary to the beliefs of many Americans, the East Asian advantage in mathematics is probably not due to a genetically-based advantage in mathematics. Instead, differences in beliefs about the role of genetics may be partly responsible. Asians strongly believe that effort plays a key role in determining a child’s level of achievement, whereas Americans believe that innate ability is most important. In addition, despite the relatively poor performance of their children, American parents are substantially more satisfied with their children’s performance than Asian parents. The American emphasis on the role of innate ability may have several consequences for children’s achievement. For example, it may lead children to fear making errors and to expend less effort on mathematics than their Asian counterparts.”

[88] V. Valian, Recruitment and retention: guidelines for chairs, heads, and deans, The Gender Equity Project, Hunter College, City University of New York, updated February 2011.
http://www.hunter.cuny.edu/genderequity/resources/equitymaterials (accessed November 17, 2014)

[89] V. Valian, D. Sperber, et al., For gender equality at academic conferences, http://forgenderequalityatconferences.blogspot.fr ; http://www.gopetition.com/petitions/commitment-to-gender-equity-at-scholarly-conferences.html (accessed July 28, 2014)

These web sites announce a movement for academics to commit themselves to appropriate representation of women and men at academic conferences. Included are an online petition and a thoughtful list of frequently asked questions, two of which are quoted here.

“Q. To the best of my knowledge, I am unbiased. I resent the idea that bias against women is at work in the invitations I make.

“A. The word ‘bias’ here is not meant to imply deliberate bias. Although there may be deliberate cases, those are not the ones we are concerned about. Rather, we are concerned about the subtle, unintentional examples. Men’s names come to mind more readily than women’s, leading to more invitations to men, leading to greater visibility for men, leading to yet easier availability of men’s names. Both men and women, to the same extent, tend to evaluate women more negatively than men in professional contexts.”

“An analogy with geographical distribution may be helpful. Organizers of international conferences often make an attempt to have geographical diversity, even if it takes more time and effort.”

“Q. To invite women, I would have to go slightly off-topic.

“A. In our experience, not everyone fits neatly into a program, even when they are all men or all women. Themes are sometimes loosely adhered to. Make sure you are not using different criteria for men and women; you don’t want to require that women adhere more closely to the theme than men do. Also, in the very choice and description of topics, you may have been influenced by the competencies and interests of the people you initially had in mind to invite. If you had thought of more women to invite, you might have ended up formulating a somewhat different but no less interesting and relevant topic. The choice of topics itself may not always be gender-neutral.”

[90] D. van Dijk, O. Manor, and L. B. Carey, Publication metrics and success on the academic job market, Current Biology 24 (2014), no. 11, R516–R517.

This article shows how men are more likely to become principal investigators (PIs) on academic research laboratories and groups, even correcting for other variables.
“Men are overrepresented as PIs, yet even after correcting for all other publication and non-publication derived features, being male is positively predictive of becoming a PI. . . . Given the same publication record, men are more likely than women to become PIs” (a figure of 7% more likely is given elsewhere in the paper).

[91] K. Wellhousen, Do’s and don’ts for eliminating hidden bias, Childhood Education 73 (1996), no. 1, 36–39.
This article describes how classroom teachers unconsciously favor boys over girls, to the detriment of the girls’ education and self-image. It also gives recommendations for teachers wishing to avoid such unequal treatment.

“Boys quickly raise their hands to respond or contribute to discussions, wave their hand around and up and down, change the arm they have raised when it gets tired, jump out of their seat and make noise or plead with the teacher to call on them. Girls, however, raise their hand but will soon put it down if they are not acknowledged. As a result, teachers call on boys and interact with them most of the time, while girls’ passive, compliant behavior often means they are ignored.”

“In addition to allowing boys more time to respond, teachers often extend boy’s answers by asking a follow-up question or by asking them to support their previous response. Girls are more likely to receive an ‘accepted’ response from teachers such as ‘Okay’ or ‘Uh-huh.’ . . . These behaviors send a very negative message about the importance of girls’ contributions to class discussions.”

“Boys call out answers (when the teacher does not call on them) eight times more often than girls do. . . . Teachers often respond to boys’ calling out, thus reinforcing the behavior. When girls call out, however, teachers are more likely to remind them that they are not following the class rules.”

Many references are given to the book *Failing At Fairness: How our schools cheat girls* (Scribner, 1995) by M. Sadker and D. Sadker, which would be an excellent source for further reading.

[92] C. Wennerås and A. Wold, Nepotism and sexism in peer-review, Nature 387 (1997), 341–343.
This article describes some of the strongest research we found on the inability of peer reviewers to ignore gender stereotypes in evaluating academics’ work.

“Our study strongly suggests that peer reviewers cannot judge scientific merit independent of gender. The peer reviewers overestimated male achievements and/or underestimated female performance. . . .”

“Did men and women with equal scientific productivity receive the same competence rating by the MRC reviewers? No! As shown in Fig. 1 for the productivity variable ‘total impact’, the peer reviewers gave female applicants lower scores than male applicants who displayed the same level of scientific productivity. In fact, the most productive group of female applicants, containing those with 100 total impact points or more, was the only group of women judged to be as competent as men, although only as competent as the least productive group of men (the one whose members had fewer than 20 total impact points).”

“If for a female scientist to be awarded the same competence score as a male colleague, she needed to exceed his scientific productivity by 64 impact points.

“This represents approximately three extra papers in Nature or Science . . . or 20 extra papers in a journal with an impact factor of around 3, which would be an excellent specialist journal. . . . Considering that the mean total impact of this cohort of applicants was 40 points, a female applicant had to be 2.5 times more productive than the average male applicant to receive the same competence score as he. . . .”

[93] Women in Number Theory, Female Number Theorists.
http://womeninnumbertheory.org/index.php?option=com_content&view=section&id=6&Itemid=13 (accessed November 17, 2014)

[94] WISELI, online brochures and booklets, Women in Science & Engineering Leadership Institute (Madison). Advancing women in science and engineering: advice to the top, http://wiseli.engr.wisc.edu/docs/AdviceTopBrochure.pdf; Benefits and challenges of diversity in academic settings, http://wiseli.engr.wisc.edu/docs/Benefits_Challenges.pdf; Fostering success for women in science and engineering, http://wiseli.engr.wisc.edu/docs/FosteringSuccessBrochure.pdf; Reviewing applicants: research on bias and assumptions, http://wiseli.engr.wisc.edu/docs/BiasBrochure_3rdEd.pdf. Accessed July 28, 2014.
These are four brochures published by the Women in Science & Engineering Leadership Institute, presumably for the express purpose of introducing institutions to the problems of gender-based inequality in STEM fields, some of their causes, and some ways to overcome the problems and the benefits of doing so.

*Benefits and challenges of diversity in academic settings* contains, among other information, a list of “Top 10 Tips for Academic Leaders to Accelerate the Advancement of Women in Science and Engineering”.

*Fostering success for women in science and engineering* gives the following summary of its contents: “Four main factors are responsible for the relatively low representation of women in leadership positions in academic science and engineering: Subtle bias; Discrimination and harassment; Lack of role models and encouragement; Work-life balance”

We obtained quite a few sources of information by looking through the citations in *Benefits and challenges of diversity in academic settings* and *Reviewing applicants: research on bias and assumptions*.

[95] WISELI, Searching for Excellence & Diversity: A guide for search committees, Women in Science & Engineering Leadership Institute (Madison), 2012.

As the title indicates, this is a set of practices and recommendations that search committees can use to mitigate the effects of gender-based implicit biases on their decisions.

“Element III, ‘Raise Awareness of Unconscious Assumptions and their Influence on Evaluation of Applicants’, presents research findings from a variety of disciplines (including cognitive psychology, social psychology, economics, and organizational behavior) that demonstrate how unconscious assumptions can influence the evaluation of applicants.”

“Element IV, ‘Ensure a Fair and Thorough Review of Applicants’, relies on research findings to suggest methods for overcoming the influence of unconscious bias and assumptions on the evaluation of applicants. It also provides suggestions and instruments for conducting equitable evaluations.”

**APPENDIX: GENDER DATA FOR CONFERENCES, PRIZES, AND EDITORIAL BOARDS**

This section contains all of the data used to calculate the statistics reported in Section 1.2 of [55]; we are grateful to W. Miao for gathering this data. In the tables below, the column heading FS counts the number of female speakers (in which we include also panelists, prizewinners, and editors), TS the total number of speakers, FO the number of female organizers (in which we include also moderators, chairs, and introducers), and TO the total number of organizers. Genders were determined via internet searches. Asterisks (*, **, ****) represent one, two, or three speakers whose genders could not be determined; these speakers were not counted in the total number of speakers.

**Joint AMS/MAA Winter Meeting, Baltimore, January 2014**

| Session                                         | FS | TS | FO | TO |
|-------------------------------------------------|----|----|----|----|
| Continuing Influence of Paul Erdős in Number Theory | 1  | 6  | 0  | 2  |
| Graphs Don’t Have to Lie Flat: The Shape of Topological Graph Theory | 2  | 4  | 1  | 2  |
| Mathematics and Effective Thinking               | 5  | 11 | 0  | 1  |
| Six Crash Courses on Mapping Class Groups        | 2  | 7  | 0  | 2  |
| Uniform Distribution, Discrepancy, and Related Fields | 0  | 6  | 1  | 2  |
| Unreasonable Effectiveness of Modern Mathematics | 1  | 4  | 1  | 2  |
### Invited Addresses

| Category                                      | FS | TS |
|----------------------------------------------|----|----|
| Joint Invited Addresses                      | 0  | 3  |
| AMS Invited Addresses                        | 1  | 7  |
| MAA Invited Addresses                        | 3  | 7  |
| Invited Addresses of Other Organizations     | 3  | 10 |

### AMS Special Sessions

| Session                                                                 | FS | TS | FO | TO |
|------------------------------------------------------------------------|----|----|----|----|
| Accelerated Advances in Higher Order Invexities/Univexities with Applications to Optimization and Mathematical Programming | 2  | 10 | 0  | 2  |
| Advances in Analysis and PDEs                                          | 5  | 14 | 0  | 2  |
| Algebraic Geometry*                                                    | 1  | 11 | 0  | 2  |
| Algebraic Structures Motivated by Knot Theory                          | 11 | 22 | 1  | 5  |
| Algebraic and Analytic Aspects of Integrable Systems and Painlevé Equations | 3  | 14 | 0  | 3  |
| Analytic Number Theory                                                 | 6  | 24 | 0  | 3  |
| Applied Harmonic Analysis: Large Data Sets, Signal Processing, and Inverse Problems | 2  | 12 | 0  | 3  |
| Banach Spaces, Metric Embeddings, and Applications                     | 1  | 14 | 1  | 2  |
| Big Data: Mathematical and Statistical Modeling, Tools, Services, and Training | 2  | 6  | 0  | 1  |
| Categorical Topology                                                   | 0  | 10 | 0  | 2  |
| The Changing Education of Preservice Teachers in Light of the Common Core | 12 | 19 | 2  | 4  |
| Classification Problems in Operator Algebras                           | 2  | 17 | 0  | 2  |
| Communication of Mathematics via Interactive Activities                | 4  | 10 | 0  | 2  |
| Complex Dynamics, I (a Mathematics Research Communities Session)       | 9  | 20 | 1  | 3  |
| Computability in Geometry and Topology                                 | 4  | 15 | 0  | 2  |
| De Bruijn Sequences and Their Generalizations                          | 2  | 12 | 0  | 2  |
| Deformation Spaces of Geometric Structures on Low-Dimensional Manifolds | 4  | 17 | 2  | 4  |
| Difference Equations and Applications                                  | 2  | 14 | 0  | 1  |
| Dispersive and Geometric Partial Differential Equations                | 4  | 18 | 0  | 3  |
| Ergodic Theory and Symbolic Dynamics                                   | 6  | 22 | 1  | 2  |
| Fractal Geometry: Mathematics of Fractals and Related Topics           | 2  | 20 | 0  | 4  |
| Fractional, Stochastic, and Hybrid Dynamic Systems with Applications   | 4  | 20 | 1  | 3  |
| Geometric Applications of Algebraic Combinatorics                      | 10 | 24 | 2  | 2  |
| Geometric Group Theory, I (a Mathematics Research Communities Session) | 5  | 20 | 1  | 4  |
| Global Dynamics and Bifurcations of Difference Equations               | 3  | 15 | 0  | 2  |
| Graph Theory: Structural and Extremal Problems                         | 1  | 22 | 0  | 2  |
| Heavy Tailed Probability Distributions and Their Applications          | 0  | 12 | 0  | 2  |
| Highlighting Achievements and Contributions of Mathematicians of the African Diaspora | 5  | 14 | 1  | 2  |
| History of Mathematics                                                 | 8  | 22 | 2  | 3  |
| Homological and Characteristic p Methods in Commutative Algebra         | 8  | 22 | 0  | 3  |
| Homotopy Theory                                                        | 7  | 22 | 0  | 5  |
| Hyperplane Arrangements and Applications*                               | 2  | 19 | 0  | 3  |
| Logic and Probability                                                  | 3  | 20 | 2  | 4  |
| Mathematics and Mathematics Education in Fiber Arts                     | 8  | 12 | 2  | 2  |
| Mathematics in Natural Resource Modeling                               | 6  | 15 | 2  | 2  |
| Mathematics of Computation: Differential Equations, Linear Algebra, and Applications* | 5  | 15 | 1  | 2  |
### AMS Special Sessions (continued)

| Session                                                                 | FS | TS | FO | TO |
|------------------------------------------------------------------------|----|----|----|----|
| My Favorite Graph Theory Conjectures                                   | 3  | 19 | 1  | 2  |
| Nineteenth Century Algebra and Analysis                                | 2  | 10 | 1  | 3  |
| Nonlinear Systems: Polynomial Equations, Nonlinear PDEs, and Applications | 0  | 20 | 0  | 1  |
| Outreach for Mathematically Talented Youth                            | 9  | 15 | 2  | 3  |
| Progress in Free Analysis and Free Probability                         | 2  | 15 | 0  | 2  |
| Quantum Walks, Quantum Computation, and Related Topics***             | 0  | 14 | 0  | 4  |
| Random Matrices: Theory and Applications                               | 1  | 10 | 0  | 2  |
| Reaction Diffusion Equations and Applications                          | 4  | 16 | 0  | 2  |
| Recent Advances in Homogenization and Model Reduction Methods for Multiscale Phenomena | 3  | 16 | 1  | 2  |
| Recent Progress in Geometric and Complex Analysis                     | 3  | 19 | 0  | 3  |
| Recent Progress in Multivariable Operator Theory                      | 7  | 22 | 0  | 2  |
| Recent Progress in the Langlands Program                              | 0  | 18 | 0  | 2  |
| Regularity Problem for Nonlinear PDEs Modeling Fluids and Complex Fluids, I (a Mathematics Research Communities Session) | 5  | 20 | 0  | 4  |
| Representation Theory of p-adic Groups and Automorphic Forms          | 1  | 8  | 0  | 2  |
| Research in Mathematics by Undergraduates and Students in Post-Baccalaureate Programs | 16 | 30 | 1  | 6  |
| Set-Valued Optimization and Variational Problems with Applications    | 4  | 16 | 1  | 4  |
| Symplectic and Contact Structures on Manifolds with Special Holonomy | 2  | 14 | 1  | 3  |
| Topological Graph Theory: Structure and Symmetry                       | 1  | 22 | 0  | 2  |
| Trends in Graph Theory                                                | 6  | 16 | 1  | 1  |
| Tropical and Nonarchimedean Analytic Geometry, I (a Mathematics Research Communities Session) | 4  | 20 | 1  | 3  |
| The Ubiquity of Dynamical Systems                                      | 3  | 9  | 1  | 2  |

### MAA General Contributed Paper Sessions

(2 female organizers, 3 total organizers)

| Session                                                                 | FS | TS |
|------------------------------------------------------------------------|----|----|
| Assessment and Outreach                                               | 3  | 6  |
| Assorted Topics I & II                                                 | 6  | 23 |
| Calculus                                                              | 4  | 8  |
| History and Philosophy of Mathematics                                 | 3  | 10 |
| Interdisciplinary Topics                                              | 4  | 4  |
| Mathematics Education I, II, & III                                    | 24 | 47 |
| Mathematics and Technology                                            | 4  | 9  |
| Modeling and Applications of Mathematics I, II, & III*                | 20 | 43 |
| Probability and Statistics I & II*                                    | 7  | 24 |
| Research in Algebra and Topology I & II*                              | 7  | 21 |
| Research in Analysis                                                 | 2  | 7  |
| Research in Applied Mathematics I & II                                | 4  | 30 |
| Research in Geometry and Linear Algebra                               | 2  | 13 |
| Research in Graph Theory and Combinatorics I, II, & III               | 12 | 44 |
| Research in Number Theory I & II*                                     | 1  | 22 |
| Teaching Introductory Mathematics*                                    | 3  | 11 |
| Teaching Mathematics Beyond the Calculus Sequence                     | 3  | 8  |
| Session                                                                 | FS | TS |
|------------------------------------------------------------------------|----|----|
| Algebraic Geometry                                                     | 3  | 21 |
| Analysis and Partial Differential Equations                            | 4  | 13 |
| Applied Mathematics I: Mechanics, Fluids, Waves                       | 4  | 15 |
| Applied Mathematics II*                                                | 4  | 11 |
| C*-Algebras and Analysis                                               | 2  | 9  |
| Combinatorics and Number Theory                                        | 3  | 16 |
| Combinatorics I & II                                                  | 12 | 29 |
| Commutative Algebra and Homological Methods                            | 5  | 12 |
| Complex and Geometric Analysis                                         | 3  | 11 |
| Difference Equations, Approximations, Sequences, and Special Functions | 4  | 13 |
| Differential and Integral Equations and Their Applications             | 2  | 12 |
| Fractal Geometry, Complex Dynamics, and Dynamical Systems              | 5  | 16 |
| Game Theory and Computing                                              | 4  | 11 |
| Geometric Applications of Combinatorics and K-Theory                  | 5  | 14 |
| Geometry and General Topology**                                        | 5  | 19 |
| Graph Theory                                                           | 4  | 12 |
| Group Theory                                                           | 6  | 19 |
| History of Mathematics*                                                | 6  | 12 |
| Knots and Their Invariants                                            | 5  | 11 |
| Knots, Topological Graphs, and Algebraic Topology                      | 5  | 19 |
| Lattices, Polynomials, and Linear Algebra                              | 3  | 13 |
| Logic and Probability                                                  | 6  | 16 |
| Mathematical Modeling and Mathematical Biology                         | 7  | 12 |
| Mathematics Education                                                  | 9  | 12 |
| Natural Resource Modeling and Mathematical Biology*                    | 7  | 15 |
| Noncommutative Algebra and Lie Theory                                  | 2  | 13 |
| Number Theory I & II*                                                  | 6  | 22 |
| Numerical Methods and Computing I & II                                 | 9  | 22 |
| Operator Theory and Banach Spaces                                     | 6  | 16 |
| Optimization, Calculus of Variations, Nonlinear Programming           | 7  | 14 |
| Partial Differential Equations                                         | 6  | 20 |
| Probability and Stochastic Dynamical Systems                           | 9  | 17 |
| Statistical Modeling, Big Data, and Computing                          | 7  | 12 |
| Structural and Extremal Problems in Graph Theory                       | 3  | 6  |
| Undergraduate Research in Algebra, Combinatorics and Number Theory     | 3  | 13 |
| Undergraduate Research in Analysis and Topology                        | 7  | 13 |
| Undergraduate Research in Applied Mathematics                          | 5  | 12 |
One of the aspects of the data in which we are interested is how having women among the organizers of a session is correlated with the proportion of female speakers in their sessions. J. Bryan performed a statistical analysis on the data from this JMM that includes organizers as well as speakers, fitting a binomial regression to the data using the percentage of female organizers as the explanatory variable and the percentage of female speakers as the outcome. As is standard, the data point corresponding to each session was weighted by the number of speakers in each session.

These data points, and the fitted function, are plotted in the figure on the next page. As Bryan (personal communication) writes: “The statistical significance of the term that capture the association between female proportion in speakers vs. organizers is extremely high. The ‘z-score’ is 7.146 and is something you can compare to a standard normal distribution. Therefore the ‘p-value’—i.e., the probability of seeing a result as or more extreme under the null of no association—is $8.91 \times 10^{-13}$."

| Session                                                                 | FS | TS | FO | TO |
|------------------------------------------------------------------------|----|----|----|----|
| Assessing Quantitative Reasoning and Literacy                          | 4  | 8  | 1  | 4  |
| Assessing Student Learning: Alternative Approaches                     | 16 | 32 | 2  | 5  |
| Assessment of Proof Writing Throughout the Mathematics Major          | 2  | 4  | 2  | 2  |
| Bridging the Gap: Designing an Introduction to Proofs Course           | 8  | 13 | 1  | 1  |
| Data, Modeling, and Computing in the Introductory Statistics Course    | 8  | 15 | 0  | 3  |
| Flipping the Classroom                                                 | 15 | 38 | 2  | 2  |
| History of Mathematical Communities                                    | 4  | 10 | 2  | 2  |
| Innovative and Effective Ways to Teach Linear Algebra                  | 5  | 15 | 1  | 3  |
| Instructional Approaches to Increase Awareness of the Societal Value   | 4  | 8  | 2  | 2  |
| Mathematics and Sports                                                 | 19 | 40 | 0  | 1  |
| Is Mathematics the Language of Science?                                | 0  | 7  | 0  | 3  |
| Mathematics Experiences in Business, Industry, and Government         | 5  | 17 | 1  | 3  |
| Mathematics Experiences in Business, Industry, and Government         | 5  | 24 | 0  | 2  |
| Open Source Mathematics Textbooks                                     | 1  | 15 | 0  | 2  |
| Programs and Approaches for Mentoring Women and Minorities in Mathematics | 7 | 8 | 2 | 2 |
| Projects, Demonstrations, and Activities that Engage Liberal Arts Mathematics Students | 13 | 22 | 1 | 1 |
| Putting a Theme in a History of Mathematics Course                     | 4  | 9  | 0  | 2  |
| Reinventing the Calculus Sequence                                      | 1  | 8  | 0  | 2  |
| Research on the Teaching and Learning of Undergraduate Mathematics     | 6  | 19 | 1  | 3  |
| Scholarship of Teaching and Learning in Collegiate Mathematics         | 9  | 15 | 2  | 5  |
| Student Activities                                                     | 9  | 20 | 2  | 2  |
| Teaching with Technology: Impact, Evaluation, and Reflection           | 6  | 23 | 0  | 1  |
| Topics and Techniques for Teaching Real Analysis                      | 5  | 18 | 0  | 4  |
| Trends in Undergraduate Mathematical Biology Education                 | 4  | 12 | 0  | 1  |
| USE Math: Undergraduate Sustainability Experiences in the Introductory Mathematics Classroom | 5 | 9 | 2 | 3 |
| Using Online Resources to Augment the Traditional Classroom           | 5  | 17 | 0  | 2  |
| Wavelets in Undergraduate Education                                   | 5  | 12 | 1  | 3  |
| We Did More with Less: Streamlining the Undergraduate Mathematics Curriculum | 3 | 5 | 1 | 2 |
### The 2014 ICM in Seoul

#### Invited ICM Panels

| Panel                                                                 | FS | TS | FO | TO |
|-----------------------------------------------------------------------|----|----|----|----|
| Panel 1. Why STEM?                                                    |    |    |    |    |
| Panel 2. How should we teach better?                                  |    | 3  |    |    |
| Panel 3. Mathematics is everywhere                                    | 0  | 3  | 1  | 1  |
| Panel 4. R&D policy (ERC+NRF)                                         | 0  | 4  | 0  | 1  |
| Panel 5. IMAGINARY - Panel: Math communication for the future - a Vision Slam | 1  | 4  | 0  | 1  |

#### Panels organized by IMU

| Panel                                                      | FS | TS | FO | TO |
|------------------------------------------------------------|----|----|----|----|
| Panel 1. Mathematical Massive Open Online Courses          | 0  | 4  | 0  | 1  |
| Panel 2. Future of Publishing                              | 1  | 6  | 0  | 1  |
| Panel 3. World Digital Mathematics Library                 | 2  | 5  | 0  | 1  |
### ICM Sections

| Section                                           | FS | TS |
|---------------------------------------------------|----|----|
| Plenary Lectures                                  | 1  | 20 |
| Algebra                                           | 2  | 9  |
| Algebraic and Complex Geometry                    | 0  | 11 |
| Analysis and its Applications                      | 3  | 17 |
| Combinatorics                                     | 3  | 11 |
| Control Theory and Optimization                   | 1  | 6  |
| Dynamical Systems and Ordinary Differential Equations | 2  | 11 |
| Geometry*                                         | 2  | 15 |
| History of Mathematics                            | 0  | 3  |
| Lie Theory and Generalizations                    | 1  | 11 |
| Logic and Foundations                             | 1  | 6  |
| Mathematical Aspects of Computer Science          | 1  | 8  |
| Mathematical Physics                              | 2  | 12 |
| Mathematics Education and Popularization of Mathematics (panels) | 2  | 8  |
| Mathematics Education and Popularization of Mathematics (speakers) | 1  | 3  |
| Mathematics in Science and Technology             | 5  | 10 |
| Number Theory                                     | 1  | 15 |
| Numerical Analysis and Scientific Computing       | 1  | 6  |
| Partial Differential Equations                    | 3  | 13 |
| Probability and Statistics                        | 0  | 13 |
| Topology                                          | 0  | 10 |

### Mathematics Awards

#### AMS Prizes

| Prize                                                                 | FS | TS |
|-----------------------------------------------------------------------|----|----|
| George David Birkhoff Prize in Applied Mathematics                    | 1  | 16 |
| Bocher Memorial Prize                                                 | 0  | 33 |
| Frank Nelson Cole Prize in Algebra                                    | 0  | 26 |
| Frank Nelson Cole Prize in Number Theory                              | 0  | 29 |
| Levi L. Conant Prize                                                  | 1  | 18 |
| Joseph L. Doob Prize                                                  | 0  | 6  |
| Leonard Eisenbud Prize for Mathematics and Physics                    | 0  | 5  |
| Delbert Ray Fulkerson Prize**                                         | 3  | 65 |
| E. H. Moore Research Article Prize                                   | 0  | 6  |
| Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student | 3  | 19 |
| David P. Robbins Prize                                               | 1  | 4  |
| Ruth Lyttle Satter Prize in Mathematics                               | 13 | 13 |
| Leroy P. Steele Prize for Lifetime Achievement                        | 1  | 25 |
| Leroy P. Steele Prize for Mathematical Exposition                     | 1  | 29 |
| Leroy P. Steele Prize for Seminal Contribution to Research            | 1  | 34 |
| Oswald Veblen Prize in Geometry                                       | 0  | 29 |
| Albert Leon Whiteman Memorial Prize                                  | 0  | 4  |
| Norbert Wiener Prize in Applied Mathematics                           | 0  | 13 |
Other Prizes

| Prize        | FS | TS |
|--------------|----|----|
| Abel Prize   | 0  | 14 |
| Fields Medal | 1  | 56 |

Editorial Boards of Mathematics Journals

These ten journals were selected by consulting multiple lists of the “top” mathematics journals. The list of journals was finalized before looking at any of their editorial boards, to avoid biasing the sample. The editorial boards (as of October 2014) were then located on the internet, and the genders of their members determined via internet searches.

| Journal                                                                 | FS | TS |
|------------------------------------------------------------------------|----|----|
| Acta Mathematica                                                       | 0  | 9  |
| Annals of Mathematics                                                  | 0  | 12 |
| Annales Scientifiques de l’École Normale Supérieure                    | 2  | 9  |
| Communications on Pure and Applied Mathematics                         | 0  | 13 |
| Duke Mathematical Journal                                             | 1  | 22 |
| Inventiones Mathematicae                                              | 0  | 10 |
| Journal für die Reine und Angewandte Mathematik                       | 0  | 5  |
| Journal of Differential Geometry                                      | 0  | 15 |
| Journal of the American Mathematical Society                           | 4  | 26 |
| Proceedings of the London Mathematical Society                         | 4  | 45 |