Genes to Cells

COMMENTARY

Maximizing the Potential of Scientists in Japan: promoting equal participation for women scientists through leadership development

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In order to examine the current status of gender equality in academic societies in Japan, we inquired about the number of women involved in leadership activities at society conferences and annual meetings, as these activities are critical in shaping scientific careers. Our findings show a clear bias against female scientists, and a need to raise consciousness and awareness in order to move closer to equality for future generations.

The objective of promoting gender equality is to create a society where every citizen can develop his/her intellectual capacity to the fullest regardless of gender. In Japan, the government has implemented various measures to break down the traditionally male-dominated culture, starting with the enactment of Japan's equivalent of the US Equal Employment Opportunity Act in 1985 and the Basic Act for Gender-Equal Society in 1999. However, the progress has been slow. At present, the Gender Gap Index of Japan is 98th among 135 countries (The World Economic Forum's Global Gender Gap Report 2011). It is even more pronounced in the field of science and technology, where the percentage of female scientists[†] in Japan is at 13.8%, the lowest among developed countries (based on data for 2011 (Fig. S1). The lack of female scientists is not entirely due to the size of the talent pool. In 2009, the percentage of female students enrolled in undergraduate programs in fields of Natural Science was 27.2% (20.7% for doctorate programs) (National Institute of Science and Technology Policy 2011). However, at the assistant professor level, the percentage of women in the sciences is only 13.6% on average (Fig. S2). Clearly, Japan has a considerable and as yet untapped supply of female scientists.

In order to investigate why Japan is so slow in maximizing the potential of female scientists, the Japan Inter-Society Liaison Association Committee for Promoting Equal Participation of Men and Women in Science and Engineering (EPMEWSE[‡]) conducted a comprehensive survey of approximately 20 000 members of the 67 EPMEWSE societies. The result (EPMEWSE 2008) identified two key factors. First, female scientists have difficulty in balancing work and child-rearing responsibilities. Second, female scientists find it difficult to re-enter the workforce after a break in career due to major life events. University faculty members in Japan, regardless of sex, are expected to spend approximately

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[†]For the purpose of this article, "Scientists" refers to professionals trained in science, technology, engineering and mathematics (STEM).

[‡]EPMEWSE was established in 2002 to promote gender equality in science and engineering, consisting of 67 professional STEM societies in Japan.

DOI: 10.1111/gtc.12065

70 hours per week on research in addition to their academic duties. Female scientists in Japan suffer a heavier burden when faced with such long working hours. Data also showed that although 50% of the spouses of male researchers are full-time homemakers, some 70% of female scientists' spouses are employed in similar fields (Fig. S3). These 'Dual Career' couples often face difficulty in finding appropriate positions in the same geographical area, and as a result require one of the partners to accept a less-valued position or give up on a career. Altogether, this situation puts female scientists at a greater disadvantage, brings hardship to the family and is a great loss of potential productivity for society.

The Japanese government recognized the importance of increasing the participation of women in the science, technology, engineering and mathematics (STEM) workforce. Under 'the 3rd Science and Technology Basic Plan (FY2006-FY2010)', the Ministry of Education, Culture, Sports, Science and Technology (MEXT) instituted two new programs designed to increase the number of female scientists, informed in part by the above-mentioned EPMEWSE survey. The first one was a 3-year program called 'Supporting Activities for Female Researchers' initiated in 2006, and renewed in 2011 for additional 3 years under a new name 'Supporting Research Activities of Female Researchers'. This program was implemented at universities/research institutes to improve the institutional support system for female scientists on campus. To date, 88 universities and research institutes throughout Japan have received funding from these MEXT programs and have been improving their work environments. These include the availability of on-campus childcare facilities or a standing pool of research assistants ready to be assigned to scientists needing to take time off from research because of family obligations, allowing them to maintain active research programs (Tohoku Women's Hurdling Project; Tohoku University, FResHU Project; Hokkaido University). The second MEXT program is a 5-year program called 'Supporting Positive Activities for Female Researchers' initiated in 2009, which focuses on increasing the number and promotion rate of female faculty at universities. As a result, some universities have seen a significant increase in the number of female faculty, especially in positions of greater responsibility (Women Researchers Promotion Project; Kyushu University). While these success stories are encouraging, the number of institutions that have received MEXT funds is less than 10% of all Japanese universities. In addition, we were concerned that the reasons for the lack of representation of women scientists go beyond the difficulties of managing work and family obligations.

Visibility survey of female scientists

As follow-on to the above-mentioned study, we investigated how female scientists are viewed as leaders and decision-makers. In 2010, we organized an ad hoc working group to conduct a survey on the visibility of female scientists, in collaboration with seven professional societies selected from the 67 EPMEWSE member societies. These societies were in the field of biological sciences, where women made up 20-25% of the general membership, significantly higher than the percentage, 5–15%, in engineering and physical sciences.

We collected data showing how female scientists are being recognized in a visible manner within the professional societies. In this survey, we focused on the following two activities as a measure of recognition of leadership ability: (I) serving as organizers and/or invited speakers at symposia and workshops and (II) receiving prestigious awards. We targeted activity (I) based on the assumption that persons of leadership status would be more likely to become organizers of symposia or workshops and to be invited as speakers than not. For this activity, we collected data on the percentage of female scientists who gave talks at annual meetings, as well as that of female scientists who served as organizers and/or invited speakers at symposia/workshops held as part of annual meetings. As for activity (II), receiving an award is an important part of a successful career path in any field, as it would raise one's visibility as a researcher. For the award study, we used the Japanese Society of Plant Physiology (JSPP) as a model to collect data on the number of female scientists receiving prestigious awards over the period of 10 years from 2001 to 2010. Concurrently, we surveyed how many female members were included in the award selection committee in each corresponding year. The aim was to determine whether there was a bias against female scientists in the selection process.

Results from these studies clearly showed that few women are in visible leadership roles. In terms of annual meeting speakers, the results showed an obvious discrepancy between membership ratio and leadership ratio. The ratio of women filling leadership roles, such as symposium/workshop organizers and invited speakers, was much lower than the female/

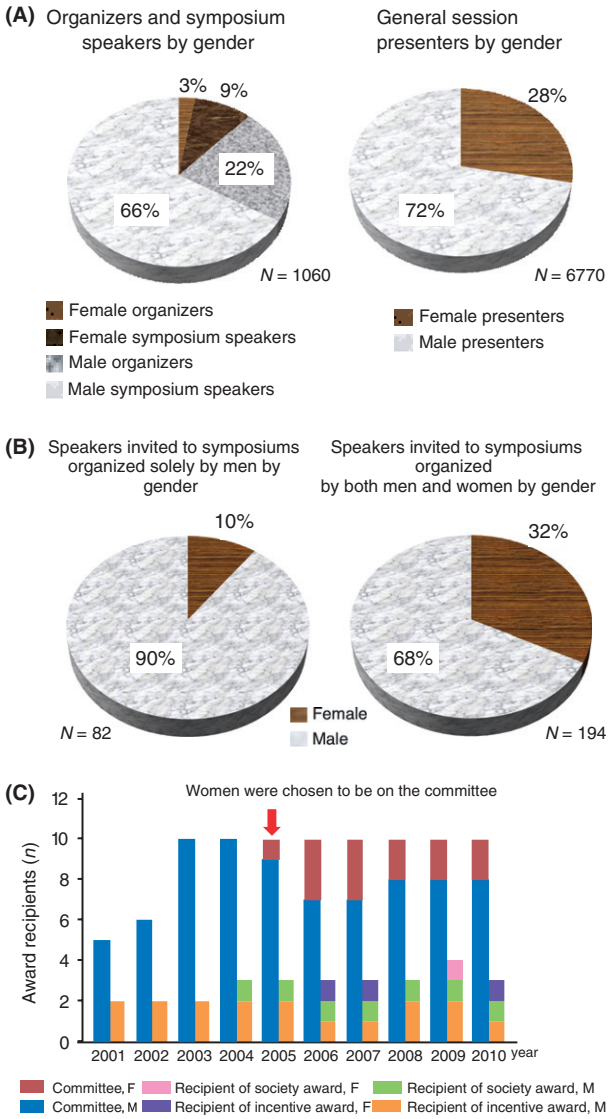

Figure 1 (A) Percentages of female leaders: Data were taken from annual meetings of MBSJ, JSPP, BSJ, GSJ and JSDS (FY2010). (B) Gender of organizers and a percentage of female speakers at annual meetings. Data were taken from BSJ (FY2008, 2009 and 2010). (C) Gender bias in the review process. Data were taken from JSPP (FY 2001–2010).

male ratio of all speakers. By combining the data from the seven societies, we found that the average percentage of female organizers was 3% and that of female invited speakers was 9%. In comparison, the ratio of female speakers in the general session was 28% (Fig. 1A). Possible reasons are identified in Fig. 1B, where the composition of selection committee members was factored into the data analysis. The ratio of female speakers invited to present papers in workshops organized by all-male committees was 10%, whereas the ratio jumped to 32% with the presence of just one female committee member. Several factors seem to lie at the root of this phenomenon. One might be unconscious bias on the part of male scientists when evaluating their female colleagues. Another is that there are simply too few women in positions of authority to provide well-qualified female scientists with the opportunity to participate in potentially career-enhancing activities. There is also evidence that female scientists themselves might tend to shy away from competing by underestimating themselves and not being assertive in seeking leadership status (Niederle & Vesterlund 2007).

In terms of whether or not a bias exists in the award process, analyses of JSPP's award recipients and processes indicated that the addition of a female member to the selection committee resulted in not only the first, but a successive string of award-winning female scientists (Fig. 1C). As in the case with speaker selection, the presence of some bias seems likely given that all-male selection committees favor male candidates. A similar type of bias was discovered in the American Physical Society (APS) in follow-up surveys over a period of 12 years, from 1997 to 2009, that compared the ratio of female awardees to that of female selection committee members (Lincoln *et al.* 2009). From the above results, we conclude that it is essential to promote female scientists into decision-making positions in order to increase their visibility. Interestingly, a study recently unveiled by the US National Academies notes as one of its three concluding themes, 'Critical role & impact of disciplinary societies: important organizational structures through which scientists and engineers build communities of practices, reward achievements and share information (Slide 13 from Didion *et al.* 2012). Raising consciousness among female scientists is a necessary first step to increasing their proportion in leadership and decision-making positions.

Conclusion and Discussion

We find that Japan is failing to take full advantage of the valuable resource in science. Biases against women in general and female scientists in particular are entrenched in the history and culture of Japan. Creating a mechanism for talented and qualified human resources to participate in society without gender bias requires a multi-faceted effort, involving all segments of society. Raising consciousness and awareness of issues among secondary education teachers and parents

is also necessary. Increasing the number of women in higher-level positions will create much-needed role models to help forge the way for future generations of female scientists. Universities and research institutions as well as academic societies can all do their part by engaging their local communities in outreach activities. Attaining gender equality will take a long sustained effort. In fact, activities in support of female researchers initiated in the U.S. in the 1980s have continued to evolve over the years, each constantly reflecting the needs of the times; such programs persist in providing vital strategies even today (NSF ADVANCE web site). In Japan, a long-term sustained strategy with support from government and universities is essential to bridge the gender gap and unlock the potential of female scientists (Homma *et al.* 2013).

Acknowledgements

We would like to thank Dr Machi Dilworth, Prof. Patricia Rankin, Dr Koichi Kitazawa and Dr Satoko Yoshida for their critical reading of this manuscript, helpful comments and discussions, Ms Natsuko Maruta for helping us in collecting data during this survey. The authors thank Drs Joanna Benette and Sanae M. Iguchi-Ariga for their encouragement. We thank EPMEWSE and seven scientific societies (MBSJ, JSPP, GSJ, BSJ, JNS, JSDB and JSHS) for their invaluable cooperation with the visibility survey. HO called M.K.H and R.M. for the ad hoc working group. M.K.H, R.M. and H.O. equally contributed to the design and execution of this work and to prepare this manuscript for publication.

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Received: 22 March 2013
Accepted: 8 April 2013

Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web site:

Figure S1 International comparison of the proportion of female researchers: The percentage stood at 13.8% as March 1, 2011. Data from "I. Facts and Figures/9. Education and Research Fields" in the pamphlet, "Women and Men in Japan (2012)" published by Gender Equality Bureau, Cabinet Office, Government of Japan. [Cited 21 Mar 2013.] Available from URL: http://www.gender.go.jp/english_contents/category/pub/pamphlet/women-and-men12/pdf/1-9.pdf.

Figure S2 Percentage of female university faculty members in Japan: The data comes from "School Basic Survey (FY2011)", Ministry of Education, Culture, Sports, Science and Technology. Each number indicates the percentage of female faculty members in universities in Japan. Note that female ratio of the faculty members in Science, Engineering and Agriculture is extremely low especially in higher positions.

Figure S3 The Gender Gap in Marital Statues in STEM in Japan. The Figures are taken from Fig. 1.58 and 1.60 in the Report of "Large-Scale Survey of Actual Conditions of Gender Equality in Scientific and Technological Professions (Large-Scale Survey of Actual Conditions of Gender Equality in Scientific and Technological Professions, by *EPMEWESE* 2008)". Abbreviations of the names of academic societies: MBSJ; Molecular Biology Society of Japan, JSPP; Japanese Society of Plant Physiologists, GSJ; Genetics Society of Japan, BSJ; Botanical Society of Japan, JNS; Japan Neuroscience Society, JSD; Japanese Society of Developmental Biologists, JSHS: Japanese Society for Horticultural Science.