Communications

ACE Forum on Women in research and higher degrees in the mathematical sciences

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The significant gender imbalance in the mathematical sciences, which starts in the primary and high school years and continues its way into universities and beyond, has been well documented over the years. Even though differences in numeracy achievement between boys and girls are small, by the time students reach the last years of secondary school, boys are more likely to choose the more advanced mathematics subjects than girls. In 2015, the percentage of students choosing intermediate mathematics in Year 12 as their 'highest' subject was 18 per cent for girls and 20.5 per cent for boys. The gender gap widens in advanced mathematics, with only 6.9 per cent of girls taking advanced mathematics in 2015 compared to 12.6 per cent of boys [1]. Universities therefore inherit a gender imbalance in the mathematical sciences, which stays intact for undergraduate students. We estimate that at universities the overall gender balance in undergraduate enrolments and completions in the mathematical sciences (and this includes service teaching to other departments) is around 65 : 35, which is (coincidental or otherwise) not dissimilar to the ratio of advanced mathematics students at high school.

However, this gender ratio is not maintained for female academic participation which, on the whole, tends to decline with increase in academic level. In 2015, only 17 per cent of associate professors, and 8 per cent of professors in the mathematical sciences were female [2]. Of course, one could argue that the current percentages of female associate professors and professors are the result of past inequality, and that the female academic participation will grow in the future. However, when we look at the entry pathway into academic careers — Honours/Masters followed by PhD degrees — it appears that the mathematical sciences are attracting proportionally fewer, rather than more Australian women.

It is against this background that on Friday 23 June, AMSI hosted a forum on Women in Research and Higher Degrees in the Mathematical Sciences, accessible via the ACE network. The forum was initiated and organised by Maaike Wienk (AMSI) to discuss and explore possible ways to counter the apparent drop in the number of female Honours and domestic PhD students in the Mathematical Sciences across Australia. The Chair for the forum was WIMSIG Chair Yvonne Stokes, and the program was as follows.

- Introduction by A/Prof Yvonne Stokes (The University of Adelaide)

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- Speakers:
  - Prof Peter Bouwknegt (Director Mathematical Sciences Institute, Australian National University)
  - A/Prof Inge Koch (AMSI CHOOSEMATHS Executive Director, The University of Adelaide)
  - Ms Courtney Darville (Honours student in Pure Mathematics, The University of Sydney)
  - Prof Cheryl Praeger (Professor of Mathematics, The University of Western Australia)
  - Ms Rheanna Mainzer (PhD Student, Statistics, La Trobe University)
- Discussion

Three of the speakers joined the forum electronically. There was an excellent audience estimated to be over 20 people, including some interstate people present by electronic means. Unfortunately, there were some technical difficulties leading to a temporary loss of video after the first speaker, which was restored just in time for the third speaker, both of whom were participating electronically.

In her introduction, Yvonne presented data for the period 2000–2014, here shown in Figures 1 and 2 which were taken from an AMSI report [3]. This report presents an analysis by AMSI of Honours and PhD completions in this period, as collected by Associate Professor Peter Johnston for the Australian Mathematical Society. She also presented the following key findings revealed by the data.

- 2004–2013: steady decrease in % female Honours completions; 33% → 23%.
- 2009: rapid increase in % female PhD completions; 28% → 35%.
- 2011–2013: rapid increase in international PhD completions; 32% → 51% of all female PhD completions.
- 2011–2013: rapid decrease in domestic female PhD completions; 24% → 17% of all PhD completions.

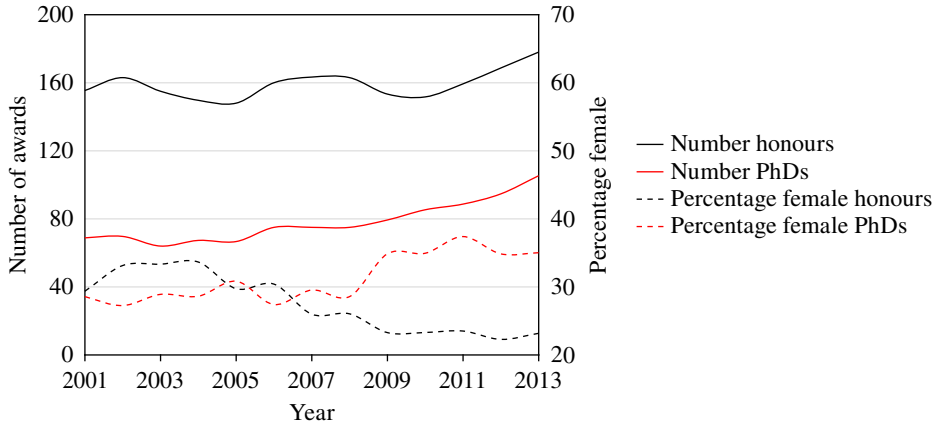

Figure 1. Total number of degrees alongside the percentage of females within each degree type, with a three-year moving average.

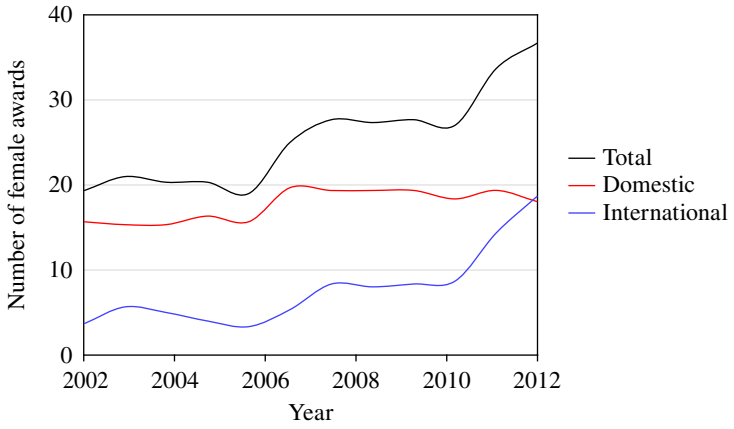

Figure 2. The number of domestic and international female PhD awards, with a three year moving average. Data from 27 institutions. Source: AMSI University Survey.

As already noted, the worrying trends in female Honours and domestic PhD completions were the focus of the forum.

Professor Peter Bouwknegt noted that these trends could not be seen in isolation of female staff on the payroll and described some initiatives at the ANU to increase the number of female staff including female-only positions in 2016, 50/50 short-list requirements and unconscious bias training. He also mentioned that mentoring of more junior students by more senior students seems to work better than mentoring by staff.

Associate Professor Inge Koch described the CHOOSEMATHS program, which aims to increase female participation in mathematics, and STEM more generally, from primary school through to university and beyond. CHOOSEMATHS is very actively involved in setting up networking opportunities for female university students at the AMSI flagship events (Summer School, Winter School, BioInfoSummer and the Vacation Research Scholarship program) and supplying travel grants and scholarships specifically aimed at female participants in AMSI events.

Ms Courtney Darville told us about the circumstances that she had found helpful and unhelpful as a woman in mathematics. Her father (who had studied mathematics himself) had fostered her interest in mathematics, and she obtained support through participation in a maths club in Year 12 with older girls mentoring younger girls. She also remembers enjoying an event organized by the Sydney University Maths society at which female speakers spoke about their career and research experiences in the field.

Professor Cheryl Praeger gave an interesting talk describing her own experiences in mathematics and mentioned that the first female mathematics professor, Hannah Neumann, had been a significant role model. Cheryl felt that role models and women mathematics lecturers were important for encouraging female students. She

also noted her positive experience of the flexible work environment that academia provided to her and highlighted the importance of having confidence in your own abilities.

The last speaker, Ms Rheanna Mainzer, described her long road to doing a PhD in statistics. Despite a childhood love of numbers, she had been told she wasn't up to the harder mathematics subjects in school and should take an easier road. Starting off with a double degree in Science and Finance, she did not initially see mathematics as a career option. However, gradually she chose more mathematics subjects, did an AMSI Vacation Research Scholarship and found a very supportive supervisor who encouraged her to apply for a PhD scholarship.

Following the speakers there was about a half hour for questions and discussion which seemed to pass very rapidly indeed. The positive influence of a good school teacher that encouraged girls to do maths seemed to be typical for the women who spoke. It was also noted that many of the women that go on to do Honours and PhDs are those that love and do maths despite the difficulties and that we need to find ways to find out what can be done for those that are put off.

It was noted that the Honours figures as collected by Peter Johnston, while including the two-year Masters by Coursework offered from 2010 by the University of Melbourne under the 'Melbourne Model', do not include Masters and similar degrees that are alternatives to Honours at other institutions. The picture is therefore not complete, and it is possible that the female participation across both Honours and Masters degrees taken together has been healthier in the last few years. Further data collection and analysis remains important to determine this.

The purpose of this forum was to start a discussion within the mathematical sciences on how to improve the retention of female students into research and higher degrees. Several participants and speakers have indicated they are interested in further discussion on the matter. We encourage everyone who wants to be part of further discussion to contact us.

References

[1] AMSI, Discipline profile of the mathematical sciences 2017. In press.
[2] AMSI Survey 2015 — Final Results, December 2016.
[3] AMSI, Gender Trends Across Universities in the Mathematical Sciences, Australian Mathematical Sciences Institute, (unpublished) July 2016.
[4] AMSI Survey 2014 — Final Results, December 2015.