THE GENDERING OF MATHEMATICS AMONG FACEBOOK USERS IN ENGLISH SPEAKING COUNTRIES

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Using an innovative recruitment tool, the social network site Facebook, survey data were gathered from samples of the Australian general public and from around the world. Views on the gendering of mathematics, science, and ICT were gathered. In this paper we report the findings from six of the 15 questions on the survey, and only from respondents in predominantly English-speaking countries. The findings reveal that the majority was not gender-stereotyped about mathematics and related careers. However, if a gendered view was held, it was overwhelming to endorse the male stereotype. Male respondents' views were more strongly gendered than were females'.

Prologue

The new focus on nature seems to be encouraging parents to indulge in sex differences even more avidly.... From girls' preschool ballet lessons and makeovers to boys' peewee football... the more we parents hear about hardwiring and biological programming, the less we bother tempering our pink and blue fantasies. (Freeman-Greene, 2009, p.11)

Providing a Context

Publication of student achievement data from large scale testings ensures that gender differences in mathematics learning continue to attract sustained attention from both the research and broader communities. Results from the Organisation for Economic Co-operation and Development's [OECD] Programme for International Student Assessment [PISA], for example, receive considerable media attention on their release. Such media reports on performance may include comments on gender differences. Often, however, simplified summaries of complex data are presented (Forgasz & Leder, 2011). This is not altogether surprising, given reporters' time and space constraints. That such media accounts often shape and sway public opinion, including views on gender issues, is well documented (e.g., Barnett, 2007; Jacobs & Eccles, 1985).

Possible Explanations for Gender Differences in Mathematics Achievements

Multiple explanations have been put forward for the persisting patterns of gender difference in mathematics achievement. After a detailed review of relevant literature, Halpern et al. (2007) concluded that the reasons for the overlap and differences in the performance of males and females were multifaceted, could not be explained by a single factor, and that "[e]arly experience, biological constraints, educational policy, and cultural context" (p. 41) could all play a part. Geist and King (2008) referred to pervasive societal beliefs about gender linked capabilities and their impact:

Many assumptions are made about differing abilities of girls and boys when it comes to mathematics. While on the 2005 NAEP girls lag only about 3 points behind boys, this is only a recent phenomenon. In the 1970's, girls actually outperformed boys in all but the 12th grade

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test.... assumptions about differing levels of ability pervade not just the classroom, but home. (pp. 43-44)

In their detailed model of achievement motivation, and implicitly of academic success, Wigfield and Eccles (2000) highlighted the influence on students' learning and behaviours not only of learner-related variables but also of the overall context in which learning occurs, that is the attitudes, actual and perceived, of critical "others" in the students' home, those at school, and societal expectations more generally.

Societal Expectations - Public Views about Mathematics: Gauging Public Opinion

Attempts to measure directly the general public's views about mathematics, science, or ICT, or the teaching of these subjects, or their impact on careers, are rare. With respect to mathematics, for example, more than two decades have passed since a genuine attempt was made by the Victorian (Australia) state government to gauge parents' attitudes towards their daughters' education and career (McAnalley, 1991). This exercise was linked to the state-wide media campaign, *Maths Multiplies Your Choices,* a program introduced to encourage parents to think more broadly about the likely influence of mathematics on their daughters' careers. Since that time, in Australia there has been no similar concerted, large scale, and appropriately funded, attempt to measure the general public's views about school mathematics, its link with technology, and possible career options.

A decade ago in the UK, Sam and Ernest (1998, p. 7) noted that "there are relatively few systematic studies conducted on the subject of myths and images of mathematics. We need an answer to the question: What are the general public's images and opinions of mathematics?" Lucas and Fugitt (2007) similarly argued that the public's views on mathematics and mathematics education were rarely sought. Yet, they found that Mid-West USA residents responding to a 10-item survey were generally interested in, and often well informed about, the way mathematics was taught in schools. The respondents generally believed that a good mathematics education offered young people a better and successful future; schools failed to offer effective mathematics education because too much emphasis was placed on technology and not enough on the basics; teachers often exerted too much pressure and criticism to the detriment of their students' attitudes to mathematics; and teachers should make learning mathematics more enjoyable. Issues such as these were also explored in the study reported in this paper. The general public's views about aspects of mathematics were explored. Also examined was whether or not the views expressed were gender stereotyped.

The Study

In the present study, data from respondents in countries in which English is the dominant language – Australia, Canada, Ireland, New Zealand, UK, and USA – were analysed. While data were also gathered from participants living in many other countries around the world, in this paper we focus predominantly on countries where English is the most commonly spoken language for the following reasons:

- In broad terms, cultural differences are small among citizens across these countries
- Almost without exception, the mathematics achievements of males in these countries are found to be superior to females'

All six countries participated in PISA 2009. The gender differences in the mean scores for these countries are shown in Figure 1 – the data were drawn from Thomson, De Bortoli, Nicholas, Hillman, and Buckley (2010).

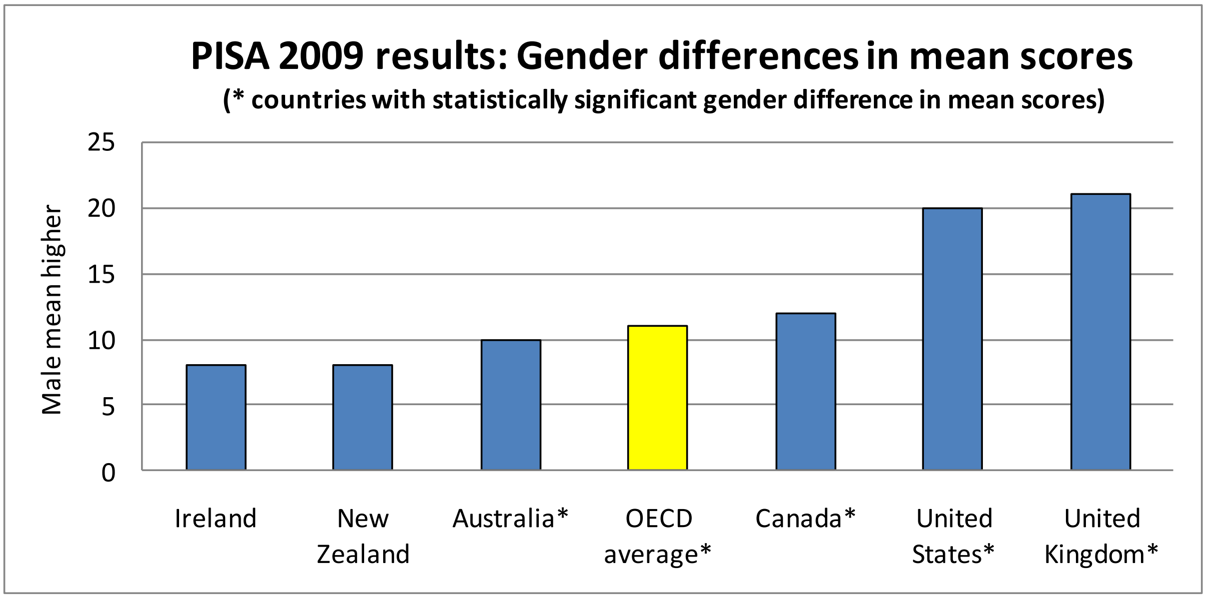

Figure 1. PISA 2009 results by country and gender difference in mean scores

From Figure 1 it can be inferred that there is much overlap in the performance of males and females. However, it is also apparent that males outperformed females in each country. As noted by Thomson et al. (2010), the differences in the mean scores were statistically significant for Australia, Canada, UK, and USA.

For many countries participating in the Trends in Mathematics and Science Study [TIMSS] in 2007, females' mean scores in mathematics were higher than males'. However, there were several countries, including all participating English-speaking countries, for which the reverse was true. Gender differences in favour of males were noted as follows at the Grade 4 and Grade 8 levels respectively: Australia (6 points, 16 points*), New Zealand (1 point, did not participate), England (1 point, 5 points*), Scotland (did not participate, 3 points) and USA (6 points*, 3 points) – see Thomson, Wernert, Underwood, and Nicholas (2008, pp. 59, 61). [NB. * indicates statistically significant gender differences.]

In this study, it was of particular interest to determine if members of the general public in English speaking countries held views that might support the hypothesis that performance differences are consistent with the perceptions of society at large with respect to the gendering of mathematics learning outcomes.

The data presented in this paper are a subset of a larger study which involved gathering data from 12 different heavy foot-traffic sites throughout Victoria (see Leder & Forgasz, 2010 for details) as well as from an 'advertisement' to recruit participants placed on the social network site, Facebook (http://www.facebook.com). Facebook was selected as the recruitment site to reach a more diverse international group of participants. The overall aim of the study is expressed concisely in an excerpt, provided below, of the "explanatory statement" made available to Victorian participants and required for obtaining ethics approval for the study.

We have stopped you in the street to invite you to be a participant in our research study. ...We are conducting this research, which has been funded by [our] University, to determine the views of the general public about girls and boys and the learning of mathematics. We believe that it is *as important to know the views of the public as well as knowing what government and educational authorities believe*.

A modified version of this statement was used in the online survey that was directly linked to the Facebook advertisement. That is, Facebook users who clicked on the advertisement were directed to the online survey.

The Instrument

To maximize cooperation and completion rates, the surveys used (in the street and on Facebook) were limited to the same 15 core items. These focused on personal background data; the learning of mathematics at school; perceived changes in the delivery of school mathematics; beliefs about boys and girls and mathematics, and their perceived facilities with calculators and computers; and careers. In this paper we focus on six questions related to the importance of mathematics and the gendering of mathematics. The six items analysed and discussed are:

- Should students study mathematics when it is no longer compulsory?
  Yes/No/Don't know/Depends
- Who is better at mathematics, girls or boys?
  Girls/Boys/Don't know/Depends
- Do you think studying mathematics is important for getting a job?
  Yes/No/Don't know/Depends
- Is it more important for girls or boys to study mathematics?
  Girls/Boys/Don't know/Depends
- Who are better at using calculators, girls or boys?
  Girls/Boys/Don't know/Depends
- Who are better at using computers, girls or boys?
  Girls/Boys/Don't know/Depends

Respondents had the option to explain their responses to each question. However, only quantitative data analysed are presented and discussed here. [Space constraints precluded the reporting of findings from the open-ended responses and from quantitative analyses by respondent gender.]

Participant Recruitment, Online Survey, and the Social Networking Site, Facebook

The social network site, Facebook (http://www.facebook.com), was the avenue adopted to recruit the participants from whom data are reported in this paper. With the rapid advancement of internet technology, online surveys have become a viable method for data-collection in research (e.g., Sue & Ritter, 2007). Social network sites (SNS) such as Facebook are rapidly gaining worldwide popularity. "As of March, 2010, Facebook is the second ranked site on the Internet traffic metrics on alexa.com, accounting for almost 5 percent of all global page views" (Hull, Lipford, & Latulipe, 2010, p.1).

Except for research in which SNS users' profiles and SNS usage are investigated, studies using Social Network sites [SNS] as a method of recruiting participants are relatively rare. In one such study, Howell, Rodzon, Kurai & Sanchez (2010) administered a well-being and happiness survey to participants recruited from a college and from the SNS, Craigslist. Incentives were offered for both data gathering methods. Although the completion rate was lower for those recruited via SNS (68.5%) than from the college (93.6%), the quality of data obtained by the two methods was comparable.

The Sample

There were 314 participants who completed surveys via Facebook. The advertisement was designed through Facebook's commercial advertising campaign system. The system allows particular groups to be targeted. Countries targets were changed on a weekly basis, but at all times, only those over 18 were sought. The advertisement appeared randomly on individual Facebook users' homepages in the targeted countries. Clicking on the advertisement was voluntary, as was completion of the survey. Thus the respondents were considered to represent a random sample of Facebook users over the age of 18 from a range of countries. The respondents represented 57 different countries around the world. Six were countries in which English is the dominant language: Australia, Canada, Ireland, New Zealand, the United Kingdom, and the United States. The composition, by gender (M=male, F=female), of the sample from each of these six countries is summarised in Table 1.

Country	N (M, F)	Country	N
Australia	74 (39M, 35F)	New Zealand	1 (OM, 1F)
Canada	12 (5M, 7F)	United Kingdom	22 (12M, 10F)
Ireland	2 (0M, 2F)	United States	6 (4M, 2F)

Table 1. Sample size, by gender, for English speaking countries

Results and Discussion

Since the Australian sample was the largest, we decided to explore if the combined data from the five other countries differed significantly from the Australian data. Chi-square tests were conducted on the responses to the six questions and no statistically significant differences were found in the response distributions for any item. This allowed us to confidently combine the data from all six countries. The valid percentage frequency distributions of the 117 participants' responses to the six questions are illustrated in Figure 2.

The data in Figure 2 indicate that the respondents generally agreed that:

- Students should study mathematics when it is no longer compulsory (65%), and that
- Studying mathematics is important for getting a job (72.2%)

For each of the questions to which respondents were asked to indicate whether boys or girls were more proficient, the majority of respondents claimed that there was no difference. This indicates that the majority is not gender-stereotyped in their views on boys' and girls' mathematics capabilities or their proficiency with calculators and computers, and that mathematics is considered equally important for both boys and girls.

However, a less positive pattern is also discernible in the data. If respondents held a gendered view on mathematics capability, calculator or computer proficiency, or for whom mathematics was considered more important, they were much more likely to indicate that it was boys rather than girls:

- Better at mathematics: 31.1% said boys, 10% said girls
- Studying mathematics is more important: 2.2% said boys, none said girls
- Better at using calculators: 14% said boys, 1.2% said girls
- Better at using computers: 34.5% said boys, 3.4% said girls

The data re-inforce earlier reported research findings. That is, there appears to be little difference between the perceptions of the general public and those of stakeholders (e.g., students, teachers, or parents) that boys are more talented mathematically and more able with technology than are girls (see Leder, 1992 with respect to views on mathematical talent; see Forgasz, 2009 with respect to teachers' views on technology for mathematics learning). There is also no evidence of a change in these perceptions over time – disappointing and pessimistic outcomes.

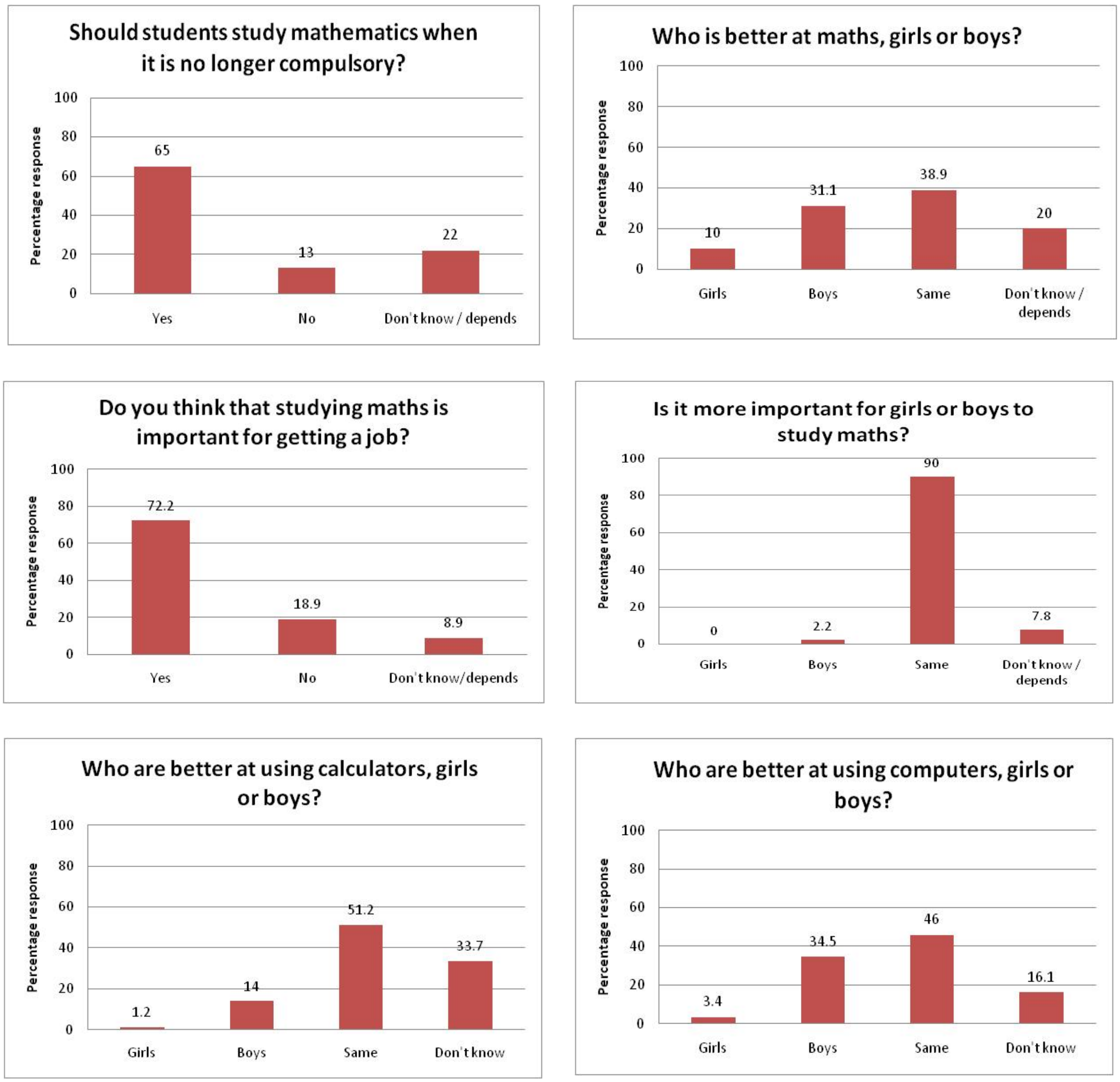

Figure 2. Valid percentage responses to the six survey items

Final Words

As noted above, gender differences favouring males in mathematics achievement are evident in large scale international testing results (PISA and TIMSS) in English speaking countries. In Australia, results from the National Assessment Program for Literacy and Numeracy [NAPLAN] reveal a similar pattern (see Leder & Forgasz, 2010). What is particularly alarming about the NAPLAN results is that the gender differences in favour of males are found at each grade level being tested: grades 3, 5, 7, and 9. This appears to be a retrograde trend since when Fennema was writing about gender differences in the 1970s (e.g., Fennema, 1974), there was little evidence of

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gender differences emerging prior to about grade 7. Gender differences in mathematics learning continue to attract media attention (see Forgasz & Leder, 2011). If the stories are not carefully crafted, the public will come away with views and beliefs shaped by the basic (simplistic) words they read (and interpret) and the images they see.

The data presented in this paper suggest that the general public from the targeted English speaking countries who engage with Facebook hold views that resonate with contemporary mathematics achievement data that they will have had thrust at them by way of the popular media and press. When the age profile of the respondent group is considered – no respondent was older than 60 and 85% was under 40 – the data become of even greater concern. It would appear that there is a critical mass of the younger generation who are reverting back to holding gender-stereotyped beliefs in favour of males with respect to mathematics and with the technology associated with mathematics learning. Their parent generation, mainly "Baby Boomers", lived through the era of feminist agitation that happened in the 1970s and 1980s. Their views were tapped by way of the street-based survey; many over 60s are in the streets during weekday hours. It was clear from the data that "[C]ompared to older respondents, the younger cohort was more likely to consider boys to be better than girls at mathematics and also better with calculators" (Leder & Forgasz, 2011).

The data presented here, although limited to a relatively small group of Facebook users in English speaking countries, lend weight to the contention that we may have come full circle and are now confronted with a young adult group holding traditionally gender-stereotyped beliefs about the domains of mathematics and the technology associated with mathematics.

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