THE PUBLIC'S VIEWS ON GENDER AND THE LEARNING OF MATHEMATICS: DOES AGE MATTER?[1]

GILAH C. LEDER
Monash University
gilah.leder@monash.edu

HELEN J. FORGASZ
Monash University
helen.forgasz@monash.edu

In this study we build on Leder and Forgasz's (2010) examination of the public's perceptions about the learning of mathematics at school and its role in determining males' and females' career preferences. Data were gathered at 12 different sites throughout Victoria and via an innovative recruitment tool, the social network site Facebook. The latter provided a unique opportunity to target a wider audience across Australia. Our finding that younger respondents (under 40) were more likely than those over 40 to question girls' aptitude for mathematics is of concern.

Background to the study

Leder and Forgasz (2010) argued that "attempts to measure directly the general public's views about mathematics, its teaching and its impact on careers are rare" (p. 329), and noted that 20 years had passed since the *Maths Multiplies Your Choices* media campaign, aimed at encouraging parents to consider their daughters' careers, had been conducted.

The findings in this paper build on the small study reported by Leder and Forgasz (2010), as more data have been gathered. The focus here is on exploring age-related, rather than gender-related, differences in respondents' views.

Age as a variable of interest stemmed from trends suggesting that gender equity considerations may be less troubling to younger Australians than to those who lived through the struggles to achieve equity in the latter part of the twentieth century. In an interview on the eve of International Women's day (ABC, 2007), Sarah Maddison argued that having once been a leader in establishing gender equity, Australia had slid backwards, and many gains achieved were now undone.

Recent changes in generational differences in views on equity issues have been reported. In summarising results from several studies, Powlishta (2002, p. 169) claimed that "attitudes become more egalitarian with age" and that in their attributions of characteristics to males, females, or both/neither, "adults were less stereotyped in their attitudes than were children". According to Farley and Haaga (2000), however, while younger people are generally more liberal than their grandparents, in the US "young

[1] We thank Glenda Jackson for gathering the raw data reported in this paper, Hazel Tan for her help in setting up the Facebook survey, and Monash University for the financial support provided.

people have become more conservative, as has the rest of America" (p. 133). This trend is also evident in Australia. In their recent examination of repeated cross-sectional surveys (1986–2005) of Australians' beliefs about family roles and men's and women's work, van Egmond, Baxter, Buchler, and Western (2010, p.162) reported that:

> … on most of the issues examined here, Australian men and women have become increasingly more egalitarian in their views about gender arrangements. But the story is not so straightforward. The trends have taken a different direction since the mid-1990s … Over the last 10 years attitudes to gender arrangements have shifted and the trend toward liberalization has slowed markedly and possibly stalled.

The study

In this study we explore whether age-related differences are found in respondents' views on gender issues associated with mathematics learning.

Participants were given a brief summary of the study's aims as part of the *Explanatory Statement* required for obtaining ethics approval. Core elements are captured in the excerpt below:

> We have stopped you in the street to invite you to be a participant in our research study. ...We are conducting this research … 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.

Data were gathered from 12 different heavy foot-traffic sites throughout Victoria. To reach an even more diverse group, participants were also solicited via Facebook. The Facebook survey contained the same core items used in the face-to-face survey. Thus our data base comprised 13 different sites[2].

To ensure maximum participation, we limited the survey to 15 core items. These covered the learning of mathematics at school, perceived changes in the delivery of school mathematics, facility with calculators and computers, and aspects of careers.

Aims

In this paper we focus on items concerned with respondents' beliefs and their expectations of parents and teachers – significant figures in the learning environment of students – about the learning of mathematics. Whether responses differed by participants' age was of particular interest. Items relevant for this paper are listed in a later section.

Method

About four hours (morning or afternoon) were spent at each site to gather the face-to-face data. This yielded around 50 completed surveys per site, exceeding the minimum number considered adequate for data to be analysed using chi-square tests (Muijs, 2004). The procedures followed were described in some detail in Leder and Forgasz (2010) and are not repeated here. Instead, we focus on the routes followed in gathering the Facebook data.

[2] Respondents from various countries participated in the Facebook component. In this paper we restrict the sample to those who indicated they were residents of Australia.

Consultation with the University's Human Ethics Committee revealed that Facebook has rights to data collected from any applications, including surveys, created within Facebook. To avoid possible privacy and ethical issues (Hull, Lipford, & Latulipe, 2010) the questionnaire used in the larger study was duplicated as an online survey using SurveyMonkey (http://www.surveymonkey.com). A link was created to it from the advertisement placed on Facebook. Briefly, the procedure used (described in detail in Forgasz, Leder & Tan, 2011) was:

1. Set up a Facebook account.
2. Design a 110 x 80 pixel image for the advertisement.
3. Produce a destination URL when participants clicked on the advertisement.
4. Create a name for the advertising campaign and text.
5. Decide the target population: individuals aged over 18[3].
6. Select a daily budget.
7. Determine pricing: i. price per click willing to be paid (varied between 60 and 80 cents) and ii. daily budget (we settled on $60).
8. Decide the length of the campaign.
9. Provide additional information e.g., currency to be used and payment method.

A copy of the Facebook advertisement is shown in Figure 1.

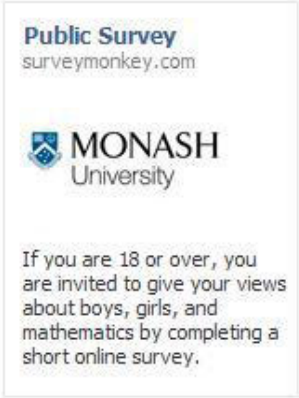

Figure 1. The Facebook advertisement

Instrument

Our discussion is limited to responses to the following questions:

1. Should students study mathematics when it is no longer compulsory?
2. Who are better at mathematics, girls or boys?
3. Who do parents believe are better at mathematics, girls or boys?
4. Who do teachers believe are better at mathematics, girls or boys?
5. Do you think that studying mathematics is important for getting a job?
6. Is it more important for girls or boys to study mathematics?
7. Who are better at using calculators, girls or boys?

These items required simple responses: "yes", "no", "don't know"; or "boys", "girls", "the same", "unsure". All participants were invited to explain their answers. The comments reported in this paper are from those recruited via Facebook, to offer greater

[3] Ethics approval conditions influenced the decision to restrict the sample to participants over the age of 18.

insights into the beliefs of this group. Individuals also provided background information, including their age which was subsequently categorized as younger group (under 40) or older group (40 or older).

Sample

The sample comprised 689 (615 face-to-face, 74 Facebook) respondents. Of these, 327 were males and 362 were females; 361 were under 40 and 328 were 40 or older. As comparisons between the responses from face-to-face and Facebook respondents to the survey questions of interest revealed no statistically significant differences, the data were pooled for the analyses discussed in this paper.

Results

Response rate for Facebook participants

During the Facebook data collection period, we focused on Australia for five days[4]. There were 2,004,460 impressions, that is, the advertisement was shown just over two million times. These yielded 339 clicks on the advertisement and 62 (18%) respondents to the survey. This response rate is within the limits for mail surveys (between 10% and 50%) reported by McBurney and White (2004) in their comparison of response rates for different methods of survey administration.

Findings for the questions

The frequencies (and percentages) of responses to the seven survey items listed above are shown in Table 1.

Table 1. Frequency and percentage responses to survey items.

Item	Yes	No	Don't know	
Should students study mathematics when it is no longer compulsory?	436 64.3%	160 23.6%	82 12.1%	
Do you think that studying mathematics is important for getting a job?	523 77.8%	82 12.2%	67 10.0%	
	Boys	**Girls**	**Same**	**Unsure**
Who are better at mathematics, girls or boys?	149 22.2%	93 13.8%	263 39.1%	167 24.9%
Who do parents believe are better at mathematics, girls or boys?	156 23.2%	90 13.4%	161 24.0%	265 39.4%
Who do teachers believe are better at mathematics, girls or boys?	79 11.8%	85 12.6%	192 28.6%	316 47.0%
Is it more important for girls or boys to study mathematics?	24 3.6%	9 1.3%	610 90.8%	29 4.3%
Who are better at using calculators, girls or boys?	87 13.0%	53 7.9%	378 56.5%	151 22.6%

[4] Prior to this time, participants resident in many different countries, as well as a small number of respondents from Australia, responded to the advertisement. In this paper only data gathered from respondents living in Australia are considered.

In Table 2 the frequencies (and percentages) of responses by age group are shown. Chi-square tests were used to determine if the frequency distributions of the responses by age group were statistically significantly different; the outcomes of the chi-square tests are also provided.

Table 2. Frequency and percentage responses to survey items by age group, and χ^2 significance levels.

	Under 40				**40 plus**				**Sig. level**
Item	Yes	No	Don't know		Yes	No	Don't know		
Should students study mathematics when it is no longer compulsory?	223 63.7%	89 25.4%	38 10.9%		213 64.9%	71 21.6%	44 13.4%		ns
Do you think that studying mathematics is important for getting a job?	250 72.5%	52 15.1%	43 12.5%		273 83.5%	30 9.2%	24 7.3%		p<.01
	Boys	**Girls**	**Same**	**Unsure**	**Boys**	**Girls**	**Same**	**Unsure**	
Who are better at mathematics, girls or boys?	89 25.8%	33 9.6%	161 46.7%	62 18.0%	60 18.3%	60 18.3%	102 31.2%	105 32.1%	p<.001
Who do parents believe are better at mathematics, girls or boys?	78 22.6%	44 12.8%	98 28.4%	125 36.2%	78 23.9%	46 14.1%	63 19.3%	140 42.8%	p<.05
Who do teachers believe are better at mathematics, girls or boys?	46 13.3%	42 12.2%	119 34.5%	138 40.0%	33 10.1%	43 13.1%	73 22.3%	178 54.4%	p<.001
Is it more important for girls or boys to study mathematics?	11 3.2%	4 1.2%	316 91.6%	14 4.1%	13 4.0%	5 1.5%	294 89.9%	15 4.6%	ns
Who are better at using calculators, girls or boys?	56 16.3%	20 5.8%	215 62.7%	52 15.2%	31 9.5%	33 10.1%	163 50.0%	99 30.4%	p<.001

In the subsequent discussion of the findings, all data referred to can be found in Tables 1 and 2.

Should students study mathematics when it is no longer compulsory?

Almost two-thirds (436: 64.3%) of those responding answered this question affirmatively, fewer (160: 23.6%) disagreed, and the rest (82: 12.1%) were equivocal. A chi-square test revealed no statistically significant differences by respondent age. Reasons given for the need to continue studying mathematics included:

> Develops analytical skills and rigorous thought. Gives a deeper understanding in sciences and other areas of thought, such as computer science and economics. Suitable also for those interested in philosophy and the pure arts, such as music (specifically, musical

composition). ...Mathematics is the underlying basis to understanding the modern world, on either a physical or social level (for example, in economics). (younger)

Maths is important. But it would be too easy to not do it. A person will always take the easy way out if possible. (older)

Explanations from those who disagreed included:

Some people don't need it. You don't need maths to become an author. My dad tells me that he has learned algebra, yet he thinks he never has used it in his life and he is a taxi driver. My mum is a bit crazy over maths, keeps pushing for me to study it ... Why learn some maths, like velocity if you won't need it for your career? (younger)

Depends on the level – my attitude is that some math should be compulsory up to year 5. After that there would be little point in forcing students to do something they don't like or have been failing at. (older)

Who are better at mathematics, girls or boys?

Approximately one-third (263: 39.1%) of the sample thought boys and girls were equally good at mathematics; a quarter (167: 24.9%) was unsure. Of the remainder, 149 (22.2%) thought boys were better; fewer believed girls were better (93: 13.8%). A chi-square test revealed a statistically significant difference in replies by respondent age (χ^2 = 37.335, p<.001, df = 3. Effect size (φ) =.24). Almost twice as many older (60: 18.3%) than younger (33: 9.6%) respondents thought girls would be better. Although more younger (161: 46.7%) than older (102: 31.2%) respondents thought there would be no difference between girls and boys, more younger (89: 25.8%) than older (60: 18.3%) respondents also thought boys would be better.

Reasons given included:

Same: I have known both girls and boys that are equally good at mathematics. The boys tend to use it more and appear to pursue it, but girls can be equally as good. (younger)

Don't know: Girls tend to do better in the earlier school years but boys do better later so by year 6 boys are generally ahead. However some of my female friends have been physics lecturers so... (older)

Boys: I've met both males and females who are good at math. Though I have only met males who are exceptional at mathematics. (younger)

Girls: Boys tend to have worse concentration than girls (younger)

Who do parents believe are better at mathematics: girls or boys?

Most respondents were unsure (265: 39.4%) or thought that parents believed that there would be no difference (161: 24%). Almost a quarter (156: 23.2%) thought parents assumed boys would be better, while 90 (13.4%) thought parents considered girls were better. A chi-square test revealed a statistically significant difference in answers by respondent age (χ^2 = 8.026, p<.05, df = 3. Effect size (φ) =.11). Older participants were less likely to believe that parents would rate them the same (older, 63: 19.3%; younger, 98: 28.4%) but were more likely to be unsure (older, 140: 42.8%; younger, 125: 36.2%). Those answering "boys" or "girls" were more likely to provide explanations:

Boys get more encouragement and positive reinforcement for achievement in maths. (younger)

I find this slightly discriminating... but anyway...probably guys. (younger)

In my experience parents are more willing to think boys are better, even if subconsciously. (younger)

Boys: Girls tend to be quiet achievers. (older)

Who do teachers believe are better at mathematics, girls or boys?

The response pattern to this item was similar to the question about parents' views. Most were unsure what teachers believed (316: 47%) or thought that teachers would consider girls and boys to be equally good at mathematics (192: 28.6%). The remainder was evenly divided whether they believed teachers thought boys (79: 11.8%) or girls (85: 12.6%) were better. A chi-square test revealed a statistically significant response difference by respondent age ($\chi^2 = 17.766$, $p<.001$, $df = 3$. Effect size (φ) =.16). Older respondents were most likely to indicate they were unsure (178: 54.4%), while many younger respondents (138: 40%) thought teachers believed that girls and boys were equally good at mathematics. Few provided reasons for their answers, with several re-iterating their explanations to the question about parents.

Do you think studying mathematics is important for getting a job?

A clear majority (523: 77.8%) answered affirmatively. The remainder disagreed (82: 12.2%) or were ambivalent (67: 10%). A chi-square test revealed a statistically significant difference in replies by respondent age ($\chi^2 = 11.828$, $p<.005$, $df = 2$. Effect size (φ) =.13). Older participants were more likely to believe mathematics was important for getting a job (older, 273: 83.5%; younger, 250: 72.5%) and less likely to be uncertain (older, 24: 7.3%; younger, 43: 12.5%).

Elaborations on the answer given included:

Creative reasoning is encouraged in mathematics. A mathematical background assists a person to problem-solve on a conceptual rather than specific level, an inherently valuable trait to many professions. Employers recognise the ability to think laterally, logically and creatively, while developing conceptual and innovative solutions to particular problems; mathematics trains the mind to do this. It is, therefore, inherently valuable to attaining a job in the field of choice. (younger)

Clearly depends on the job - but in almost every walk of life a better understanding of the processes/machinery/product is enhanced by a better understanding and almost inevitably some maths is required for that. Even fine arts and music. (older)

Is it more important for girls or boys to study mathematics?

Almost all (younger, 316: 91.6%; older, 294: 89.9%) considered it equally important for boys and girls to study mathematics.

There is becoming less of a gap between "male" jobs and "female" jobs. There is no reason that it's more important for one gender than another. (younger)

They are quite likely to be going for the same jobs so need the same skills (older)

Just under half (29: 4.3%) of the remaining 10% were equivocal. Of the rest, a slightly higher proportion of respondents considered mathematics more important for boys

(24: 3.6%) than for girls (9: 1.3%). A chi-square test revealed no statistically significant response differences by respondent age.

Who are better at using calculators, girls or boys?

Over half the respondents (378: 56.5%) thought there would be no difference. A chi-square test revealed a statistically significant response difference by respondent age ($\chi^2 = 31.744$, $p<.001$, df = 3. Effect size (φ) =.22). More older respondents nominated girls as the better group (younger, 20: 5.8%; older, 33: 10.1%), and more younger respondents nominated boys (younger, 56: 16.3%; older, 31: 9.5%).

Comments included:

> All gen-y kids are very tech savvy, this is not restricted to one gender. (younger)
>
> I suspect they are both the same. (older)
>
> Boys: Calculator = Machine (somewhat) = Boys will operate it better. (younger)

Discussion

Of the seven (out of 15) survey questions examined in this paper, no statistically significant differences by respondent age were found on two. About two-thirds of respondents indicated that pursuing mathematics beyond the compulsory period was important. Almost all believed that mathematics was equally important for girls and boys. These are heartening findings.

A statistically significant difference by respondent age was found on items regarding the importance of mathematics for getting jobs. The older cohort agreed more strongly than the younger respondents who were less certain.

The four remaining items with statistically significant differences by respondent age involved gender-related beliefs. The older group was more convinced that teachers and parents would consider boys and girls to be equally good at mathematics, and was less equivocal than the younger cohort. Compared to older respondents, the younger cohort was more likely to consider boys to be better than girls at mathematics and also better with calculators. Collectively these findings suggest that while those under 40 believed that parents and teachers were likely to be more egalitarian, they themselves hold more strongly than those in the older group to the traditional gender-stereotyped view that boys are more suited to and successful in mathematics than girls. These data imply a backwards slide in Australians' views of gender equity in mathematics. Whether the findings of this study link to the small but consistent gender gap favouring boys in NAPLAN results and the increasing gender gap in Australian results in TIMSS over time (see Leder & Forgasz, 2010) needs to be explored further.

Reflections at the time of the celebration of the 100th International Women's Day indicate that this "backward slide" is not unique to issues linked to the learning of mathematics. As noted by Cox (2011, p. 13), "[T]he F-word [Feminism] is not very popular these days with many younger women, who feel it does not relate to their lives. Newman (2011) questioned whether schools have a role to play with respect to gender issues in schooling. He claimed that "[A]fter more than a century of struggle, feminists say gender inequality is alive and well… The extent to which gender-related themes are incorporated in lessons remains at teachers' discretion… (and) the reality remains that there is no unit of study in the (Victorian) state secondary curriculum devoted to gender

issues" (p. 14). In the past, interventions had a place in raising awareness of gender issues in mathematics and science learning but over time funding dried up. The extent to which pre-service teacher education programs now incorporate gender-related issues in their curricula varies from institution to institution. The findings of the present study suggest that some action is again needed to alert the teaching profession and the general community that differences remain in perceptions of boys' and girls' mathematics capabilities and future career potential.

References

ABC (2007). *Gender equity in Australia: All for nothing?* [Podcast] Retrieved December 29, 2010, from http://www.abc.net.au/rn/lifematters/stories/2007/1864309.htm

Cox, E. (2011, March 8). Macho economics still rules the agenda. *The Age*, p. 13.

Farley, R., & Haaga, J. (2005). *The American people: Census 2000.* NY: Russell Sage Foundation.

Forgasz, H., Leder, G., & Tan, H. (2011). *Facebook and gendered views of ICT*. Paper presented to the Global Learn Asia Pacific 2011 – Global Conference on Learning and Technology, Melbourne.

Hull, G., Lipford, H., & Latulipe, C. (2010). Contextual gaps: Privacy issues on Facebook. *Ethics and Information Technology*, 1–14. Retrieved October 11, 2010, from http://www.springerlink.com/content/072730305020wm26/

Leder, G. C. & Forgasz, H. J. (2010). I liked it till Pythagoras: The public's views of mathematics. In L. Sparrow, B. Kissane, & C. Hurst (Eds.), *Shaping the future of mathematics education* (Proceedings of the 33rd annual conference of the Mathematics Education Research Group of Australasia, pp. 328–335). Fremantle: MERGA.

McBurney, D. H., & White, T. L. (2004). *Research methods*. Belmont CA: Wadsworth.

Muijs, D. (2004). *Doing quantitative research in education with SPSS*. London: Sage Publications.

Newman, G. (2011, March 7). You might think you're equal, but ... *The Age*, p. 14.

Powlishta, K. K. (2002). Measures and models of gender differentiation. In L. S. Liben & R. Bigler (Eds.), *The developmental course of gender differentiation: Conceptuality, measuring and evaluating constructs and pathways. Monographs of the Society for Research in Child Development, 67*(2), 167–178.

van Egmond, M., Baxter, J., Buchler, S., & Western, M. (2010). A stalled revolution. Gender role attitudes in Australia, 1986–2005. *Journal of Population Research 27*, 147-168.