OF COURSE I CAN['T] DO MATHEMATICS: ETHNICITY AND THE STEREOTYPING OF MATHEMATICS

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A new instrument aimed at measuring the extent to which mathematics is stereotyped as a gendered domain was recently trialed. Included among the participating schools were two with distinct student populations from strong, but different, ethnic and religious backgrounds. In this paper we report the findings from comparisons made between the responses of students from the two schools (N = 75 and N = 67) and those of students from other schools participating in the trial (N = 394). The results indicate that ethnic/cultural backgrounds influence stereotyping of some dimensions of mathematics education.

INTRODUCTION AND PREVIOUS RESEARCH

In the past, the study of mathematics and participation in related jobs were viewed as more suitable for boys than for girls. This was a strongly held belief in society at large. More boys than girls were found to study mathematics and, on average, boys outperformed girls. In the mid 1970s, girls were identified to be educationally disadvantaged with respect to mathematics and much effort was expended to re-dress inequities (Leder, Forgasz, & Solar, 1996).

Times have changed. Traditional societal expectations of men's and women's roles at home and in the workforce are now challenged. Although mathematics participation rates, particularly in the most demanding mathematics options offered at the school level continue to favour boys, the gap in performance levels has closed. The recent *Third International Mathematics and Science Study* [TIMSS] results, for example, revealed relatively few differences in the performance, on average, of Australian girls and boys in the middle school years. Far greater differences in performance were noted when comparisons were made between students who spoke English at home, and those who did not, an indicator often used as a crude measure of cultural background. At both the lower and upper year levels, students born in a non-English speaking country but using English as their main language at home, on average, did better than students born in an English speaking country and using English as their home language. The latter group, in turn, did better than students born in an English speaking country but using a language other than English in the home (Lokan, Ford, & Greenwood, 1996). However, in other countries involved in TIMSS - including Belgium, Ireland, Hong Kong, Switzerland and England (Beaton et al, 1996) - more traditional gender differences favouring boys continued to be reported. Collectively, these findings suggest that factors other than gender alone contribute to the observed performance levels of boys and girls.

The stereotyping of mathematics as a male domain is often included in models postulating explanations for the under-representation of women in the mathematics and science fields (see Leder, 1992). More recent research into equity issues within mathematics education (Secada, Fennema, & Adajian, 1995) recognises the interacting roles of gender and cultural backgrounds on individuals' beliefs and attitudes. Interactions between gender and cultural background were also found by Bishop and Leder (1999) in a recently completed study involving students from eight co-educational secondary schools in the metropolitan area of Melbourne. For example, there appeared to be greater differences in self appraisal on a

host of variables between boys from Anglo cultural and non-Anglo cultural backgrounds than between girls from these groups.

The Fennema-Sherman *Mathematics Attitude Scales* [MAS] (Fennema & Sherman, 1976) have often been used in research on gender differences in mathematics learning outcomes. The need for a new instrument to replace the 'Mathematics as a Male Domain' subscale was recently established (Forgasz, Leder & Gardner, in press). These authors argued that the assumptions underpinning the development of some of the items on the MD scale were anachronistic and that the interpretation of responses to some items were no longer valid.

A new instrument, loosely based on the 'Mathematics as a Male Domain' subscale, and aimed at measuring the extent to which mathematics is now stereotyped as a gendered domain has recently been trialed (Forgasz, Leder, & Barkatsas, 1998). More specifically, the themes explored overlapped with those tapped by the 'Mathematics as a Male Domain' scale but the response format differed substantially. The results of the trial of the new instrument challenged some previous research findings while others were confirmed (Forgasz, Leder & Barkatsas, 1998). Taken together the data strongly implied that views on the stereotyping of mathematics are changing. Given Australia's multicultural profile, it was of interest to know if varying views would be found among students of different cultural backgrounds. Included among the schools participating in the trial was one school affiliated with the Jewish community (school J) and one associated with the Greek community (school G). Students attending these schools share strong, yet vastly different, ethnic and religious backgrounds. In this paper, we present findings comparing the views of students at each of these two schools with the views of students from the other schools (combined as school O) in the trial.

THE STUDY

The Instrument

In developing the items, we drew on previous research findings about gender issues in mathematics learning. Completed items were read and modified, if appropriate, by 10 volunteer mathematics educators. Remaining items were attempted by some two dozen volunteer grade 7 to 10 students. Various items were omitted or further modified on the basis of reactions obtained from this group. Following these trials, 24 items remained for inclusion in the instrument (see Table 1). On the survey, each item took the form of a statement to which students were asked to select one of the following response categories:

BD: Boys definitely more likely than girls
BP: Boys probably more likely than girls
ND: No difference between girls and boys
GP: Girls probably more likely than boys
GD: Girls definitely more likely than boys

Table 1
Items included in the survey instrument

Qn	Item	Qn	Item
1	Think mathematics will be important in their adult life	*13*	Think they did not work hard enough if they do not do well in mathematics tests
2	Think the mathematics test must have been easy if they do well	*14*	Give up when they find a mathematics problem is too difficult
3	Get on with their work in mathematics classes	*15*	Tease girls if they are good at mathematics
4	Are not good at mathematics	*16*	Care about doing well in mathematics
5	Need mathematics to maximise future employment opportunities	*17*	Think it is important to understand the work in mathematics classes
6	Are thought of as 'nerds' if they do well in mathematics	*18*	Expect to do well in mathematics
7	Worry if they do not do well in mathematics	*19*	Think it is OK to be excellent at mathematics
8	Are asked more questions by the mathematics teacher	*20*	Mathematics teachers spend more time with them
9	Get the wrong answers in mathematics	*21*	Distract other students from their mathematics work
10	Mathematics teachers think they will do well	*22*	Tease boys if they are good at mathematics
11	Need more help with mathematics	*23*	Likely to work with computers in future jobs
12	Find mathematics easy	*24*	Consider mathematics to be boring

The Sample

In all, 536 (281M, 255F) Grade 7-10 students from eight Australian schools completed the survey. Of these, 75 (34M, 41F) were from school J and 67 (35M, 32F) from school G. Results from these two schools were compared with each other and with data from the other participating schools (combined as school O; N=394: 212M, 182F).

Test Administration

After obtaining the necessary ethical consent the instruments were distributed to the participating schools. Administration procedures were discussed with the teachers who administered the questionnaire within class time.

Data Analysis

For each survey item, a chi-square test was conducted to determine if there was a statistically significant difference in the distribution patterns across the five response categories for the three groups of schools. Significance was set at the .05 level.

RESULTS

The results can be summarised as follows:

- For each item on the survey, the most frequent response category was generally that there was 'no difference' between girls and boys
- On 16 items (Qns 2, 6, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 22, 24), more students from school J than from schools G and O responded that there was no difference between girls and boys. On two items (Qns 3, 13) more students from school G than from the other schools responded that there was no difference between

boys and girls. No difference was scored higher by students from school O than by students from schools J and G on the remaining six items (Qns 1, 4, 5, 7, 21, 23).

- For 15 items there were no statistically significant differences in the distribution patterns of the responses of students in the three groups. The nine items (Qns 1, 3, 6, 7, 11, 12, 15, 20, 23) for which statistically significant results were obtained and descriptions of how the groups differed on these items are shown on Table 2.

Table 2
Items with statistically significant differences

Qn	Result	Sig. level
1	Overall, students felt that boys and girls would not differ in thinking that mathematics was important to their adult lives (75%). However, a higher proportion of students from school J (22%) than from schools G (14%) and O (16%) considered boys more likely to hold this view, and proportionally more school G (15%) students that it would be girls (school J: 5%, school O: 9%).	χ^2=16.01 p<0.05
3	The majority of students from all schools indicated that girls (61%) were more likely than boys (7%) to get on with their work in mathematics. Students from schools G (66%) and J (69%) believed this more strongly than students from school O (58%). No student from school G believed that boys get on with their work in mathematics. Only about 1/3 of all students perceived that there was no difference between boys and girls.	χ^2=20.46 p<0.01
6	The data indicated that many more students overall considered boys (47%) than girls (12%) to be thought of as 'nerds' if they did well in mathematics. Students from school O (54%) held that view more strongly than students from schools G (31%) and J (33%). Students from school J (61%) believed more strongly than at schools G (47%) and O (35%) that there is no difference between boys and girls being considered 'nerds'.	χ^2=35.36 p<0.01
7	Overall, girls (49%) were considered more likely than boys (12%) to worry if they did not do well in mathematics. Students from school G (25%) believed that this was definitely the case more strongly than students from schools J (10%) and O (10%).	χ^2=17.93 p<0.05
11	At all schools, boys (37%) were considered more likely than girls (8%) to need help in mathematics. This belief was held more strongly at schools O (35%) and G (36%) than at school J (22%). Compared to schools G (57%) and O (58%), students at school J (75%) strongly believed that there is no difference between boys and girls.	χ^2=15.62 p<0.05
12	Much higher proportions of students from schools O (29%) and G (32%) than from school J (9%) believed that girls were more likely than boys to find mathematics easy. Students from school J (75%) were more likely than students from schools O (60%) and G (61%) to indicate that there is no difference between boys and girls.	χ^2=24.91 p<0.01
15	The data indicated that many more students from all schools considered boys (44%) more likely than girls (12%) to tease girls who are good at mathematics. Students from school G (60%) held that view more strongly than students from schools O (41%) and J (41%). Students from school G (31%) also perceived less strongly than students from schools O (46%) and J (51%) that there is no difference between girls and boys.	χ^2=20.15 p<0.01
20	A higher proportion of students from school O (26%) than from schools J (7%) and G (17%) responded that teachers spend more time with boys than with girls. Students from school J (74%) believed more strongly than students from schools O (56%) and G (60%) that there was no difference between girls and boys in the time teachers spent with them.	χ^2=24.83 p<0.01
23	Many more students overall considered that boys (29%) were more likely than girls (12%) to work with computers in their future jobs. The pattern of responses was similar at each school. But, the largest difference favouring boys (54%) over girls (3%) was found at school J. Students at school O (54%) believed more strongly than students from schools J (43%) and G (35%) that there was no difference in the likelihood of girls and boys working with computers in the future.	χ^2=29.00 p<0.01

Key: school J: affiliated to Jewish community; school G associated with the Greek community; school O = all other schools

DISCUSSION

There were 16 items for which there were no statistically significant differences in the response patterns by school. Although the general distributions of responses across the five categories were similar for the remaining nine items, statistically significant differences were found. The nine items related to: future careers (1, 23), classroom factors (3, 15, 20), mathematical ability (6, 11, 12), and confidence (7). Cultural factors may be implicated in understanding the differences that emerged.

How Students from Ethnic Background Schools Differed from 'Others'

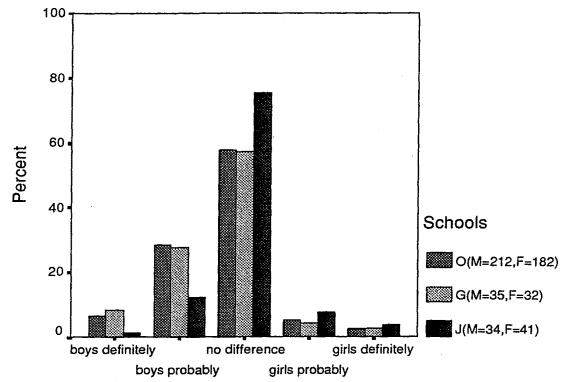
Responses to items 3, 6, 20 and 23, indicated that students at the two ethnic schools, J and G, held different beliefs from the others. They believed more strongly that girls got on with their work in class (O: 58%: G: 66%, J: 69%), and less strongly that teachers spent more time with boys (O: 25%, G: 17%: J: 7%), that boys were more likely than girls to be considered 'nerds' if they were good at mathematics (O: 54%, G: 31%, J: 33%), and that there was no difference in the likelihood of girls and boys working with computers in their future careers (O: 54%, G: 35%, J: 43%).

Although the students at the ethnic schools viewed some aspects of mathematics education differently from students at other schools, there was a clearer pattern in the differences that emerged when the data were examined to see how students at each ethnic schools differed from the others.

How Students at School J Differed from the Others

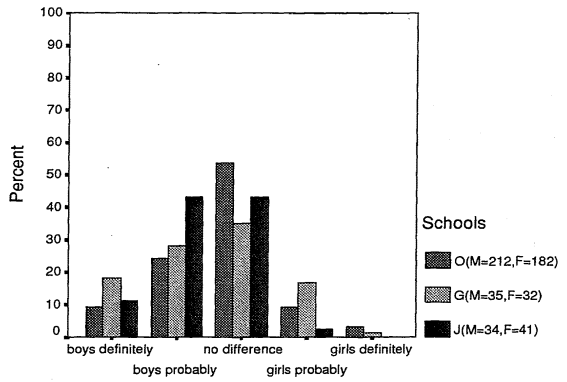
For 16 of the 24 items, including five out of the nine items on which significant differences were found - the three 'ability items' (6 - 'nerds', 11- need more help, 12 - mathematics easy) and two items related to classroom factors (15 - tease successful girls, 20 - teacher time) - school J students believed more strongly than students at schools G and O that there was no difference between girls and boys (see Figure 1, for example). Students from Jewish schools are known in the broader community to achieve excellent results in grade 12. In explaining their outstanding performance on the 1996 Victorian Certificate of Education, Lee Dow (1997) claimed that "the achievement of Jewish schools... points less to social and financial advantage than to a community... recognised for its respect and value of educational excellence" (p.19). Does this community's high expectations contribute to the apparently more equitable views about the gender-appropriateness of many aspects of mathematics education held by the students at school J? Simultaneously, however, does the community hold strongly to more traditional views of future career paths? It was noteworthy that with respect to items related to future careers (3, 23), school J students believed more strongly than students from the other schools that boys were more likely than girls to consider mathematics important in their adult lives and to use computers in their future work (see Figure 2).

Fig. 1.
Frequency Distributions for Item 11 by School and Gender



Qn11: Need more help in mathematics

Fig. 2.
Frequency Distributions for Item 23 by School and Gender



Q23: Likely to work with computers in future jobs

How Students at School G Differed from the Others

Students at school G differed from the others in their beliefs on three items - two classroom-related factors (3, 15) and the confidence item (7). They believed most strongly that girls would definitely be more likely than boys to worry about not doing well in mathematics, and that boys were more likely than girls to tease girls who did well in mathematics. Overall, only 7% of students believed boys were more likely than girls to get on with their work in mathematics classes. However, there was not a single student at school G who indicated that this was the case.

In a study which focussed on the experiences of Greek students in a government high school located in a low socio-economic area, Polesel (1997) noted that:

> It would seem that certain characteristics of Greek culture, which value and support the education of boys at the expense of girls, combine with school-based gender stereotypes to undermine the confidence and expectations of these Greek girls, particularly in the gender sensitive domain of mathematics. (pp.41-42)

The implications of school G students' response patterns on the classroom-related items are that boys 'muck around' in mathematics classes, do not get on with their work, and tease capable girls. This scenario has 'macho' overtones. The stereotyped directions of these responses appear to support Polesel's (1997) claims and are also consistent with previous findings that reflect classrooms which can be considered 'male domains' (e.g., Forgasz & Leder, 1996).

In summary, the aspects of mathematics education that have traditionally been viewed to reflect mathematics as a 'male domain' were explored in the present study using a new instrument. In general, the patterns found for the two ethnic schools were similar to those in all the other schools. Some specific differences were noted, however. In the school associated with the Jewish community, students were less stereotyped in their views than the other students on the majority of items. However, they reflected more traditionally stereotyped beliefs that mathematics was more likely to feature in the future careers of males than of females. At the school affiliated with the Greek community the image of mathematics classrooms portrayed was more strongly consistent with a 'male enclave' than could be inferred from the responses of students at the other schools. Taken together, these findings suggest that cultural background has a role in shaping students' belief systems.

FINAL WORDS

Findings from the present study support the hypothesis that gender and culture interact to influence students' beliefs about the gender-appropriateness of mathematics. However, more work is needed to confirm the findings reported here and to explore patterns among students from a range of different cultural backgrounds. In the present study, data were gathered from only two schools with strong ethnic associations. The results were also based on findings from a trial version of a new instrument which requires further refinement and a second administration to establish its reliability. However, a number of questions are raised by the findings. Do students in schools with strong ethnic associations hold the same views as their counterparts who are enrolled in other schools with a mixed ethnic enrolment profile? Can equity be attained in schools with strong ethnic associations if their purpose is to perpetuate, and not to challenge, the culture they represent? Do male and female students from the same ethnic background differ in their beliefs about the stereotyping of mathematics?

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