Paper presented at the annual AARE Conference, Sydney, 4-7 December 2000

Exploring Perceived Personal and Social Gender Stereotypes of Maths with Secondary Students: An Explanation for Continued Gender Differences in Participation?

Helen M. G. Watt

University of Sydney

h.watt@edfac.usyd.edu.au

A longitudinal study of three sequential cohorts over three years (N=428, 436, 459 for cohorts 1 to 3 respectively) indicated their intended levels of participation in both HSC maths course selection and career plans, revealing a persistent gender imbalance in higher levels of participation favouring boys. Given this continued gender difference in participation, explanations are sought in students' perceptions of personal and social stereotypes about maths being more suited to males or females (or neither). Students rated the extent to which they themselves perceived maths as more suited to males or females, as well as the extent to which they perceived 'society' as perceiving maths as more suited to males or females. In addition, students provided qualitative explanations for their ratings of personal and social gender stereotypes. Quantitative and qualitative data were collated for each gender within each cohort, and explanations thematically grouped. Despite most students' ratings favouring neither gender, stereotypes favoured boys for maths where these occurred. Social stereotypes appeared more prevalent than personal stereotypes, perhaps reflecting cultural change and perhaps indicating a degree of 'political correctness' on the part of students' reported self-perceptions. There was limited suggestion that social stereotypes are stronger for older students. The study focuses on personal versus social stereotypes for boys versus girls, how these may develop and how these might contribute to the gender imbalance in maths participation.

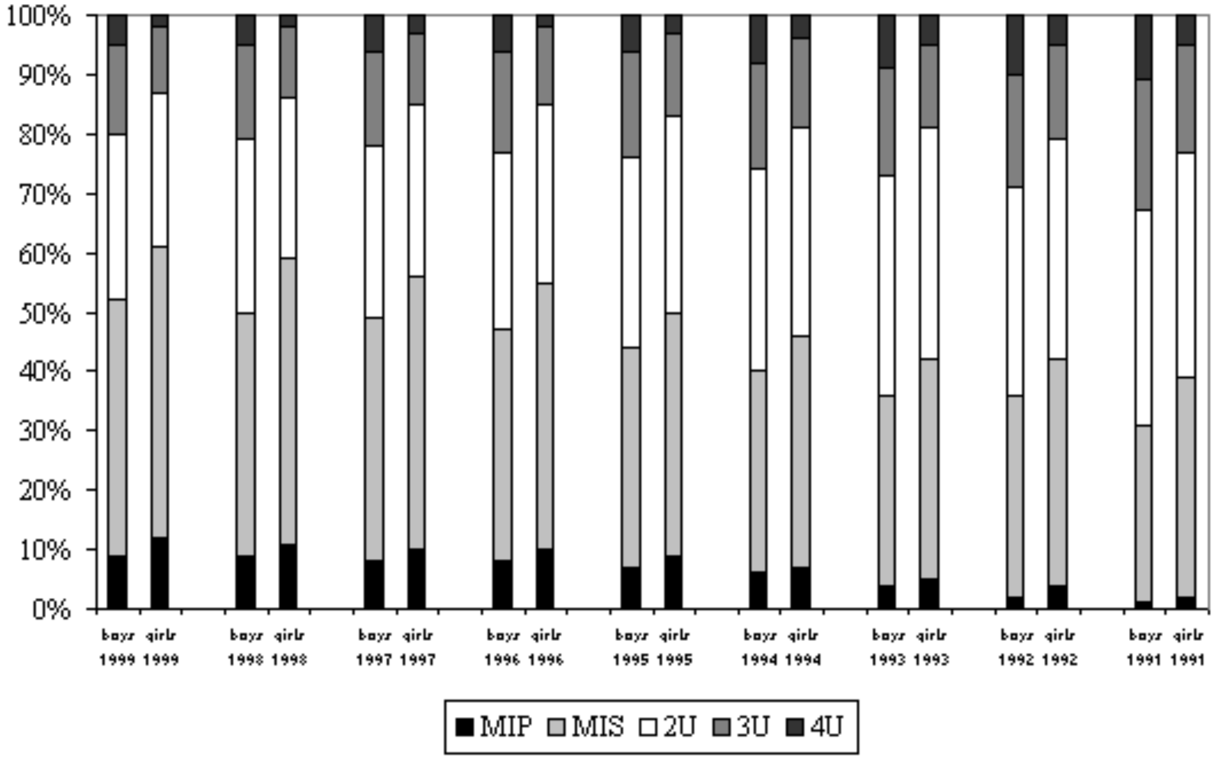
Acknowledgments

Thank you to my PhD Supervisor, A/Prof Ray Debus, for his comments and support on this and other papers. Thanks also to my friend and colleague Ms Anne McMaugh for her insights and critical feedback.

It has long been a concern expressed by educators, policy makers and researchers that women are under-represented in the study of maths and in careers requiring maths (e.g., Fennema, Wolleat, Pedro, & Becker, 1981; Sherman, 1982; Willis, 1989; Leder, 1992). This study asks about the social factors that explain women's participation in maths, given that maths is a 'critical filter' (Sells, 1973) determining access to many well paid high-status careers. The importance of addressing the gender imbalance in maths participation is informed from several perspectives. A 'waste of talent' argument is often implied in the view that students should participate in maths at a level commensurate with abilities (Willis, 1989). It is also argued that mathematically talented and knowledgeable women as well as men are needed to aid the nation's technological advance (Willis, 1989). We may question expectations of equal proportions of men and women, ask about the relevance of higher level maths courses, or even suggest the over-selection of men. Regardless of the perspective taken, it is clear that the unequal participation of men and women in maths is a persistent issue.

In the State of New South Wales (NSW) in Australia, inspection of Higher School Certificate (HSC) maths course participation statistics over the past decade reveals persistent gender imbalances in these expected directions. A greater proportion of boys elect to study the highest 4- and 3-unit maths courses. Conversely, a greater proportion of girls elect the lowest Maths in Practice (MIP) and Maths in Society (MIS) maths courses (see Figure 1).

Figure 1. Gendered participation rates for HSC maths courses 1991-1999.



Explanations Beyond Maths Performance

Although recent research suggests that girls and boys approach maths problems in various ways (Fennema & Carpenter, 1998), similarities in maths performance by boys and girls make previous actual achievement an unlikely factor responsible for differential participation rates in maths. Meta-analyses have established similar mathematical performance for girls and boys. Research articles from 1967 to 1987 about maths performance by students from primary school to undergraduate university (Hyde, Fennema, & Lamon, 1990) showed negligible differences between the performance of girls and boys in overall scores (d =-.05, favouring girls), as well as understanding of mathematical concepts (d =-.03), computation (d =-.14) and complex problem solving tasks (d =.08). Further, a meta-analysis of 98 studies from 1974 to mid-1987 (Friedman, 1989) found the 95% confidence interval for maths performance by gender covered zero. In the local situation, records of final maths examinations in New South Wales also show similar performance for boys and girls (e.g., Gagen, 1993; NSW Board of Studies). It would seem that explanations other than differential maths performance are needed for the gender imbalance in maths participation.

Gender Stereotypes as Possible Explanations

It is possible that some part of the explanation for why fewer girls than boys (or more boys than girls) participate in higher levels of maths both in the HSC and careers, may be due to students holding stereotypes about the appropriateness of maths for males versus females. Particularly amongst cognitive theorists, gender stereotypes are believed to provide the knowledge base against which behaviour is matched and its appropriateness evaluated (Eisenberg, Martin, & Fabes, 1996).

A developmental trend has been identified whereby gender-stereotyped judgments become more extreme as children grow older (Eisenberg, Martin, & Fabes, 1996). These developmental changes may be due to increased exposure to gender-stereotypic socialisation experiences and information. It is to be expected then that students from the eldest cohort in the present study may exhibit stronger evidence of gender stereotyped perceptions than the two younger cohorts.

In order to differentiate between gender stereotypes to which students subscribe, and socialisation forces of which they report being aware, the present study asks about students' perceived personal as well as social stereotypes. The explicit distinction between these two student-perceived stereotypes is made in order to identify any discrepancy between the two, which would imply either a discrepancy between students' awareness of gendered socialisation forces and their own gendered attitudes in relation to maths, or a discrepancy between their awareness of such social forces and their own reporting of self-perceptions. Qualitative reasons supplied by students to explain their gender stereotypic ratings should help illuminate which of these explanations is most likely.

Proposed sources of gender stereotypes are many and varied, ranging from exposure to role models (eg., Monaco & Gaier, 1992), to reinforcement experienced for sex-appropriate and sex-inappropriate behaviours (eg., Lamb, Easterbrooks, & Holden, 1980), to differential teacher and classroom experiences (eg., Spender & Sarah, 1992), to the important role played by the media in shaping ideas and attitudes (eg., Leder, 1992). To explore formative influences for participants in the present study, students were asked to nominate reasons for their reported personal and social gender stereotypes.

METHOD

Design

The present study examines gender differences in planned and actual achievement-related choices, in the form of HSC maths course selections, and further, career plans. Having established gender differences in the expected directions here, explanations are sought in students' perceptions of personal and social stereotypes about maths being more suited to males or females. In addition, qualitative explanations for students' sex-typed attitudes are investigated.

Participants

Participants spanned grades 7 to 11 in a cohort-sequential design comprising 1323 students in 3 cohorts. Table 1 depicts the sample size for each cohort, the grade of participants at each year of data collection and the gender composition for each cohort. The combined sample provides information on students from grades 7 to 11, with replication of grade effects across cohorts. Participants were drawn from three upper-middle class coeducational secondary schools in northern metropolitan Sydney, matched for socioeconomic status according to the Index of Education and Occupation, based on 1991 census data .

For the present study, HSC and career maths participation data from each administration were included, however gender stereotyping data were only collected on the first occasion for each of the three cohorts, being December Year 7 for Cohort 1, February Year 7 for Cohort 2 and December Year 9 for Cohort 3. Qualitative explanations for gender stereotypes were only collected for students from Cohort 1 (see Table 1) and only on occasion 1.

Table 1

Cohort Sample Size, Grade and Gender Composition

	1995 grade	**1996 grade**	**1997 grade**	**1998 grade**	**% girls**
Cohort 1 (n=428)	7(Dec)	8(June)	9(Feb)	10(Feb)	44.9
Cohort 2 (n=436)	-	7(Feb&Dec)	8(June)	9(Feb)	43.6
Cohort 3 (n=459)	-	9(Feb)	10(Feb)	11(Feb)	42.9

Materials

Maths Participation. Maths participation comprised HSC course plans as well as career intentions. HSC plans were ascertained via students checking boxes to indicate which level of maths HSC they planned to study. Since HSC coursework commences in Year 11, Year 11 reports are of actual rather than intended level of participation.

Career plans were ascertained via an open-ended question asking what career students intended pursuing. The maths relatedness of these plans was quantified using O*NET™98: The Occupational Information Network (U.S. Government, 1998). Categorisations were performed on the career content of students' nominated career plans for maths, as involving high, average, any or no mathematical content.

Gender Stereotyping of Maths. Personal and social gender stereotypes of maths were assessed via two items, each of which asked students to respond using 7-point Likert-type scales. Personal gender stereotypes were measured by the item: '*Would you describe maths as being more suited to males or females?*', and social gender stereotypes by: '*Would society in general describe maths as being more suited to males or females?*', each ranging from 1 (very feminine) through 4 (neutral) to 7 (very masculine).

Item distributions were found to be highly kurtotic, with the vast majority of students giving 'neutral' ratings to both questions (see Figures 4 and 5). It was therefore decided to use these items as grouping variables, such that students indicating maths as at all masculine formed one group, those indicating it as at all feminine formed another, and those seeing it as neutral formed a third group, respectively for each item.

Procedure

The study was conducted with informed student and parent consent, and the approval of the School Principals and formal University and Departmental ethical bodies. Administration was in the regular classroom to maximise ecological validity. The researcher was present at each administration to clarify or answer questions where necessary, with a trained assistant to aid with disseminating and collecting instruments and answering questions.

Analyses

Boys' and girls' planned participation in maths through HSC course selection and related careers were analysed using dominance analysis, summarised by the *d* statistic, which measures the extent to which one sample distribution lies above another and is used to make inferences about d, which measures the extent to which that is true in the population. This is a well established but not widely used measure for comparing two distributions . For a random variable X sampled from one distribution and a Y from another, d is the probability that X>Y minus the reverse probability: $d=Pr(x_i>y_j)-Pr(x_i<y_j)$. The sample estimate *d* of d is the proportion of *x*s from one population that are higher than those from the other, minus the reverse proportion: $d=(\#(x_i>x_j)-\#(x_i< x_j))/mn$. As a descriptive statistic, *d* is a direct reflection of the overlap in two sample distributions and is an unbiased estimate of d. Since the *d* distribution is asymptotically equivalent to the *z* distribution, inferential statistics can also be simply derived by converting *d* to a *z* score and comparing this with the appropriate critical value.

Evidence of personal gender stereotyping of maths was indicated by rating departures from the middle (neutral) category, and similarly for social gender stereotyping. Ratings below the midpoint reflected 'feminine', and ratings exceeding the midpoint 'masculine' gender stereotyping in each case. Chi-square tests examined whether there was any evidence for older Year 9 students holding stronger gender stereotypes, by comparing numbers of students from each cohort reporting maths as masculine, feminine or neutral, for each of personal and social stereotypes, separately for boys and girls. Students' qualitative explanations for ratings were thematically grouped and proportions of girls and boys from each cohort ascribing to the same explanations reported, for each of personal and social gender stereotypes.

RESULTS

Gender Differences in Maths Participation

As expected, boys planned to participate in higher levels of maths more than girls, as measured by senior high course level selections and career intentions. These differences were remarkably robust across grades.

Career Plans. As anticipated, at every grade level, a greater proportion of boys than girls intended pursuing highly maths related careers as shown in Figure 2. Calculation of *d*shows the boys' distribution lies .12 (in Year 7) to .21 (in Year 11) higher than girls'. Effect sizes are significant in each instance (p<.05, see Table 2). Table 2 reports the *d*statistic and its significance for each grade.

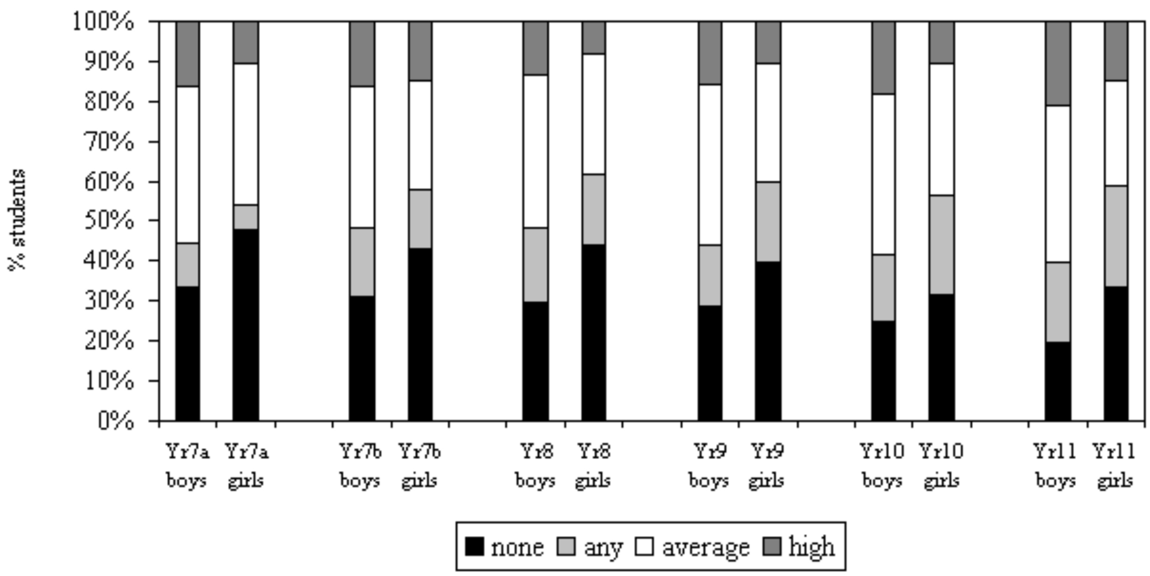


Figure 2. Mathematical relatedness of boys' and girls' career plans throughout secondary school (combined across three cohorts).

HSC Course Selection. Consistent with the trend for boys to plan greater participation in maths evident in career plans, a similar pattern clearly emerged with regard to planned participation in maths in senior high school. Students at each grade indicated which level of maths (Maths in Practice, Maths in Society, 2-unit, 3-unit, 4-unit, coded 1 to 5 respectively) they intended choosing in senior high school. Differences in proportions favouring boys were evident at each grade level, with effect sizes ranging from .13 to .18 (see Figure 4), and were statistically significant in each case (see Table 2). Recall that Year 11 responses reflect students' actual course level in senior high rather than intentions only.

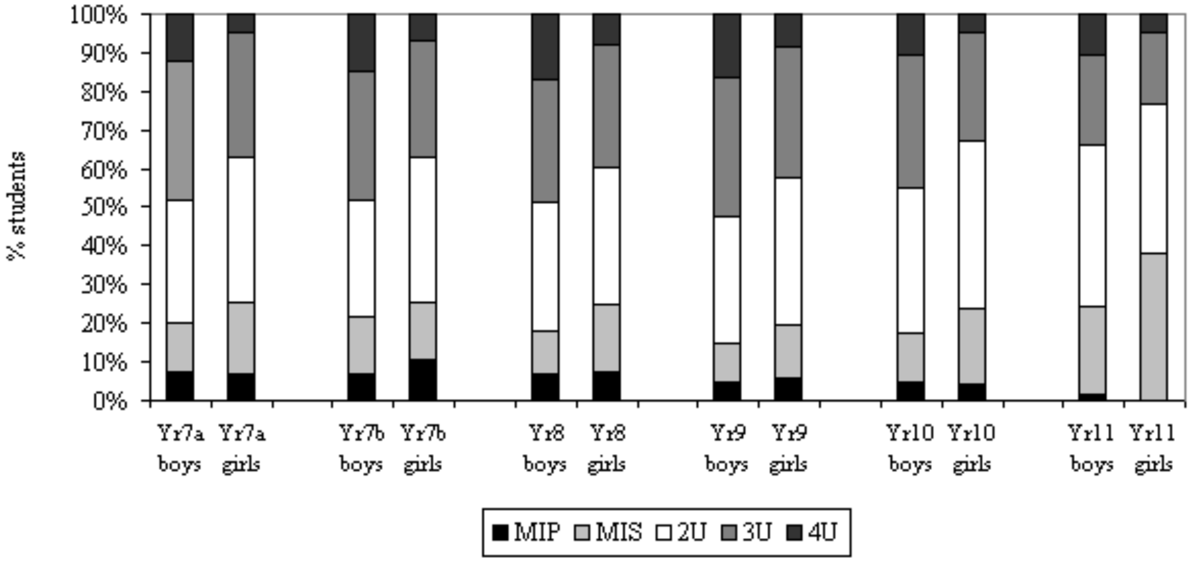


Figure 3. Gendered intentions for senior high maths course selection (combined across three cohorts).

Note. Year 11 results reflect students' actual course levels, since senior high maths commences in Year 11.

Table 2

Gender Differences in Maths Participation as Measured by Cohen's *d* for Career Plans and HSC Courses

Academic Choice		Year 7 start	Year 7 end	Year 8	Year 9	Year 10	Year 11
Career plans	*d*	.145*	.119*	.178*	.168*	.158*	.207*
	s_d	.066	.047	.046	.037	.045	.064
	z	2.20	2.53	3.87	4.54	3.51	3.23
HSC course level	*d*	.136*	.137*	.126*	.138*	.162*	.175*
	s_d	.060	.043	.041	.033	.040	.059
	z	2.27	3.19	3.07	4.18	4.05	2.97

Note. Positive values correspond to higher ratings for boys, negative values to higher ratings for girls, *denotes significance at $p<.05$.

Gender Stereotyping of Maths

Personal Gender Stereotypes. Overwhelmingly, students rated maths as equally suited to males and females (see Figure 4). For students reporting personal gender stereotypes, a greater proportion of both boys and girls perceived maths as 'masculine', with negligible proportions of students perceiving maths as 'feminine'. Chi-square testing comparing numbers of boys from each cohort rating maths as masculine, feminine or neutral was not significant (c^2 (4, N=604) = 6.39, p>.05), and neither was it for girls (c^2 (4, N=488) = 3.37, p>.05), failing to support the hypothesis that personal gender stereotypes may be stronger for older Year 9 students.

Social Gender Stereotypes. Similarly to personal gender stereotypes, the majority of students rated societal perceptions of maths as being equally suited to males and females (see Figure 5). Where social gender stereotypes occurred, a greater proportion of students reported societal perceptions of maths as 'masculine', with again a negligible proportion reporting them as 'feminine'. Social gender stereotypes appear more prevalent than personal ones, with an apparent age trend, whereby social gender stereotypes appear more prevalent for the eldest cohort as hypothesised. However, this developmental trend failed to achieve statistical significance for either boys (c^2 (4, N=588) = 4.26, p>.05), or girls (c^2 (4, N=483) = 7.15, p>.05).

Differences Between Personal and Social Gender Stereotypes. Social gender stereotypes were more prevalent than personal gender stereotypes for each cohort (see Figures 4 and 5). A greater proportion of both boys and girls within each of Cohorts 1 to 3 rated societal perceptions of maths as being masculine. As for personal stereotypes, social stereotypes of maths as feminine were negligible.

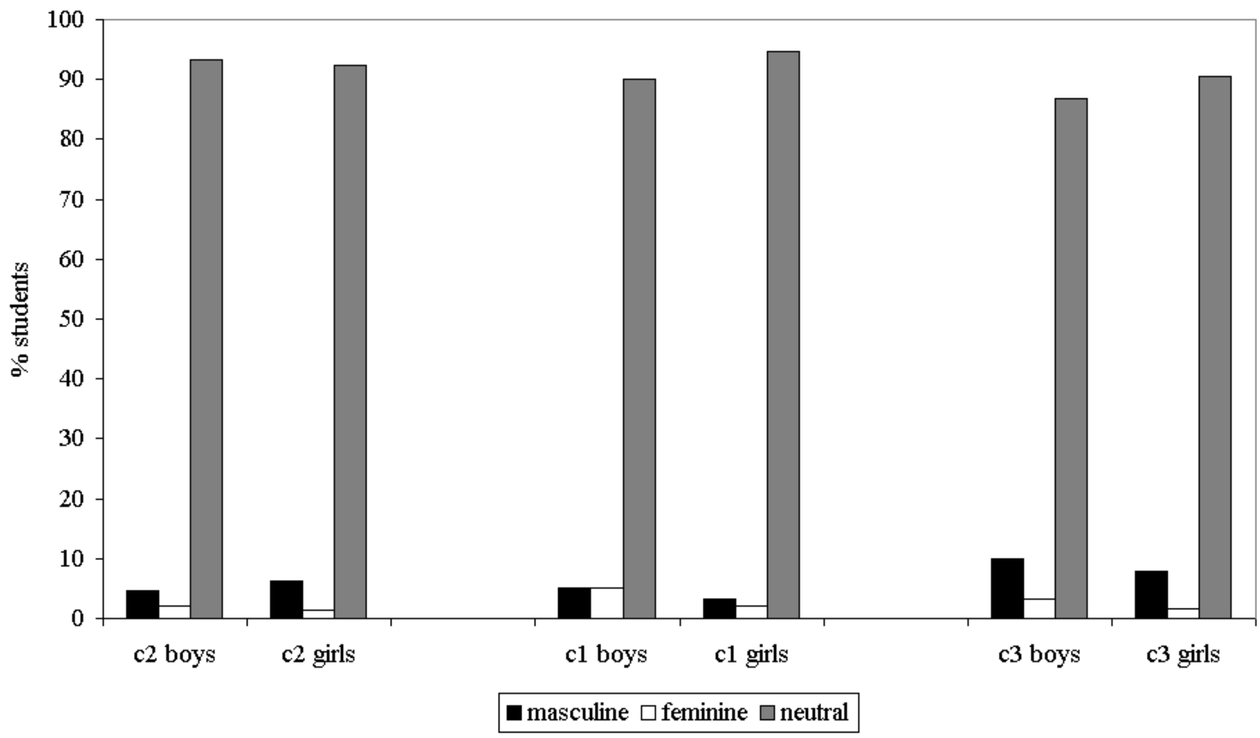


Figure 4. Proportions of boys and girls from each cohort rating personal perceptions of maths as being more suited to boys, girls or neither.

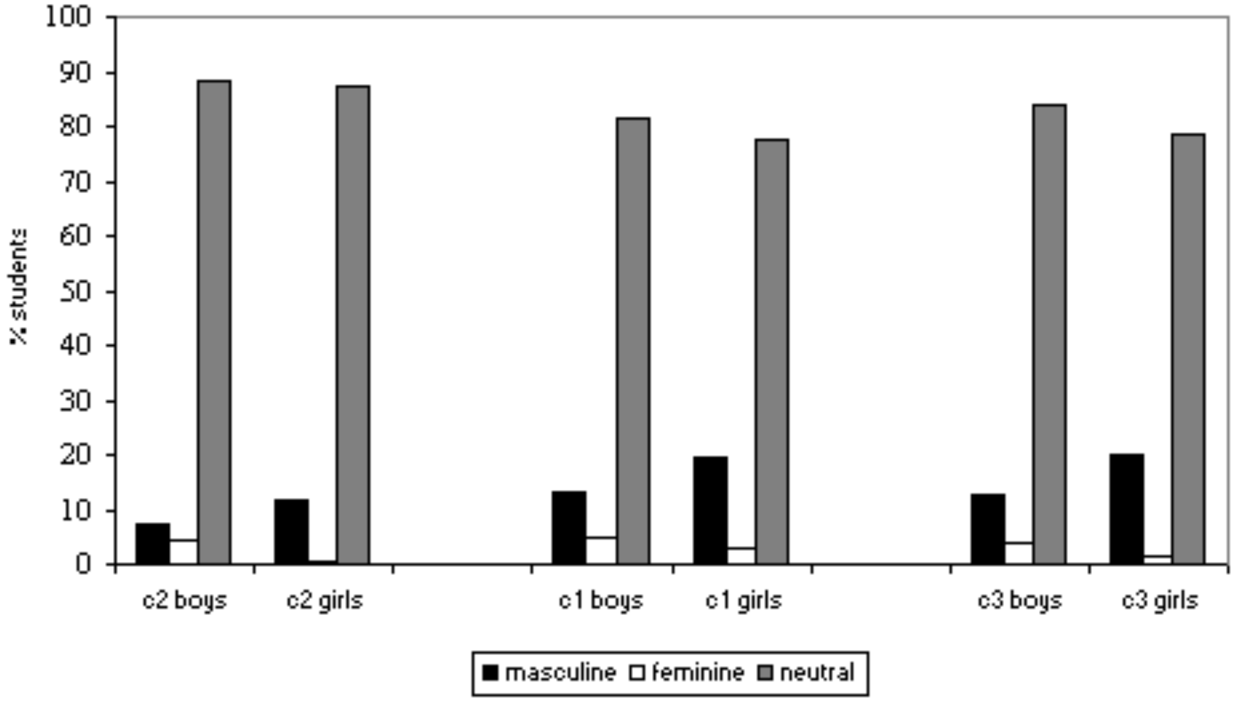


Figure 5. Proportions of boys and girls from each cohort rating societal perceptions of maths as being more suited to boys, girls or neither.

Explanations for Gender Stereotypes

Personal Gender Stereotypes. For boys personally stereotyping maths as masculine, feminine or neutral, reasons for masculine ratings included the existence of male role models (40%), males being smarter at maths (40%) and being sexist (20%). Boys' reasons for feminine ratings included girls performing better (29%), trying harder (29%), needing maths more for their careers (29%) and teachers favouring girls (14%). Reasons for neutral ratings were that it depends on individuals (5%), not being sexist (15%), both sexes being the same (61%), the gender overlap in maths performance (7%) and both sexes needing maths (12%). These reasons are tabulated in Table 3a.

Girls' reasons for masculine stereotypes were because boys perform better at maths (100%). Reasons for feminine stereotypes included girls trying harder (67%) and that it depends on the individual (33%). Reasons for neutral ratings were that it depends on the individual (8%), not being sexist (13%), both sexes being the same (53%), the gender overlap in maths performance (12%) and both sexes needing maths (14%). These reasons are tabulated in Table 3b.

Social Gender Stereotypes. Boys' explanations for masculine social gender stereotypes of maths again included the existence of male role models (54%), males being smarter at maths (15%) and society being sexist (31%). Boys' explanations for feminine social stereotypes were the existence of female role models (20%), no-one being fair to boys (20%), girls trying harder (40%) and girls needing maths more for their careers (20%). Reasons given for neutral social stereotypes were that it depends on the individual (4%), society not being sexist (22%), both sexes being the same (60%), the gender overlap in maths performance (6%) and both sexes needing maths (8%). These reasons are tabulated in Table 4a.

Girls' explanations for masculine social maths gender stereotypes were the existence of male role models (75%), boys performing better at maths (13%) and societal sexism (13%). Reasons for feminine social stereotypes included sexism (50%) and female work needing maths more (50%). Reasons for neutral social stereotypes were that it depends on the individual (2%), society not being sexist (21%), both sexes being the same (59%), both sexes needing maths (15%) and the gender overlap in maths performance (3%). These reasons are tabulated in Table 4b.

Table 3a

Explanations for Boys' Personal Gender Stereotypes (Cohort 1)

	Masculine N=5	**Feminine** N=7	**Neutral** N=99
Male role models	40.0 (2)		
Males smarter at maths	40.0 (2)		
I am sexist	20.0 (1)		
Girls do better		28.6 (2)	
Girls try harder		28.6 (2)	
Female work needs it more		28.6 (2)	
Teachers favour girls		14.2 (1)	
Depends on the individual			5.1 (5)
I'm not sexist			15.2 (15)
Both sexes are the same			60.6 (60)
Gender overlap in performance			7.0 (7)
Both sexes need maths			12.1 (12)

Table 3b

Explanations for Girls' Personal Gender Stereotypes (Cohort 1)

	Masculine **N=4**	**Feminine** **N=3**	**Neutral** **N=113**
Boys do better	100.0 (4)		
Girls try harder		66.7 (2)	
Depends on the individual		33.3 (1)	8.0 (9)
I'm not sexist			13.2 (15)
Both sexes are the same			53.1 (60)
Gender overlap in performance			11.5 (13)
Both sexes need maths			14.2 (16)

Table 4a

Explanations for Boys' Social Gender Stereotypes (Cohort 1)

	Masculine **N=13**	**Feminine** **N=5**	**Neutral** **N=50**
Male role models	53.8 (7)		
Males smarter at maths	15.4 (2)		
Sexist	30.8 (4)		
Female role models		20.0 (1)	
No-one fair to boys		20.0 (1)	
Girls try harder		40.0 (2)	
Female work needs it more		20.0 (1)	
Depends on the individual			4.0 (2)

Not sexist			22.0 (11)
Both sexes are the same			60.0 (30)
Gender overlap in performance			6.0 (3)
Both sexes need maths			8.0 (4)

Table 4b

Explanations for Girls' Social Gender Stereotypes (Cohort 1)

	Masculine N=8	**Feminine** N=2	**Neutral** N=66
Male role models	75.0 (6)		
Boys do better	12.5 (1)		
Sexism still exists	12.5 (1)		
Sexist		50.0 (1)	
Female work needs it more		50.0 (1)	
Depends on the individual			1.5 (1)
Not sexist			21.2 (14)
Both sexes are the same			59.1 (39)
Gender overlap in performance			3.0 (2)
Both sexes need maths			15.2 (10)

DISCUSSION

As anticipated, boys planned to participate in maths to a greater extent than girls, as operationalised through examination of students' planned levels of HSC maths and maths-related career intentions. Boys planned both to pursue higher levels of HSC maths and have more highly maths-related careers than girls. Conversely, a greater proportion of girls planned to pursue the lowest levels of HSC maths and careers involving no maths. It is worth noting that reported intentions appeared remarkably stable through grades 7 to 11. In the case of HSC maths plans, where grade 11 data reflect actual rather than intended level of participation, the similarity of earlier with grade 11 data supports the veracity of student intentions as predictors of later behaviour. It is remarkable, given the wealth of experience students accumulate through high school, and the efforts of educators to moderate students' beliefs about subject choice, that plans for participation in maths are quite stable throughout high school.

Gender differences in maths participation identified in this study support a plethora of research findings that women are under-represented in the study of maths and in careers requiring maths (e.g., Fennema, Wolleat, Pedro, & Becker, 1981; Sherman, 1982; Willis, 1989; Leder, 1992). Given that differences in maths performance are unlikely to account for differences in participation (Hyde, Fennema, & Lamon, 1990; Friedman, 1989), students' perceived maths gender stereotypes were examined, since gender stereotypes are believed to provide the knowledge base against which adolescents match behaviour and evaluate its appropriateness (Eisenberg, Martin, & Fabes, 1996).

As expected, gender stereotypes about maths favoured males where they occurred, with the highest proportion of students holding masculine personal gender stereotypes being 10% (cohort 3 boys), although the overwhelming majority of students professed holding no gender stereotypes about maths. Student perceptions of societal gender stereotypes about maths also favoured males where these occurred, the highest proportion for any group reporting masculine societal perceptions being 20% (girls in cohorts 1 and 3) although again, the vast majority of students reported societal perceptions about maths to be non-gender-stereotypic.

Both personal and social gender stereotyping of maths as 'masculine' may be expected to impact on boys' and girls' intentions regarding maths participation. Girls who personally stereotype maths as masculine are unlikely to pursue high levels of maths, perceiving themselves as unsuited to it. Boys personally stereotyping maths as masculine may be encouraged to participate strongly in it, perceiving themselves as well suited to this domain. Also, girls perceiving societal gender stereotyping of maths as 'masculine' may be less eager particularly to pursue highly maths-related careers, perceiving impediments to their success via lack of social support and even social antipathy. Conversely, boys perceiving societal stereotypes of maths as 'masculine', may feel their likelihood of success in this domain is enhanced through social support. Stereotyping of maths as 'feminine' may be expected to have the reverse impact, although proportions of students subscribing to maths as feminine were negligible (less than 5%) in any case.

Although it is certainly possible that cultural conceptions of maths are no longer stereotyped as masculine, students' qualitative responses provided at Year 7 by students in Cohort 1, explaining their personal ratings, suggest an alternative explanation. 15% of boys and 13% of girls gave the explanation that they are 'not sexist' to explain their 'neutral' personal stereotypic ratings. This, however, may be more of a defensive than an explanatory response to the question. Similarly simplistically, 61% of boys and 53% of girls cited 'both sexes are the same' as their explanation. This could also be construed as a politically correct response. For social gender stereotypes, 22% of boys and 21% of girls gave 'not sexist' as their explanation for neutral societal gender-stereotypic ratings, and 60% of boys and 59% of girls gave 'both sexes are the same' as their explanation for these neutral ratings. It is suggested then that these students may be desirous of giving what are perceived as politically correct responses to questions about gender difference. This possibility is further strengthened by student comments on the study when they were encouraged to ask questions of the researcher following administration, where several independent comments about the 'sexist survey' were made. Considering that there were only three questions relating to gender stereotypes in a 97-item survey followed by a 28-item multiple-choice maths test, such comments appear significant. The interpretation is further strengthened by the fact that social gender stereotypes were more prevalent than personal stereotypes. This may suggest the possibility that students feel constrained by views of political correctness to report their personal perceptions as 'neutral', and it is only under the guise of reporting others' perceptions (society's), that their true perceptions are revealed. Alternatively, it is possible that students reporting societal perceptions of maths as masculine but not their personal perceptions, may be aware of social influences but reject them. More in-depth questioning would be needed to substantiate this possibility, as the evidence here is suggestive only.

The anticipated age trend whereby gender stereotypes were expected to be stronger for older students, was not supported in the present study. Proportions of students *personally*stereotyping maths as masculine were too small for such patterns to emerge. Descriptive statistics are in the expected developmental direction for *social* masculine gender stereotypes, although this trend failed to achieve statistical significance. Possible explanations for no developmental pattern are first, that as discussed above, students are not really reporting what they think, or indeed, not thinking about what they might believe, due to the constraints of political correctness. Alternatively, perhaps the developmental pattern, if it occurs, may occur in younger years, and by the time students are in secondary school such acculturation is complete. Finally, it is possible that gender stereotyping of maths is reducing or has reduced to the extent that such effects on students are insignificant.

Given these caveats about the veracity of students' neutral stereotypic ratings, the negligible proportions of feminine stereotypes, and the failure to identify a developmental pattern of stereotypes, students' qualitative reasons for their reported masculine and neutral views are discussed. Explanations for masculine personal gender stereotypes were mainly in terms of boys being better at maths, and specifically for boys, the existence of male role models. For masculine social gender stereotypes, the main reason given by both genders was this existence of male role models. As reported earlier, the main reasons given for neutral stereotypes, both personal and social, were both sexes being the same, and not being sexist. Other reasons both boys and girls gave, in the same order of descent, for personal gender stereotypes were that both sexes need maths, the gender overlap in maths performance, and that it depends on the individual. For neutral social gender stereotypes, aside from the previously discussed 'not sexist' and 'both sexes are the same' responses, other responses were as for personal gender stereotypes. Again in the same order of descent for boys and girls, these were that both sexes need maths, the gender overlap in performance and that it depends on the individual.

The 'both sexes need maths' explanation implies that the fact that both genders have to study maths at school and are told maths is useful for their future lives and careers, is likely to result in students not stereotyping maths as more suited to either gender. On the other hand, awareness that students of both genders study maths at school is clearly not enough to outweigh the impact of male role models for students stereotyping maths as masculine citing this as their reason. The gender overlap in maths performance, awareness of which is often due to studying alongside students of both genders, and also to media reports, similarly is likely to result in students not stereotyping maths as more suited to either gender. However, for those students stereotyping maths as masculine, citing boys being better at maths as their reason, this is clearly not enough to outweigh emphasis on high-achieving boys in maths, which may well be due to the emphasis the media places on any suggestion of gender difference in maths. There are many examples of selective media reporting on students in maths. For example, in 1988 after a one-week ANZAAS (Australian and New Zealand Association for the Advancement of Science) Conference, the only conference paper to make national front page and headline news was headed 'Girls Don't Count in Maths', and was followed by a biased and inaccurate summary of the work presented (Willis, 1989). The research of Benbow and Stanley (1980), which attempted to find a biological basis for male and female mathematical achievement, prompted a highly disturbing response from the media. Some news report headlines of this research were *'Do Males have a Math Gene?'*, *'The Gender Factor in Math'*, *'Male Superiority'*, *'Are Boys Better at Math?'*, *'Boys Have Superior Math Ability, Study Says'*, *'Sex + Math = ?*', and *'Study Suggests Boys May be Better at Math'* (Eccles & Jacobs, 1986). One must be concerned about the effect of such coverage on students' maths-related attitudes. In the face of such pervasive gender stereotyping by the media, passive non-discrimination is simply not an adequate intervention strategy, given the proportions of boys and girls citing boys being better at maths as explanations for their masculine personal gender stereotypes about maths.

What are the implications of these findings for policy and practice? Clearly educators could easily give examples of female role models as well as the oft-cited great male mathematicians of the past. It is likely that ensuring similar proportions of male and female maths teachers, particularly for the higher levels of maths, would also have a positive effect in reducing masculine stereotypes about maths. In addition, active strategies should be undertaken to counter-balance invalid and disproportionate media emphasis on boys being naturally better at maths than girls. This could be in the form of a 'current research about students and schools' section in the weekly school newsletter for example, with information drawn from reputable academic journals. Although it appears encouraging that incidence of gender stereotyping of maths is low from this study, the overwhelming 'neutral' reported gender stereotypes should be interpreted with some caution, given that explanations for these perceptions suggest possible constraints of the current climate of political correctness.

Helen M G Watt
Lecturer and PhD Candidate
School of Educational Psychology
Faculty of Education (A35)
University of Sydney 2006
AUSTRALIA
Tel: +612 9351 6390
Fax: +612 9351 2606
Email: h.watt@edfac.usyd.edu.au
Homepage: http://www.edfac.usyd.edu.au/staff/watth/

References

Eccles, J. & Jacobs, J. (1986). Social forces shape math attitudes and performance. Signs, 11, 367-380.

Eisenberg, N., Martin, C. L., & Fabes, R.A. (1996). Gender development and gender effects. In D. C. Berliner & R. C. Calfee (Eds.), Handbook of educational psychology (pp. 358-396). New York: Macmillan.

Fennema, E. & Carpenter, T.P. (1998) New perspectives on gender differences in mathematics, Educational Researcher, 27, 4-5.

Fennema, E., Wolleat, P.L., Pedro, J.D., & Becker, A.deV. (1981). Increasing women's participation in mathematics: An intervention study. Journal for Research in Mathematics Education, 12, 3-14.

Friedman, L. (1989). Mathematics and the gender gap: A meta-analysis of recent studies on sex differences in mathematical tasks. Review of Educational Research, 59(2), 185-213.

Gagen, T.M. (1993). Overview of HSC statistics. Reflections, 18(1), 51-59.

Hyde, J.S., Fennema, E., & Lamon, S.J. (1990). Gender differences in mathematics performance: A meta-analysis. Psychological Bulletin, 107(2), 139-155.

Lamb, M.E., Easterbrooks, M.A., & Holden, G.W. (1980). Reinforcement and punishment among preschoolers. Child Development, 51, 1230-1236.

Leder, G. (1992). Mathematics and gender: Changing perspectives. In D. A. Grouws (Ed.), Handbook of research on mathematics teaching and learning. New York: Macmillan.

Monaco, N.M. & Gaier, E.L. (1992). Single-sex versus coeducational environment and achievement in adolescent females. Adolescence, 27, 579-94.

Sells, L.W. (1973). High school mathematics as the critical filter in the job market. In R. T. Thomas (Ed.), Developing opportunities for minorities in graduate education(pp. 37-39). Berkeley: University of California Press.

Sherman, J. (1982). Mathematics the critical filter: A look at some residues. Psychology of Women Quarterly, 6, 428-444.

Spender, D. & Sarah, E. (1992). Learning to lose: Sexism and education (2nd Ed.). London: Women's Press.

U.S. Government (1998). O*NET98: The occupational information network data dictionary (Release 1.0). U.S. Department of Labor, Employment and Training Administration.

Willis, S. (1989). 'Real girls don't do maths': Gender and the construction of privilege. Geelong, Victoria: Deakin University Press.