CHANGE

TRANSFORMATIONS IN EDUCATION

Editorial

This edition of CHANGE presents contributions from China, Australia, Norway and England and New Zealand. The issues canvassed in these papers indicate the diversity of research being undertaken in these countries. The papers represent work being undertaken in the fields of sociology, psychology, cultural studies, comparative education and curriculum. The work presented is indicative of investigations into higher education research in China, practitioner research that develops the idea of a knowledge building school, investigations into equity that relate to gender and class in Australia and New Zealand, rethinking leadership and methodologies for investigating educational leaders at work and finally an examination of past Higher School Certificate English Exams in New South Wales.

What do then these contributions tell us about current education research being undertaken in these countries? First and foremost, they indicate the diversity of methodologies and interests of academics working in the field of education. Second, these papers demonstrate the levels of activity of academic practice. From China we get a sense of the broad political project of research into higher education, From Norway, England and Australia we see how academics are working with practitioners to better understand practice. In Australia and New Zealand, researchers are trying to better understand how issues of gender and class affect student performance and students' perceptions of their performance. Finally, in various ways, we get a sense that education research does make a difference to education policy and practice. It informs the policy making process, it helps to communicate ideas about practice to various constituencies and contributes to the critique of taken for granted aspects of education in order to theorise the field.

The first paper by Pan, Li and Chen from China provides a chronicle of higher education research in China. The authors argue that since the mid 1990s, China's higher education research has entered a stage of steady development and improvement. Research into theoretical and practical problems of reform and development have been the main focus. Importantly, this research has had a significant impact decision-making and in the education reform process itself. Many researchers elsewhere would be more than happy for their research to have such an impact on government policy.

The paper by Groundwater-Smith and Mockler provides an account the work of two school-based facilitators: an external consultant in the form of researcher in residence and the Director of Learning. Both use forms of practitioner research as a teacher development strategy. The paper describes the impact that these positions had on the development of an active school based research community.

Roy Nash's paper reports on the Progress at School Project in New Zealand. This project is designed to investigate school effects, found progress at school to be associated with non-cognitive dispositions, most importantly aspiration, self concept and a willingness to be subject ed to the discourse of schooling. The paper presents some preliminary results into the conditions of differential attainment based on responses from a sample of secondary school pupils who had been identified as having demonstrated positive or negative relative progress. Using Bourdieu's theory of habitus and the stratified self, Nash develops the idea of the dispositions of the self, which, he argues, direct the individual to behave in accordance with socialised habits. Nash makes the important point that a school where students are treated unfairly will depress their aspirations, their-self confidence, and their willingness to accept the order of the school as legitimate.

Helen Watt presents the results of a longitudinal study of three sequential cohorts of students over three years to explore adolescent personal and social gender stereotypes about maths. Students rated the extent to which they perceived maths as more suitable to males than to females (or to both equally), as well as the extent to which they believed 'society' perceived maths as more suited to either gender. Watt reports that despite most students' ratings favouring neither gender, stereotypes favoured boys for maths when stereotyping occurred. She goes on to argue that social stereotypes appeared to be more prevalent than personal stereotypes, perhaps reflecting cultural change and indicating perhaps a degree of political correctness on the part of students' self perceptions.

Neil Cranston in his paper on revolutionary leadership seeks to raise debate about issues of leadership, strategy, structures and culture of many contemporary education systems. He argues that past reforms have failed to deliver the required changes to deal with uncertain and rapidly changing political agendas. In response to this problem, Cranston suggests the need for new mindsets that, at their core, fundamentally challenge and change the culture, the principles, values and power relationships in education systems. Such shifts, Cranston suggests, will provide the opportunity to generate new ideas that lead to doing things differently and put student learning as the driver of any new education initiative.

The penultimate paper by Moller and Spindler presents research from a comparative study undertaken in Norway and England. This paper explores the language games implicit in the interactions between researchers and school principals in the process of co-construction. It examines how 'rules' that structure interactions between researchers and school principles were established and sustained during the course of interviews. The issue of power is important, for as Moller and Spindler observe, the analysis of the language games inherent in the interviews has implications for the research process in general and school leadership in particular.

The final contribution to this edition is by Gary Rossiter and is concerned with examining past Higher School Certificate (HSC) English examinations with an eye to critiquing the questions that were asked and the criteria by which they were answered. Rossiter argues that since 1965 the HSC English examination has attempted to call forth a style of writing that will allow students to 'pass' as members of an upper middle class. He maintains that this has produced a particular kind of knowledge and given preference to a particular kind of individual.

PROFESSOR JUDYTH SACHS, EDITOR

Bunge, M. (1996) *Finding Philosophy in Social Science*, New Haven: Yale University Press.
Bunge, M. (1998) *Social Science Under Debate: A Philosophical Perspective*, Toronto: University of Toronto Press.
Christie, F. (1997) 'Curriculum macrogenres as forms of initiation into a culture', in F. Christie & J. R. Martin(eds), *Genre and Institutions: Social Processes in the Workplace and School*, Cassell: London, pp. 134-160.
Collier, A. (1989) *Scientific Realism and Socialist Thought*, Hemel Hempstead, Harvester.
Corrigan, P. (1990) *Social Forms/human Capacities: Essays in Authority and Difference*, London: Routledge.
Davies, B. (1993) Shards of Glass: *Children Reading and Writing: Beyond Gendered Identities*, St Leonards, NSW: Allen & Unwin.
Davies, B. & Harré, R. (1990) 'Positioning: the discursive production of selves', *Journal for the theory of social behaviour*, 20 (1), pp. 43-63.
Eagleton, T. (1996) *The Illusions of Post-modernism*, Oxford: Blackwell.
Foucault, M. (1980) *Truth and Power in Power/knowledge: Selected Interviews and Other Writings 1972-1977*, Brighton: Harvester.
Harré, R. (1997) 'Forward to Aristotle', *Journal for the Theory of Social Behaviour*, 27, (2/3), pp. 173-191.
Hird, M. J. (1998) 'Theorizing student identity as fragmented: some implications for feminist critical pedagogy', *British Journal of Sociology of Education*, 19 (4), pp. 517-527.
Hunter, I. (1988) 'Learning the literature lesson: the limits of the aesthetic personality', in C. Baker & A. Luke, (eds), *Towards a Critical Sociology of Reading and Pedagogy*, John Benjamin: Amsterdam, pp. 52-82.
Kenway, J., & Willis, S. (eds), (1993) *Hearts and Minds: Self-esteem and the Schooling of Girls*, London: Falmer.
Margolis, J. (1993) *The Flux of History and the Flux of Science*, Berkeley, CA: University of California Press.
Margolis, J. (1998) '*Habitus* and the logic of practice', in R. Shusterman (ed.), *Bourdieu: A Critical Reader*, Oxford: Blackwell, pp. 64-83.
Nash, R. (1999) *School Learning: Conversations with the Sociology of Education*, Delta Studies in Education, No. 3, Palmerston North: Delta Press.
Nash, R. & Harker, R. K. (1998) Making Progress: *Adding Value in Secondary Education*, Palmerston North: ERDC Press.
Outhwaite, W. (1987) *New Philosophies of Social Science: Realism, Hermeneutics and Critical Theory*. London: Macmillan.
Pollard, A. (1990) 'Towards a sociological learning in primary schools', *British Journal of Sociology of Education,* 11 (2), pp. 241-256
Sayer, A. (1992) Method in Social Science: A Realist Approach, 2nd edition, London: Routledge.
Shavit, Y. & Blossfield, H. P. (1993) *Persisting Inequality: Changing Educational Attainment in Thirteen Countries*, Boulder, CO: Westview Press.
Smith, D. & Tomlinson, S. (1989) *The School Effect: A Study of Multi-racial Comprehensives*, London, Institute of Policy Studies.
Wagemaker, H. (1993) (ed.), *Achievement in Reading Literacy: New Zealand's Future in a National and International Context*, Wellington, Research Section, Ministry of Education.
Williams, T. & Batten, M. (1981) *The Quality of School Life*, Hawthorn, Victoria: ACER Research Monograph No. 12.

Exploring adolescent personal and social gender stereotypes about maths:

An explanation for continued gender differences in participation?

HELEN M. G. WATT, UNIVERSITY OF SYDNEY

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 to both equally). 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.

EXPLORING ADOLESCENT PERSONAL AND SOCIAL GENDER STEREOTYPES ABOUT MATHS: AN EXPLANATION FOR CONTINUED GENDER DIFFERENCES IN PARTICIPATION?

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; Leder, 1992; Leder & Forgasz, 1997; Sherman, 1982; Watt & Bornholt, 2000; Willis, 1989). 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).

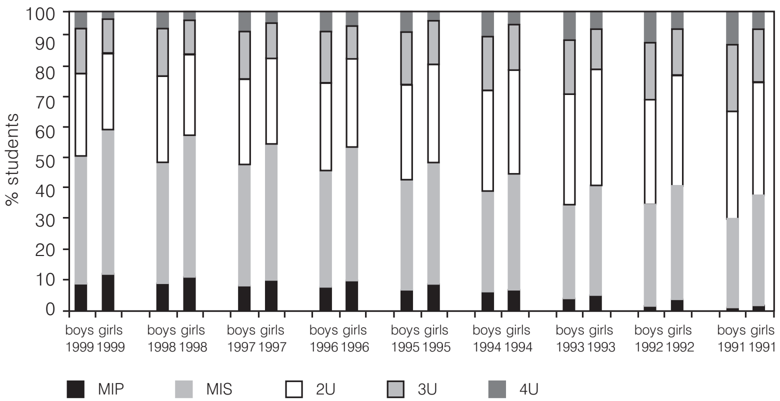


Figure 1: Gendered participation rates for HSC maths courses 1991-1999.

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). 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 (e.g., Monaco & Gaier, 1992), to reinforcement experienced for sex-appropriate and sex-inappropriate behaviours (e.g., Lamb, Easterbrooks, & Holden, 1980), to differential teacher and classroom experiences (e.g., Spender & Sarah, 1992), to the important role played by the media in shaping ideas and attitudes (e.g., 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 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 (ABS, 1991).

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 at 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)	9(Feb)	44.9
Cohort 2 (n=436)		7(Feb&Dec)	8(June)	8(June)	43.6
Cohort 3 (n=459)		9(Feb)	10(Feb)	10(Feb)	42.9

Materials

Maths Participation

Maths participation consisted of 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, see Watt, 2002 for details). 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 δ, 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 (Cliff, 1993). For a random variable X sampled from one distribution and a Y from another, δ is the probability that X>Y minus the reverse probability: $\delta=\Pr(x_i>y_j)-\Pr(x_i<y_j)$. The sample estimate d of δ is the proportion of xs 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 δ. 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.

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 3), 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.

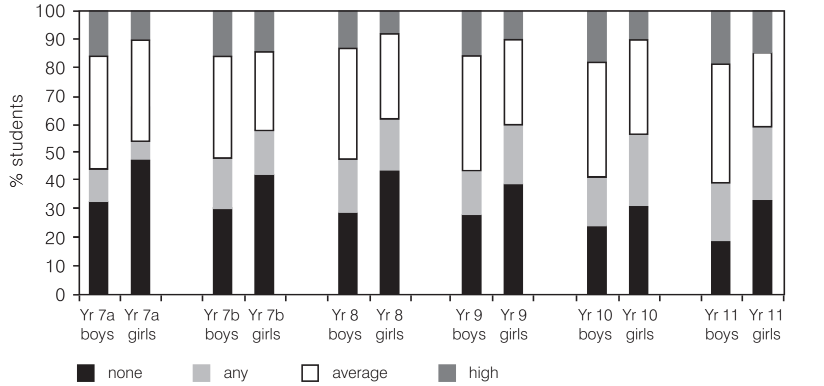
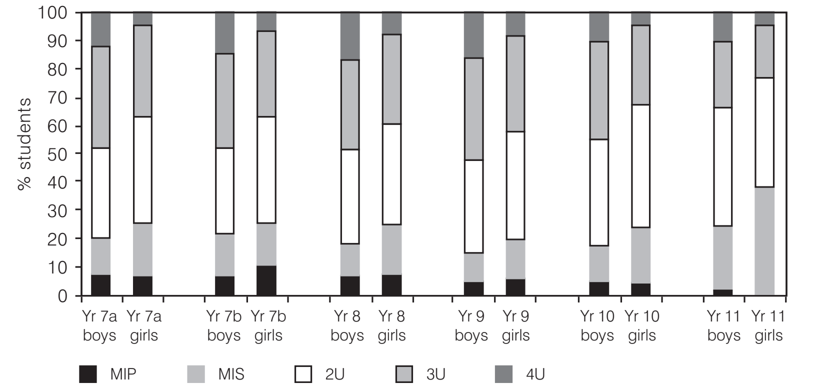


Figure 2: Mathematical relatedness of boys’ and girls’ career plans throughout secondary school (combined across three cohorts).



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

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

Table 2: Gender differences in maths participation as measured by Cliff's *d* for career plans and HSC courses

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

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 (c2 (4, N=604) = 6.39, p>.05), and neither was it for girls (c2 (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 are more prevalent for the eldest cohort as hypothesised. However, this developmental trend failed to achieve statistical significance for either boys (c2 (4, N=588) = 4.26, p>.05), or girls (c2 (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.

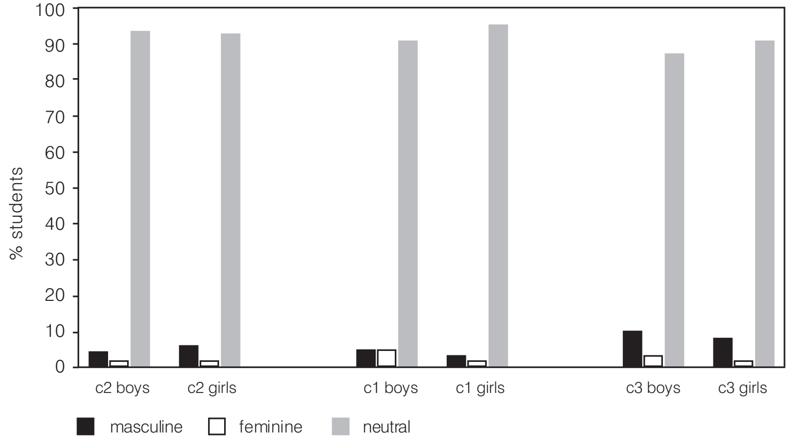


Figure 4: Proportions of boys and girls from each cohort rating personal perceptions of maths as being more suited to boys, girls or neither.

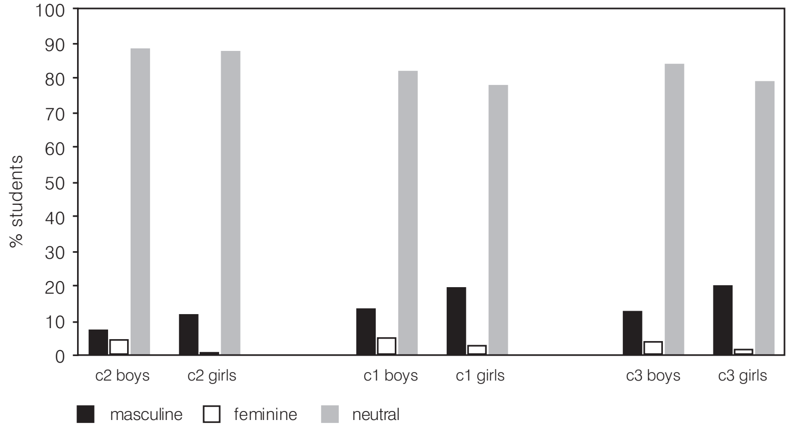


Figure 5: Proportions of boys and girls from each cohort rating societal perceptions of maths as being more suited to boys, girls or neither.

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 % (n)	Feminine n=7 % (n)	Neutral n=99 % (n)
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 % (n)	Feminine n=3 % (n)	Neutral n=113 % (n)
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 $n=13$ % (n)	Feminine $n=5$ % (n)	Neutral $n=50$ % (n)
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 $n=8$ % (n)	Feminine $n=2$ % (n)	Neutral $n=66$ % (n)
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 later 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; Leder, 1992; Leder & Forgasz, 1997; Sherman, 1982; Watt & Bornholt, 2000; Willis, 1989). 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.

It is certainly possible that cultural conceptions of maths are no longer stereotyped as masculine, as has been suggested by other researchers (e.g., Wigfield, Eccles, Mac Iver, Reuman, & Midgley, 1991). An interesting alternative hypothesis is suggested by students' qualitative responses provided at Year 7 by students in Cohort 1, to explain their personal ratings. 15% of boys and 13% of girls gave the explanation that they are 'not sexist' to explain their 'neutral' personal stereotypic ratings. It is possible that this 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 possible that these students may be desirous of giving what are perceived as politically correct responses to questions about gender difference. This possibility is 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 greater frequency of social than personal gender stereotypes may also suggest the possibility that students feel constrained by views of political correctness to report their personal perceptions as 'neutral', and only reveal their 'true' perceptions under the guise of reporting others' perceptions (society's). 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 explore this possibility, as the evidence here suggests 'political correctness' as an interesting hypothesis 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 were 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.

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 frequency of these masculine gender stereotypes was, however, extremely low, with the overwhelming majority of students giving 'neutral' ratings.

Evidence of students' personal gender stereotypes and their perceptions of social gender stereotypes about mathematics were not forthcoming from the results of the present study. Perhaps maths is no longer perceived as a masculine domain (Wigfield, Eccles, Mac Iver, Reuman, & Midgley, 1991), or perhaps the measures employed in the present study were not sufficiently sensitive to assess the existence of such stereotypes. From the overwhelmingly 'neutral' stereotypes related to maths, it seems that students' personal gender stereotypes and perceptions of social gender stereotypes do not explain continued gendered participation in maths-related choices for HSC course levels and career plans. Other explanations such as socialisation of gender differences are more likely to explain this continued gender imbalance in maths participation.

REFERENCES

ABS (1991). *Index of Education and Occupation* (Catalogue No. 2912.0). Sydney: Australian Bureau of Statistics.

Benbow, C. & Stanley, J. (1980). Sex differences in mathematics ability: Fact or artifact? *Science, 210*, 1262-1264.

Cliff, N. (1993). Dominance statistics: Ordinal analyses to answer ordinal questions. *Psychological Bulletin*, 114, 494-509.

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.
Leder, G. C., & Forgasz, H. J. (1997). A case study in mathematics: Looking back towards the future. *Australian Educational Researcher*, 24, 97-113.
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.
Watt, H. M. G.(2002). *Gender achievement-related choices and behaviors in mathematics and English: The nature and influence of self-, task-, and value perceptions.* Unpublished PhD, University of Sydney
Watt, H. M. G., & Bornholt, L. J. (2000). Social categories and student perceptions in high school mathematics. *Journal of Applied Social Psychology*, 30, 1492-1503.
Wigfield, A., Eccles, J., Mac Iver, D., Reuman, D., & Midgley, C. (1991). Transitions at early adolescence: Changes in children's domain-specific self-perceptions and general self-esteem across the transition to junior high school. *Developmental Psychology*, 27, 552-565.
Willis, S. (1989). *'Real girls don't do maths': Gender and the construction of privilege.* Geelong, Victoria: Deakin University Press.

Revolutionary leadership, education systems and new times:

More of the same or time for real change?

NEIL CRANSTON, QUEENSLAND UNIVERSITY OF TECHNOLOGY

This article seeks to raise debate about issues of leadership, strategy, structure and culture of many of our education systems in these new times of rapid and discontinuous change. It argues that, in the main, the plethora of past reforms and restructures of education systems, schools and schooling have failed to deliver the needed changes for these times. It posits that a revolutionary leadership approach to change at the centre, not an evolutionary one, is needed, characterised by new mind-sets in educational leaders that fundamentally challenge and change the culture, the principles, the values and the power relationships in how education systems have been conceptualised and organised in the past. While acknowledging that change must also occur in many other areas and aspects of the education milieu – these are not considered here - the article is deliberately provocative in its approach in an endeavour to encourage debate about many issues that have in a sense remained "undiscussable". It does not offer a recipe of solutions to the challenges it raises. Rather, hopefully it catalyses the application of new mind-sets to these challenges and the generation of ideas that lead to new ways of doing things that see the teaching and learning of young people as the dominating driver of the strategy, structure and culture of education systems.

bureaucracies … (are) bloated public services, staffed by indolent bureaucrats, motivated by insular status acquisition, and organised by hierarchic order. Power and status … related to the size of the empire established. Numbers of staff … taken as a measure of the importance of a particular department or authority. (O'Faircheallaigh, Wanna & Weller, 1999, p. 25)

We must break the chains of the old mind-set if we are to grapple successfully with the task of managing adaptive organisations. … The enemy 'within ourselves' is the old mindset. (Pascale, 1990, p. 88).