

Tertiary mathematics students: Why are they here?

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This paper is concerned with factors influencing students' decisions to attend university, to study mathematics at university and at school, and their levels of enjoyment of mathematics in these settings. The sample comprised just under 1900 students from five universities. All were enrolled in mathematics subjects. Generally, fewer students liked mathematics at university than at school. Many chose mathematics to keep their options open or because mathematics was a pre-requisite for further study, rather than because of family advice or university publicity. Comparisons were also made between the responses of younger and mature age students, and between females and males.

Background to the study

Mathematics remains an important area of study and serves as a barrier to a range of educational opportunities and career options. While in many countries more students than ever before are accessing higher education, there is growing international concern about enrolment profiles and waning interest in the study of advanced mathematics (see Conference Program, 1997).

In Australia, changes in emphasis for entry into higher education from school leavers to first time participants, irrespective of age, has provided greater opportunities for 'older' (mature age) students to embark on university courses (e.g., Hore & Barwood, 1989). Yet, there is some uncertainty about the effects on enrolments of more recent changes to the fee structure for higher education (Andrews, 1977). In 1996, mature age¹ students comprised about 35% of the overall higher education population (Leder & Forgasz, in press). The enrolment profile also revealed that more females than males were studying at the undergraduate level (Australian Bureau of Statistics, 1996). Both mature age students and females, however, continue to be under-represented in science-related courses generally, and in mathematics in particular (Leder & Forgasz, in press; Lumley, 1992; Townsend & Madden, 1994).

¹ An entry category for tertiary study in Australia. There are variations among institutions. "Students who have not necessarily completed the formal academic pre-requisites required generally, or for specific courses, and who are 21 or over on March 1 in the year of tertiary entry" is a frequently used definition.

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An important impetus for the present study was our belief that the reasons behind these inequities in enrolment patterns in mathematics courses were worthy of further exploration.

The main aim of the present study was to examine factors influencing students' decisions to pursue tertiary mathematics studies. In an initial stage of the study, mature age students emerged as a new, unexpected, and potentially important source of serious mathematics students (see Forgasz, 1996). In this paper, we examine and compare the motivations for studying tertiary mathematics of younger (school leavers) and mature-age students, and of male and female students. The survey questionnaire that was devised to explore these factors was based on findings from relevant previous research discussed in some detail in the next section.

Previous research

Previous work has identified various factors which seem to influence school completion rates and university attendance in general. We drew on this research, as well as on studies concerned directly with participation in university level mathematics courses as we developed the survey instrument used in the present study. Research on mature age students was also examined. As the study was set in the Australian context, we placed some emphasis on Australian sources. However, the issues pertinent to the present study are not restricted to the Australian situation. Thus our work was further informed by relevant international research studies. Headings are used to cluster findings reported to date.

School completion rates

Gender, socio-economic status [SES] and home location influence school completion rates. The influential Ministerial Council on Education, Employment, Training and Youth Affairs [MCEETYA] (1994) reported that higher proportions of females than males, of students from high SES than low SES backgrounds, and from urban than rural or remote locations, were likely to complete grade 12 at school.

Participation in grade 12 school mathematics

In Australia, the proportions of males and females studying mathematics is almost gender neutral at the grade 12 level. However, statistics consistently reveal that a higher proportion of males than

females pursues the most advanced grade 12 mathematics options which lead to the broadest range of post-school options. For many years the ratio has been about 2:1 (Leder & Forgasz 1992). A comprehensive Australia-wide study revealed that males were more likely to achieve the highest achievement grades for mathematics and that the gender gap widened as parental social disadvantage increased (Teese, Davies, Charlton & Polesel, 1995). Participation rates in non-compulsory mathematics courses have also been found to be higher among students from higher SES backgrounds (e.g., Ainley, Robinson, Harvey-Beavis, Elsworth & Fleming, 1994). Lamb (1997) reported that gender differences in participation rates were related to the interaction of SES and positive attitudes and beliefs about mathematics. Extensive reviews of research on gender differences in mathematics learning at the school level reveal that cognitive and affective factors within the classroom, in society at large, in the family, and in children's wider social milieu can differentially influence students' attitudes towards mathematics and their intentions to persist with their mathematical studies (e.g., Leder 1992; Leder, Forgasz & Solar 1996). Whether these factors are also pertinent at the tertiary level has attracted far less research attention.

Influences on university attendance and persistence

The Higher Education Council [HEC] (1995) reported that equity in tertiary education had not been achieved for women in non-traditional fields nor for the socially disadvantaged. Students' beliefs about tertiary studies, decisions to enrol in higher education courses and level of achievement attained were found to be affected by social, cultural and affective factors. Findings reported to date relating secondary school attended, university attendance, and course selection are inconclusive (e.g., Hunter, 1987; Jones, 1990; Lumley, 1992). Graetz (1991) reported that social background factors, followed by ability, were the most important determinants of tertiary achievement with the attainment of females "much more constrained by social origins" (p.7) than were males' achievements. The most important reasons for enrolling at university cited by commencing undergraduate students at one Australian university were wanting to study in a field that interested them and to gain entry into an attractive career (Ramsay, Tranter, Sumner & Barrett, 1996). These same factors for enrolling at university were given in an unrelated survey which covered students in seven universities (McInnis, James, & McNaught, 1995).

Reasons for studying and dropping out of tertiary mathematics courses

The reasons for dropping out of tertiary courses reported by students are far-ranging. In the study conducted by Abbott-Chapman et al. (1992) various factors associated with the course of study were cited. These included: difficulty, pressures, expectations, poor teaching, boredom, and fear of failure. Contextual factors including: large and impersonal class sizes, ineffective tutorial system, lack of support, assistance and encouragement, poor facilities, and unhappiness were also ranked highly by withdrawing students. A tertiary culture hostile to them has been implicated in the high drop-out rates among ethnic students from low SES backgrounds (D'Netto, Rivera & D'Netto, 1996).

Almost two decades ago Holland and Eisenhart (1992) began an ambitious longitudinal, ethnographic project to explore why relatively few American college women, including those with high grades, chose subjects and courses that could lead to the traditionally male-dominated fields of science and mathematics. Peer pressures, and the recognition and acceptance that they

"faced constant evaluations of their worth on the basis of their sexual appeal to men" (p. 21),

apparently led many to lower their academic and career goals. The researchers subtly speculated that at least some of the women might revisit their educational options as time progressed, particularly if personal relationships did not live up to expectations. They concluded their book with the enigmatic sentence: *"Their stories are far from finished" (p. 231)*. Whether older and younger students might indeed react differently to their university environment was, however, outside the scope of the study they devised.

The high loss out of the sciences, mathematics, and engineering [SME] into other areas of study was confirmed by an extensive, and quite separate study, begun in 1990 (Seymour & Hewitt, 1997). While some students, it emerged, switched courses because they discovered a greater passion or interest in a different field, many gave different reasons for leaving the SME field they had initially selected. Among these were: the poverty of the educational experience, poor teaching, inappropriate departmental practices, disappointment with advisor or teaching assistant. Those who did persist with their initial choice of SME majors typically showed

“interest in the discipline and career(s) to which it leads, realism about career goals, ...[and the] acquisition of particular attitudes and strategies. Whether they find sufficient academic and personal support (from institutional, faculty, peer and other sources) to sustain their motivation and morale is also critical (Seymour & Hewitt, 1997 pp. 393-394).

Becker (1990) summarised the findings from several studies investigating factors which might (dis)encourage male and female (post)graduate mathematics students from pursuing their degrees. Women, she found, were likely to be encouraged by: successful contact with female role-models, encouragement from at least one person (usually a teacher), and support from advisors. Working against women were: the sex-stereotyping of mathematics as a male domain, and lower confidence and career aspirations compared to men.

Pedagogical approaches (e.g., Rogers 1990) and curricular content (e.g., Brown & Porter 1990) can affect students' mathematics achievements and attitudes, as well as the gender composition of cohorts (see also Rosser, 1995). Jacobsson (1994) reported that greater emphasis on 'project work' may have contributed in attracting more women into mathematics courses. Taylor's (1990) interviews with 12 American professors revealed how the ethos of a university mathematics department can affect students differentially. While none of the six males reported experiences of discrimination while studying mathematics, one female described the negative impact of a calculus tutor with sexist attitudes which had influenced her decision to pursue a sociology rather than mathematics major. Perceived levels of discrimination by gender and ethnicity, Forgasz (in press) contended, had the potential to impact negatively on the decisions of some students to persist with tertiary mathematics study.

The proportion of women has been found to decrease at each progressive tertiary level of mathematics courses (Gaffney & Gill 1996). Abbott-Chapman, Hughes and Wyld (1992) identified able young women to be at greater risk of dropping out of science courses than most other groups. These Australian trends are also evident in the USA. Gray (1996) reported that women were awarded nearly 50% of all undergraduate degrees in the mathematical sciences but received only 35% of the masters degrees and 20% of the Ph.Ds. Gray (1996) and Moses (1990) postulated that a lack of female role models in tertiary mathematics departments deterred females from embarking on postgraduate studies.

Mature age students

There have been two extensive Australian studies of mature age students (see Isaacs, 1979, 1982 and Hore & West, 1980; West, Hore, Eaton & Kermond, 1986). Both were conducted nearly 20 years ago and neither focussed on mathematics students. Relevant findings common to both studies included:

- those who had left school early were from lower SES origins than younger students
- for some women, university attendance was the culmination of the struggle to overcome the social prejudices of their youth; some indicated that their parents had believed tertiary study was unnecessary for girls
- performance was similar to part-time students across Australia, and better than for younger students. They were considered to be serious about their studies with high aspirations and willing to work
- As in a more recent study (Ramsey et al., 1996), it was recommended that universities needed to address the special needs of mature age students

Other, smaller scale studies have reported similar findings. Smart and Pascarella (1987) found that job/life dissatisfaction was a reason for some mature age students to undertake tertiary education.

Commencing in the 1960s, several Australian government-sponsored reports have recognised the waste in potential arising from the dearth of women in particular tertiary courses (e.g., Linke, 1995). HEC (1990) identified "*women in non-traditional areas*" as one of the six equity groups for which tertiary institutions were set increased participation targets. Several recent studies have focussed on mature age mathematics students. Fitzsimons (1994) claimed that

"adults returning to study represent an untapped economic resource for Australia" (p.1)

and that women returning to study had to overcome many barriers including employment and family responsibilities. Mature age mathematics students are typically highly motivated and success oriented (Forgasz, 1996; Pierce, 1995). Pierce (1995) further reported that mature age students were more anxious, made more use of

available help, and achieved higher grades than their school leaver counterparts. Lack of appropriate background, difficulties arranging for assistance, study constraints, and confusion during lectures were common concerns. Forgasz (1996) argued that more mature-age students should be accepted into tertiary mathematics courses.

The findings summarised above and the outcomes of exploratory interviews with 23 tertiary mathematics students during 1995 (see Forgasz, 1996; in press) informed the contents of our survey.

The study

Aims, instrument and methods

As part of a the larger study exploring factors which might influence students' decisions to pursue and persist with tertiary studies of mathematics, survey questionnaires were administered over two successive years to large numbers of students enrolled in tertiary mathematics courses at Australian universities. The survey instrument used in 1996 described fully by Forgasz (in press), was administered to students enrolled in mathematics courses at all undergraduate levels. Minor modifications were made to the 1997 version of the instrument to allow for a sample population of first year undergraduate students only. Both versions elicited the following data on students: biographical and background information (e.g., sex and age), self-perceptions as a learner of mathematics (e.g., perceived achievement levels), perceptions of the tertiary learning environment (e.g, quality of teaching) and a range of items exploring for possible influences on decision-making with respect to school and tertiary studies of mathematics.

This paper focuses on students' responses to checklists of suggested influences on their decisions to attend university, to study mathematics at school, and at the tertiary level as well as on their levels of enjoyment of mathematics at school and at university. The content of many of the items can be inferred from our reporting of results below.

Most of the survey items discussed in this article required students to check a box (yes/no). For the two questions about the enjoyment of mathematics the categories yes/no/sometimes were used. The categorical responses were analysed using SPSS. Chi-squared tests, with statistical significance set at the .05 level, were used to explore for differences in the response distributions by gender and by age. Students were classified as school leavers if they were less than 21 of age when they first enrolled in their current university course. Older

students were considered to be of 'mature age'. These definitions are consistent with the entry categories of many Australian higher education institutions (see Leder, Forgasz & Brew, 1998).

Interviews with a smaller number of students (71) were also conducted after the survey data were gathered. These data are not reported separately. Instead, where appropriate, they served to guide our interpretations of the large scale data findings.

The samples

In 1996, 1072 students enrolled in undergraduate mathematics subjects at three universities completed the survey. The following year the survey was administered to 811 first year mathematics students at five universities, three of which were the same as in 1996. By administering the survey only to first year students in 1997, the possibility that any students were surveyed twice was minimised. For the purposes of this paper, the data gathered over the two years have been combined.

Results and Discussion

The combined sample size from the two years of survey administration was 1883. Of these, 1670 were school leavers (SL) and 212 mature age students (MA); 1113 were male (M) and 757 were female (F). Missing data account for the differences in totals.

For each item from the questionnaire relevant to this paper, the students were instructed to mark one or more items of the checklists provided. The category 'other' was also included. Discussed in turn below are results of clusters of items which examined: reasons for studying mathematics in grade 12, progression to university, factors influencing study decisions at university, including those affecting participation in mathematics, and enjoyment of mathematics

Why did you study mathematics in grade 12 at school?

The percentage frequencies of responses to each of the reasons marked by students for having studied grade 12 mathematics are shown on Table 1. The results by age and by gender are also shown. Statistically significant differences are indicated.

REASON	% of students	All N=1883	MA N=212	SL N=1670	M N=1113	F N=757
to keep options open		71	43	74***	69	74**
wanted to		53	40	54***	51	55
parents wanted		14	6	15***	12	17**
teacher encouraged		26	15	28***	23	31***
careers advice		24	16	25**	24	24
like mathematics		47	43	47	45	49
good at mathematics		51	35	53***	52	48
to be with friends		4	4	4	4	2**
pre-requisite for university course		74	48	77***	73	74
the other choices were worse		7	5	7	7	7
to improve university entrance score		41	16	44***	39	43*
other		4	8	3***	4	4

* p<.05 ** p<.01 *** p<.001

Table 1: Why students studied mathematics in grade 12 at school

The data on Table 1 reveal that the majority of students indicated that they had studied mathematics at school to keep their options open (71%) and/or because it was a pre-requisite for their university courses (74%). It was somewhat disappointing to note that only about half of the students had studied mathematics because they wanted to (53%) or because they liked it (47%). About a quarter of the students indicated they had been encouraged by teachers (26%) or had received careers advice (24%). A surprisingly large proportion (41%) believed that studying mathematics would improve their tertiary entrance scores - bonuses are available for students taking some subjects, including mathematics, but high scores are required for the bonus to make a real difference.

Several gender differences were found. A statistically significant higher proportion of females than males indicated that they had studied mathematics at school to keep options open (F=74%, M=69%), because their parents had wanted them to (F=17%, M=12%) and because they had been encouraged by teachers (F=31% , M=23%). A higher percentage of females (43%) than males (39%) also believed that their tertiary entrance scores would be improved. These findings suggest that females may be more tentative than males about their future studies and career directions. Females may also be swayed more easily by the views of significant 'others' in their lives: parents and teachers.

When the data for mature age students and school leavers were compared, many statistically significant differences were found. For example, a smaller proportion of the mature age students than the school leavers had studied mathematics at grade 12 because it kept options open (MA=43%, SL=74%), they wanted to (MA=40%, SL=54%), they were encouraged by significant others (MA=6%-16%, SL=15%-28%), it was a pre-requisite for a university course (MA=48%, SL=77%), it might improve their university entrance score (MA=16%, SL=44%), or because they believed they were good at it (MA=35%, SL=53%). At least some of these differences are consistent with changes over time in societal expectations for participation in tertiary studies. It also appears that those who embarked on university studies as mature age students had been less career oriented when at school than those now proceeding more directly from school to university. Further insight into students' reasons for delaying their entrance to university is provided by responses to an item specifically requesting this information.

Did you proceed directly from school to this course at your current university?

The number of students responding "No" to this item was 331 (MA:158, SL:172; M:220, F=108, ?=3). The percentage frequencies for the reasons given are shown on Table 2.

REASON	% of students	All	MA	SL	M	F
		N= 331	N=158	N=172	N=220	N=108
Not decided on career	15	20	10**	16	13	
wanted to travel	16	11	20*	13	22*	
wanted break from study	28	25	31	26	35	
wanted outside experience	19	19	19	16	24	
family influence	3	3	4	2	6	
no intention to go to university	5	8	2*	7	1*	
not academically qualified	3	6	1*	4	2	
studied at another tertiary institution	36	39	34	36	36	
had to work to support family	6	12	0***	8	2*	
had to work to support myself ¹	21	32	9***	22	18	
other reasons	24	20	27	24	24	

* p<.05 ** p<.01 *** p<.001

Table 2: Reasons for not proceeding directly from school to this course at university

¹ This item was not included in 1996 survey: 140 students replied "No" in 1997 (MA=71, SL=69); (M=88, F=50, ?=2).

As shown on Table 2, students had a range of reasons for not proceeding directly from school to their present courses at university. Clear differences, however, emerged when the school leavers and the mature age students' reasons were compared. More mature age students than school leavers had not yet decided on careers (MA=10%, SL=20%) and/or had to support themselves (MA=32%, SL=9%) or their families (MA=12%, SL=0%). On the other hand, more school leavers than mature age students had wanted to travel (SL=20%, MA=11%). Taken together these findings suggest a socio-economic difference between the two groups of students. The gender differences that emerged showed no clear pattern but were also interesting. More females than males had wanted to travel (F=22%, M=13%) while more males than females had initially had no intention of studying at the tertiary level (M=7%, F=1%) and/or had to support their families (M=8%, F=2%).

Factors influencing decisions to study at university

The students were asked why they were studying at university and who or what had influenced their decisions. The results are shown on Tables 3 and 4.

The data on Table 3 reveal that most students were at university because they wanted to continue learning (75%), to enhance their career prospects (85%), because they had always wanted to (53%) and/or because they considered a degree to be important (54%). For each of these reasons, there was a higher proportion of females than males (to continue learning: F=80%, M=71%; to enhance career prospects: F=87%, M=83%, considered a degree important: F=58%, M=52%; had always wanted to go to university: F=59%, M=48%). Males, on the other hand, were more likely than females to have said they were at university because they were dissatisfied with their current situations (M=11%, F=7%). Females, it could be argued, have greater intrinsic motivations than males to study at university.

Significant differences between the school leavers and the mature age students emerged in different spheres. A higher percentage of school leavers than mature age students were at university because of parental (SL=41%, MA=19%) and/or friends' expectations (SL=11%, MA=3%), to enhance career prospects (SL=87%, MA=69%) and because they had always wanted to (SL=54%, MA=43%) and/or because they believed degrees were important (SL=56%, MA=39%). More mature age students (38%) than school leavers (6%) indicated that dissatisfaction with their current positions was a motivating

influence. The mature age students' greater maturity, independence, and experience of the world outside educational institutions may partially account for these differences between the two groups.

FACTOR % of students	All N=1883	MA N=212	SL N=1670	M N=1113	F N=757
wanted to continue learning	75	72	75	71	80***
escape unemployment	26	24	26	27	24
family expectations	38	19	41***	38	40
friends' expectations	10	3	11***	11	9
nothing better to do	14	9	14	14	12
enhance career prospects	85	69	87***	83	87*
degree is important	54	39	56***	52	58**
dissatisfied with current position	10	38	6***	11	7***
always wanted to go to university	53	43	54**	48	59***
other	5	9	4**	5	5

* p<.05 ** p<.01 *** p<.001

Table 3: Why students were studying at university

WHO/WHAT? % of students	All N=1883	MA N=212	SL N=1670	M N=1113	F N=757
school teacher/s	32	13	34***	30	35**
school careers adviser	21	3	24***	21	21
father	53	29	56***	50	58***
mother	54	31	57***	50	59***
brother	13	13	13	13	12
sister	12	10	12	10	15**
other family member/s	12	7	13**	11	14
friends	21	14	22**	20	22
own decision	90	87	91	88	94***
open days	11	6	11*	11	11
information booklets	13	9	14*	12	14
other	7	11	7*	8	6

* p<.05 ** p<.01 *** p<.001

Table 4: Who/what had influenced decision to study at university

The data on Table 4 reveal that nearly all students felt that studying at university was their own decision (90%). However, more than 50% of the students indicated that mothers and fathers had been influential. This was so for a much smaller proportion of mature age students than school leavers (SL=.55%, MA.30%) and for a larger proportion of females than males (F=.60%, M.50%). The data show that a higher proportion of school leavers than mature age students had been influenced by school

teachers (SL=34%, MA=13%), career advisers (SL=24%, MA=3%), friends (SL=22%, MA=14%) and university publicity (open days and information books). Compared to males, a higher proportion of females indicated that their decisions to study at university were influenced by teachers (F=35%, M=30%) and sisters (F=15%, M=10%). In general, university publicity, and family members other than parents had not had much impact on students' decisions to go to university.

The response differences between mature age students and school leavers are again consistent with changes over time in societal expectations for participation in tertiary studies. Older students, for whatever reason, appear not to have had, or not to remember, support from school sources and females appear to have been affected by other peoples' views to a greater extent than males. That university publicity appears to have had a negligent affect on students' decision-making has some implications for the relevance of the universities' targeting efforts.

Influences on decisions to study mathematics at university

Similar questions sought information on why the students were studying mathematics at university and who or what had influenced their decisions. The results are shown on Tables 5 and 6.

REASON % of students	All	MA	SL	M	F
	N=1883	N=212	N=1670	N=1113	N=757
like mathematics	40	44	40	39	42
good at mathematics	31	25	31	32	29
wanted to study maths	35	39	34	32	38*
parents wanted	5	1	5**	4	7**
to keep options open	36	20	38***	30	44***
teacher/lecturer encouraged	5	3	5	4	6*
careers advice	12	8	13*	10	14**
to be with friends	2	1	2	2	2
compulsory for another subject this year	38	39	38	44	30***
pre-requisite for maths next year	28	28	28	32	23***
pre-requisite for non-maths next year	30	25	31	32	27*
essential for career options	29	25	29	30	27
other choices were worse	10	4	11**	8	14***
other	9	8	9	9	10

* p<.05 ** p<.01 *** p<.001

Table 5: Reasons for studying mathematics at university

WHO/WHAT? % of students	All	MA	SL	M	F
	N=1883	N=212	N=1670	N=1113	N=757
school teacher/s	13	5	14***	11	15**
school careers adviser	7	1	8***	7	8
father	9	4	9**	7	10*
mother	6	2	7**	5	8**
brother	2	1	2	1	2
sister	1	1	1	1	2*
other family member/s	1	1	1	0	1
friends	3	2	3	2	3
own decision	62	58	63	59	67***
open days	2	1	2	2	3*
information booklets	5	2	5	4	6*
other	10	12	9	11	7**

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 6: Who/what influenced decision to study mathematics at university

Table 5 indicates that the reasons for studying mathematics were varied. It was noteworthy that none of the options attracted responses from more than 50% of the students. Fewer than 10% of the students indicated that they were studying mathematics because their parents wanted them to, to be with friends, or because their teachers/lecturers had encouraged them. A higher proportion of school leavers than mature age students and a higher proportion of females than males were studying mathematics to keep their options open (SL=38%, MA=20%; F=44%, M=30%), in response to career advice (SL=13%, MA=8%; F=14%, M=10%), and/or considered other options to be worse than mathematics (SL=11%, MA=4%; F=14%, M=8%). Again, these data suggest that mature age students and males were more certain about their future studies and career directions than were the school leavers and females.

As was found for studying at university in general, Table 6 reveals that the influence on decisions to study mathematics attracting the highest frequency of responses was students' own decisions (62%). Only one other choice, teachers, attracted responses from more than 10% of the students. The statistically significant differences between mature age students and school leavers were not unexpected. The older students' responses indicated that school teachers, career advisers, and parents had been less influential than for school leavers. Again, females indicated that they had been more influenced by school teachers, parents and university publicity than had males.

The differences in the percentage responses shown on Tables 4 and 6 are noteworthy. Overall, it seems, students have been more

aware of, or are more readily able to remember, the influences on them to study at university generally than for studying mathematics specifically. Perhaps being at university is considered a greater personal achievement than is enrolment in mathematics courses.

Enjoyment of mathematics

As reported above, students had been asked why they had studied mathematics at school and why they were doing so at the tertiary level. Their responses were shown on Tables 1 and 5 respectively. The frequencies of responses for the reason 'like mathematics' were 47% for school mathematics and 40% for tertiary level mathematics. The relatively low levels of enjoyment experienced by students who continue with mathematics when it is no longer compulsory should be of concern to mathematics educators at both the school and tertiary levels. The somewhat lower level of enjoyment of mathematics at the tertiary level is a cause for concern and was able to be explored further by the responses to an item directly concerned with this issue. The percentage frequencies of students' responses to whether they had enjoyed mathematics at school (yes/no/sometimes) and whether they were enjoying tertiary level mathematics are shown on Table 7.

		All N=1883	MA N=212	SL N=1670	M N=1113	F N=757
ENJOY MATHEMATICS?						
At school	Yes	59	59	59	59	60
	No	9	11	8	10	7
	Sometimes/depends	32	29	32	31	33*
At university	Yes	35	53	33	37	32
	No	19	12	20	21	17
	Sometimes/depends	45	35	47***	42	51**

* p<.05 ** p<.01 *** p<.001

Table 7: Enjoyment of mathematics at school and university

The data on Table 7 show a sharp decline in enjoyment of mathematics from school to university. The decrease in enjoyment was significantly more evident among school leavers than mature age students and among females than males.

Final comments

The findings in this paper are based on responses from some 1,900 students enrolled in mathematics courses at five different universities. Enhanced career prospects had enticed the majority (85%) to embark on university studies. Most of our respondents claimed that continuing with their education had been their own decision. Parents' advice

had also been influential; that of teachers less so. More females than males were apparently influenced by these significant figures in their lives. Despite the considerable sums of money spent on advertising universities and their courses, relatively few students indicated that they were influenced in their career choice by these sources of information.

Many of our sample, approximately three-quarters, had chosen mathematics as one of their final year high school subjects because they wanted to keep their options open, or because they recognized mathematics as a prerequisite for the university course of their choice. Just under half had done so because they liked mathematics. Enrolling in first year mathematics because it was a pre-requisite for a mathematics or non-mathematics subject or course the following year was a most powerful factor for our sample to choose mathematics: overall 66% fell into this category, with 76% of males indicating that this was true for them. A much lower proportion, only two out of five in our sample, gave liking mathematics as their reason for continuing with it at university. Few students, less than 10%, had seemingly enrolled in mathematics on the advice of their parents, or of their teachers (13%).

More students indicated a liking for mathematics at senior high school than at university: 59% compared with 35%. Not surprisingly, then, more students expressly disliked mathematics at university than at school: 19% compared with 9%. These findings were of considerable concern to the participating institutions. Unlike the work of Abbott-Chapman et al. (1992), Holland and Eisenhart (1992), and Seymour and Hewitt (1997), our survey did not explicitly explore students' reasons for opting out of mathematics. Our interview data indicated, however, that those who were unhappy with their first year university mathematics course also referred to poor teaching, peer pressures, and inappropriate departmental practices.

Gender differences, often reported in the literature, also emerged in our study. Some have already been noted. Given the frequent rhetoric in Australia in recent years about the importance of mathematics as a critical filter to educational and career opportunities, it is interesting that more females than males apparently chose to do mathematics to keep their options open, both in grade 12 and at university. As the statistics have persistently revealed (e.g., Leder & Forgasz, in press) and is also the case in the present study, more males than females are still aiming for mathematics related careers. Certainly, as already noted, more males indicated that they were taking mathematics because it was listed as a pre-requisite for their further study.

There were several differences in the responses of the mature age and school leaver groups. The former seemed to have attached less importance to mathematics while at school and so, apparently, did their parents and teachers. As already mentioned earlier, this may be as much a reflection of society's changing attribution of importance to mathematics as the students' own inclinations. Financial constraints may also have affected the educational decisions of the mature age students as was reported two decades ago by Hore and West (1980). Several mature age students indicated that dissatisfaction with their current situations was a reason motivating them to commence their university courses, a finding also noted by Smart and Pascarella (1987). Consistent with previous research on mature age students (West et al., 1986; Pierce, 1995), our interview data suggested that the mature age students in our sample were more focused and determined than their school leaver counterparts when they eventually embark on university studies. In the next phase of our study we explore in greater depth the motivations and experiences of life at university of these, educationally speaking, late starters.

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Abstrakt

Studentar i høgare utdanning: Kvifor er dei der?

Denne artikkelen er basert på data som er henta frå i underkant av 1900 studentar som studerte matematikk ved fem universitet i Australia. Forgasz og Leder diskuterer faktorar som ligg til grunn for studentane sitt val når dei ønskjer å ta høgare utdanning. Arbeidet er sentrert om faktorar som styrer val av eit eventuelt studium i matematikk i skoleverket og i høgare utdanning. Det blir også rapportert i kva grad ein opplever glede ved matematikken i desse samanhengane.

Det er relativt færre studentar som likar faget ved universiteta enn i skoleverket og det er samstundes ein høgare andel som mislikar faget ved universiteta. Mellom dei som mislikar faget blir det ofte referert til dårleg undervisning.

Mange vel matematikk for at det skal vere mogeleg å halde vegen open sidan utdanning i faget er eit krav både for vidare studiar og for val av karriere. Dette er viktigare omsyn til råd frå foreldre eller frå tilrådingar frå universitetshald. Samanlikningar blir gjort mellom svar frå mannlege og kvinnelege studentar og mellom yngre og eldre studentar. Studiet som er presentert i denne artikkelen vil gå vidare med ei grundigare analyse av motivasjonsfaktorar og erfaringar til dei studentane som starta si universitetsutdanning seint.

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