AMSI CHOOSEMATHS RESEARCH

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CHOOSEMATHS Days

for Year 9 and 10 students 2018

Julia Collins & Inge Koch

CHOOSE**MATHS** Days for Year 9 and 10 Students

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Australian Mathematical Sciences Institute

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Executive Summary

Choose Maths Days are events conducted at schools and universities around Australia, aiming to raise mathematical enjoyment and aspirations of girls in Year 9 and 10. Initial surveys undertaken at these events provide information about students' prior engagement with mathematics, their career ambitions, and their expectations around Year 11/12 subject selections. Second surveys completed at the end of Choose Maths Days show how the activities and speakers at these events have changed students' opinions around these topics.

A total of 942 students attended Choose Maths Days in 2018. Of these, 392 female students at university Choose Maths events completed the two surveys. This report describes the analysis of and findings from these data from the university events.

The number of students reporting that they "enjoyed maths" or "enjoyed maths very much" increased from 62% to 70%. Among students who said that they did not like maths or weren't sure if they liked maths in the initial survey, 87% said in the second survey that they "quite liked", "enjoyed" or "enjoyed very much" the mathematics at the event. Over 90% of students reported that the university Choose Maths Days had given them a more positive view of mathematics than before.

Around 60% of the students said that the university Choose Maths Days had influenced the level of mathematics they wished to take in Year 11/12, with a quarter of students explicitly stating that they now want to take a higher level of mathematics than they had previously decided upon.

Our surveys have found that about half of the students attending university Choose Maths Days are interested in STEM careers. There is, however, a disconnect between career aspirations and engagement with STEM at school, which worsens as students transition from Year 9 to Year 10. Out of those students who list mathematics or science as a favourite subject at school, the proportion wanting to pursue a STEM career drops from 64% in Year 9 to 52% in Year 10.

The events which had the biggest impact on students' reported levels of mathematics enjoyment were those which targeted students with lower levels of mathematics enjoyment and future mathematics aspirations. Year 9 students were also more influenced than Year 10 students.

Choose Maths Days will continue in 2019, and will be informed by the results from the 2018 days regarding the target audience and activities which have maximum effect. Future plans and directions including planned changes for these events in 2019 are described in the Conclusions.

Contents

1 Introduction

Women are severely underrepresented in science, technology, engineering and mathematics (STEM) in schools, university and the workforce, with mathematics, computer science, physics and engineering being most affected by this inequality.

The Choose Maths project of the Australian Mathematical Sciences Institute (AMSI) addresses this underrepresentation of women by aiming to increase participation of girls and young women in mathematics and disciplines requiring mathematics throughout the school and university education and into the workforce. The project is funded by the BHP Foundation from 2015 to 2019 and has a staff of 18 including eight experienced primary and secondary teachers, referred to as Schools Outreach Officers. The project's multilevel approach includes:

- Working actively with 120 schools across Australia, a quarter of which are secondary schools. Schools Outreach Officers visit these schools twice per term to conduct professional development, model lessons, advise on lesson planning, and to give specific help to the local teachers involved in teaching mathematics.
- Affecting a change in attitude and behaviour towards mathematics through a careers awareness campaign. This includes a team of Choose Maths careers ambassadors who appear in marketing campaigns and who are trained to speak at public events.
- Supporting girls and young women with a strong mentoring network and with female-focused events.
- Celebrating the achievements of mathematics teachers and students in annual awards ceremonies.

Choose Maths Days, as detailed in Section 2, are part of a range of activities run by the Choose Maths team, in Choose Maths schools and beyond, to encourage the uptake of higher levels of mathematics among young women beyond Year 10. They bring together different aspects of the Choose Maths project: the AMSI careers ambassadors who are part of the nationwide careers campaign are also invited as speakers to Choose Maths Days, as are the mentors involved with Choose Maths Mentoring. AMSI's research into student and teacher attitudes towards mathematics and teaching of mathematics [1] will help to inform the format of Choose Maths Days, while the surveys of students at Choose Maths Days will themselves form part of the body of research about student attitudes to mathematics and STEM careers.

This report details the results from student surveys at the 2018 Choose Maths Days around Australia, focusing in particular on events held at universities for Year 9 and 10 girls. It then uses these results to make recommendations for modifications to this survey in the future, and will be used to inform the direction and content of 2019 Choose Maths Days.

2 CHOOSE**MATHS** Days

Choose Maths Days are events aimed primarily at girls in Years 9 and 10, before they make their subject selections for Year 11. Similar events for Year 12 female students have run successfully at UNSW and the University of Adelaide for a number of years.

Choose Maths Days have two formats:

- University Choose Maths Days: AMSI Choose Maths works with one or more of its member universities to host each event, and multiple schools from the university feeder schools are invited to attend. Each school is offered up to 20 student places and we recommend that students be selected on the basis of their potential for increased

engagement with mathematics, rather than school grades. The schedule typically comprises short talks by industry and academic speakers and Choose Maths careers ambassadors, hands-on activities, and a Q&A session with the speakers and current university students.

- School Choose Maths Days: AMSI works with its Choose Maths secondary schools to host events. Nearby schools are invited to attend. The schedule typically comprises talks by industry speakers and Choose Maths careers ambassadors, hands-on activities, and a 'speed-dating' session with speakers and other local mathematics champions.

University events in 2018 have been held in state capital cities, while school events have been in regional or remote locations and are typically held at Choose Maths schools. The school-based events include boys and sometimes students from Year 8 in the more remote schools.

The aim of these events is to encourage students to choose a higher level of mathematics in Year 11 than they were currently considering. That is, if a student was not planning to take any mathematics, to encourage them to choose *some* mathematics; if they were planning to do an elementary mathematics subject, to encourage them to choose the intermediate subject, and so on. To this end, the events focus on the range of careers that are accessible to those with a mathematics background, personal stories from people who are using mathematics in their jobs or studies, and activities that broaden students' conceptions of what mathematics is and why it is important. The hands-on activities nurture the teamwork and problem-solving aspects of mathematics, and aim to build students' confidence in their own abilities.

As a secondary aim, the events are intended to provide professional development to those teachers who attend. These teachers may be mathematics classroom teachers, either in-field or out-of-field, or they may be careers teachers.

The data in this report comes from the surveys done at the beginning and end of each event. The surveys were designed by the Choose Maths team. All surveys are anonymous, asking for no identifying details apart from gender and year group. It is made clear to the students that completion of the surveys, and thus participation in this research, is voluntary.

In total we have data from six university events and two school events, with a total of 942 attendees and 519 student surveys returned (see **Table 1**). This is an overall response rate of 68% among those surveyed. The analysis in this report will focus on the university data excluding boys (392 surveys; a response rate of 76%), since the event format and audience is more consistent across these events. The school-based events only make up 39 surveys in total from girls across Years 9 and 10.

University or School event	Date	Location	Number of attendees	Number of surveys returned
S	20 March	Muswellbrook High School	180	N/A
U	25 May	University of Sydney (jointly organised with UNSW & UTS)	180	140
U	4 June	La Trobe University	92	74
U	6 June	QUT	80	61 (11 boys)
U	8 June	Murdoch University	70	45
U	13 June	University of Melbourne	50	31
U	3 July	University of Adelaide	60	52
S	31 May	Hedland Senior High School	90	38 (21 boys)
S	16 August	Roxby Downs Area School	140	78 (31 boys; 8 undisclosed)

Table 1: *List of Choose Maths Days 2018*

We hope to expand the Choose Maths Days in 2019 and future reports are expected to include data from school events, since it will be interesting to compare the demographics attending the two kinds of events and the slightly different formats of each.

3 Surveys at CHOOSE**MATHS** Days

All students attending Choose Maths Days receive their surveys upon arrival at the venue. They are asked to complete the pre-survey before the main activities of the day begin, and the post-survey (on the back of the same paper) at the end of the day after the last activity has finished but before they leave the venue. Each survey has a unique identifying number; no personal details are asked for apart from gender and school year. Ethics approval for these surveys has been obtained from the Human Ethics Committee of the University of Melbourne in 2018.

The questions in the survey are given below in **Table 2**.

Survey questions

Pre-survey		**Post-survey**	
1	What grade are you in?	1	Which activity or presentation did you like best?
2	What gender do you identify with?	2	Circle the number [from 1 to 5] that best describes your enjoyment of today's mathematical activities.
3	Circle the number [from 1 to 5] that best describes your enjoyment of mathematics.	3	To what extent did the CHOOSE**MATHS** Day cause you to think positively about mathematics in a way you haven't thought about before?
4	What level of mathematics subjects (if any) are you planning to take in Years 11 and 12?	4	Has the CHOOSE**MATHS** Day influenced the level of maths you want to take in Years 11 and 12? If so, how?
5	What do you intend to study/train for after school and what career(s) are you interested in?	5	Did today's activities change your mind about the type of career you want to pursue?
6	What are your two favourite subjects at school?		
7	What do you hope to get out of attending the CHOOSE**MATHS** Day today?		

Table 2: *Choose Maths Day survey questions*

The pair of questions (Q3 pre, Q2 post) allow us to compare each student's general enjoyment of mathematics with their enjoyment of the mathematics activities at the Choose Maths Day. Both questions ask students to rate their enjoyment of mathematics on a scale from 1 to 5, where 1 is "I don't like maths", 3 is "I sometimes like maths", and 5 is "I enjoy maths very much". A follow-up question on the post-survey asks explicitly whether the Choose Maths Day has caused the student to think positively about mathematics in a way they hadn't thought of before (Q3 post).

The next pair of matched questions (Q4 pre, Q4 post) concerns the student's subject selections in Year 11. The pre-survey asks the student to tick which level of mathematics they are planning to study in Years 11 and 12, choosing from Elementary, Intermediate and Advanced (using the corresponding names for those courses in each state), with an option for 'Undecided'. The post-survey contains a free text box where students are asked to write about whether the Choose Maths Day has influenced the level of mathematics they want to take in Years 11 and 12.

The final pair of matched questions (Q5 pre, Q5 post) concerns the student's intentions about careers. On the pre-survey is a free text box which asks the student what they intend to study/train for after school and what careers they are interested in. The post-survey contains a free text box asking whether the day's activities have changed their mind about the type of career they want to pursue.

The pre-survey asks students to name their two favourite school subjects (Q6). This will form a point of comparison between subjects they are engaged with at school and their choice of career path.

Finally, there are two questions which ask about the Choose Maths Day itself (Q7 pre, Q1 post). The pre-survey asks what the student hopes to get out of attending the event while the post-survey asks which activity or presentation they liked best. These are designed to help us improve the marketing and experiences of future Choose Maths Days.

3.1 Participation in CHOOSE**MATHS** Days and surveys

A total of 532 students attended the university Choose Maths Days. Of these, 403 students returned surveys, which is 76% of the total. Eleven of the surveys returned (2.7%) were from boys; all other surveys were from girls. The university events were female-only, with the exception of the event at QUT.

Of the 392 female surveys returned at the university events, 190 (48%) were from Year 9 students, and 202 (52%) were from Year 10 students. All of the university events had students from both year groups, apart from the event at Murdoch University, which was Year 10 only.

In total, 27 schools attended university Choose Maths Days in 2018. These were a mixture of government (21), private (1), Catholic (4) and selective (1) schools. Seven of the schools were girls-only and twenty were co-educational.

A total of 410 students attended the school Choose Maths Days across three events. One of these events did not administer student surveys. Of the remaining two events, 116 students out of 230 returned surveys, which is 50%. However, 51 of these surveys (44%) were from boys, with a further 8 of undisclosed gender (7%), leaving 57 surveys from girls. These include 16 from students in Years 6-8, 13 from Year 9s, and 26 from Year 10s.

In this report we analyse the 392 surveys done by female students at university events.

4 Analysis of Survey Data

4.1 Enjoyment of mathematics

One of the aims of the Choose Maths Days was to increase students' engagement with mathematics, by doing hands-on activities to show that mathematics is a subject which is interesting and important, emphasising team-work and problem solving. It is therefore instructive to compare the students' answer to Q3 on the pre-survey with their answer to Q2 on the post-survey. In these questions the students rated their enjoyment of mathematics on a scale of 1 to 5, in both the pre- and post-survey

1. I don't like maths / I did not like today's maths
2. I am not sure if I like maths / I am not sure if I liked today's maths
3. I sometimes like maths / I quite liked the maths
4. I enjoy maths / I enjoyed the maths
5. I enjoy maths very much / I enjoyed the maths very much

In **Figure 1** we compare the percentages of students in each response group. This graph shows us that the largest shifts are for option 3 – decreasing from 34% to 25% – and for answer 5 – increasing from 14% to 24%. Overall the proportion of students saying they "enjoyed mathematics" (answer 4) or "enjoyed mathematics very much" (answer 5) increased from 62% to 70%.

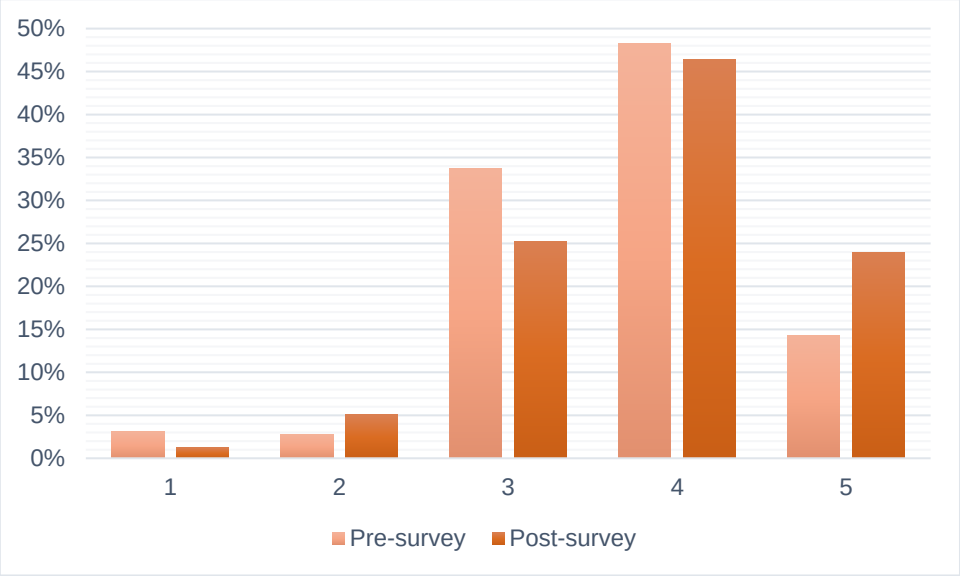

Figure 1: *Percentages of students choosing options 1-5 on maths enjoyment, in the pre-survey Q3 (light orange) and the post-survey Q2 (dark orange). Here 1 is low and 5 is high.*

In **Figure 2** we take a closer look at how the students' answers changed between the pre- and post-surveys. The darker the colour of the square, the higher the proportion of the students who chose that pair of answers. For example, 11% of students chose 4 in the pre-survey and 5 in the post-survey (shown in row 2 and fourth percentage column). The grey cells give the total percentages for the rows and columns.

The largest positive shift was from those who chose 3 in the pre-survey: 43% of these students changed to a 4 in the post-survey (14% of all students), and 23% changed to a 5 in the post-survey (8% of all students). Although the numbers are small, all of the students who chose 1

or 2 in the pre-survey increased their answer in the post-survey, with 87% changing their choice to a 3 or more.

The 47% of students who chose option 4 in the pre-survey were equally likely to move down to a 3 or up to a 5, while just under half of the initial 5 voters dropped to a 4 in the post-survey.

		3%	3%	33%	47%	14%	100%
Post-survey	5	1%	1%	8%	11%	3%	24%
	4	1%	1%	14%	23%	6%	46%
	3	0.5%	1%	9%	10%	4%	25%
	2	0.5%	0%	1.5%	2%	1%	5%
	1	0%	0%	0.4%	0%	0.5%	1%
		1	2	3	4	5	
		Pre-survey					

Figure 2: *Percentages of students choosing pairs of responses on mathematics enjoyment (Q3 pre, Q2 post), where 1 is lowest and 5 is highest. The darker the colour, the higher the percentage. The grey cells give the total percentages in each row and column.*

From this analysis we see that the Choose Maths Days had the greatest positive effect on those who only sometimes enjoy mathematics. This is encouraging, as this is the demographic we most wish to target – those students who are considering taking *some* mathematics in Year 11 but who may not have the confidence or interest to do as high a level as they are capable of.

In **Figure 3** we look at the breakdown of results by year group, with Year 9 in green (left) and Year 10 in blue (right). The change in opinion on mathematics enjoyment is more pronounced among the Year 9 students, who have the greatest increase in the number saying they "enjoy mathematics very much", from 11% in the pre-survey to 27% in the post-survey. By Year 10 it seems that student opinions about mathematics are more fixed, with positive change still possible but not to the same extent as the younger students.

Figure 3: *Percentages of students choosing options 1-5 on maths enjoyment (Q3 pre, Q2 post), separated by year group: Year 9 (green) and Year 10 (blue). Here 1 is low and 5 is high.*

The conclusion that Year 9 students were more influenced in their views on mathematics than the Year 10 students is also borne out by **Figure 4**, which shows that the Year 9 students were more likely to select 'Very' or 'Extremely' than Year 10s, about whether the Choose Maths Day caused them to think more positively about mathematics. However, the results are encouraging for both year groups, with over 90% in both cases saying that the event had given them a more positive view of mathematics than before.

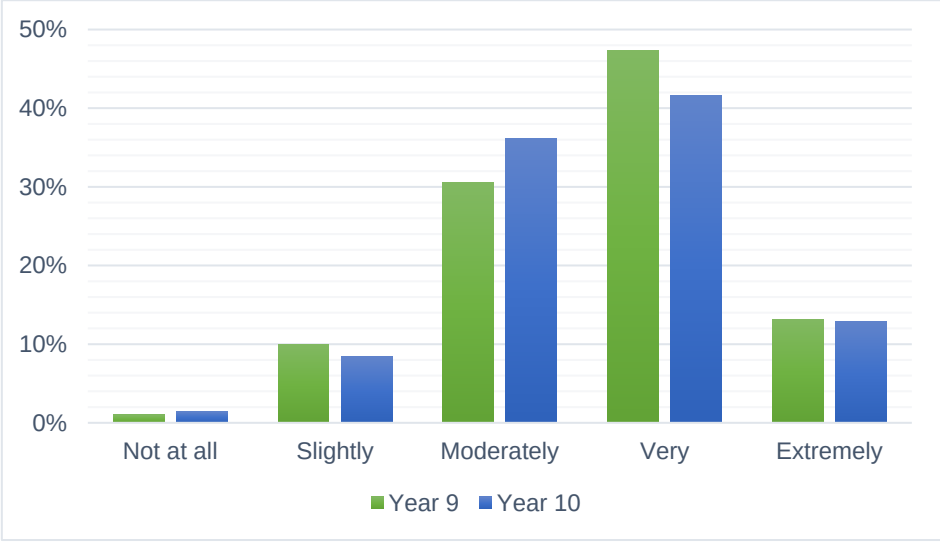

Figure 4: *Percentages of student responses for post-survey Q3, on whether the Choose Maths Days caused them to think more positively about mathematics, broken down by year group (Year 9 green, Year 10 blue).*

4.2 Year 11/12 subject selections

The main aim of Choose Maths Days is to encourage students to choose as high a level of mathematics in Year 11/12 as they are capable of and, where possible, to increase the level they are thinking of taking. Here we analyse the responses to Q4 on the pre-survey and Q4 on the post-survey (see **Table 2**) to see which subjects students were aspiring to take in Year 11/12 and whether the Choose Maths Days changed their opinion on this.

Figure 5 shows the percentages of students selecting each of the three categories of Year 11/12 mathematics in the pre-survey, as well as those who are undecided. The 'elementary' category contains those students expecting to take non-ATAR courses as well as the lowest level of ATAR mathematics. The names of the different courses in each state and their ascribed category can be found in Appendix 1 of the AMSI Gender Report 2017 [2].

Note that no student indicated that they did not want to do mathematics in Year 11. However, it is unclear among those who were undecided whether they were undecided about taking mathematics, or undecided about the level of mathematics. This ambiguity is something that will be addressed in the 2019 surveys.

There is a clear difference in the answers given by the Year 9 students and the Year 10 students. Namely, nearly half (49%) of the Year 9 students are undecided about their subject selections, while only 14% of Year 10 students are undecided. Of the students who have made a decision, the majority in both year groups is for the intermediate level of mathematics, followed by advanced, and then elementary.

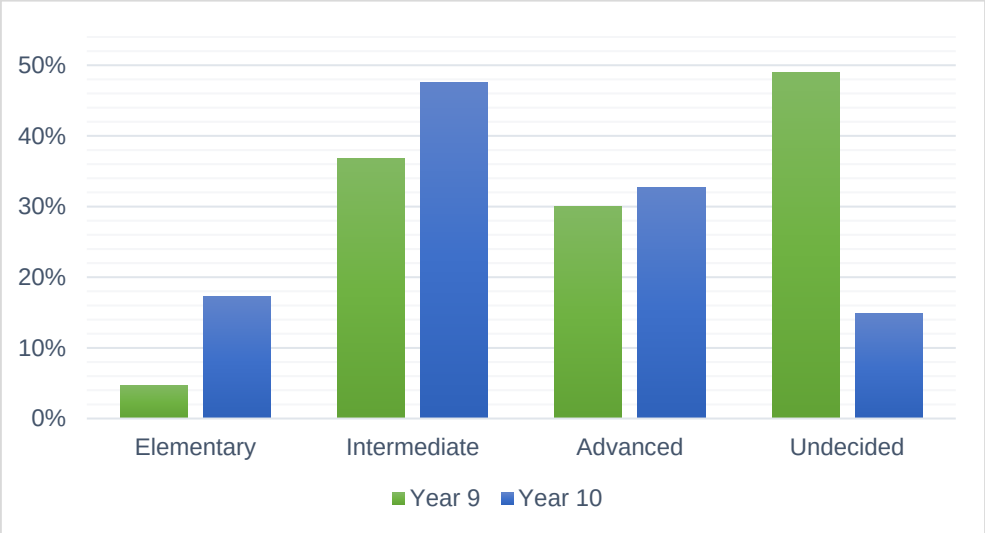

Figure 5: *Percentages of students expecting to take elementary, intermediate and advanced mathematics subjects in Year 11/12, as shown by answers to pre-survey Q4. Results are separated by year group, with Year 9 in green and Year 10 in blue.*

Figure 5 shows us that the distribution of students attending the university Choose Maths Days differs from that of the general female population. Of the students in our cohort, 17% expect to choose elementary mathematics and 32% to choose advanced mathematics. In contrast, in the general population of Year 12 students, 53% of girls chose elementary

mathematics and 7% chose advanced mathematics in 2016 [2, pg 11]. Since Choose Maths Days are voluntary, those students already interested in mathematics are more likely to attend than those who are not planning to continue with mathematics.

In the post-survey (Q4), students were asked whether the Choose Maths Day had influenced the level of mathematics they wanted to take in Year 11/12. The results are given in **Figure 6** below. Here a 'strong yes' means that the student has indicated that they would now like to take a higher level of mathematics than the one they had suggested in the pre-survey. A 'yes' means that the student gave a positive response to the question but without being specific on the action they would take. (Some sample responses are given at the end of this section.) In total, 60% of Year 9 students and 57% of Year 10 students wrote 'yes' or 'strong yes' to this question, and about a third of each year group wrote 'no'. The Year 9 students were once again more positively influenced than the Year 10 students, as measured by the choices for the 'strong yes' category.

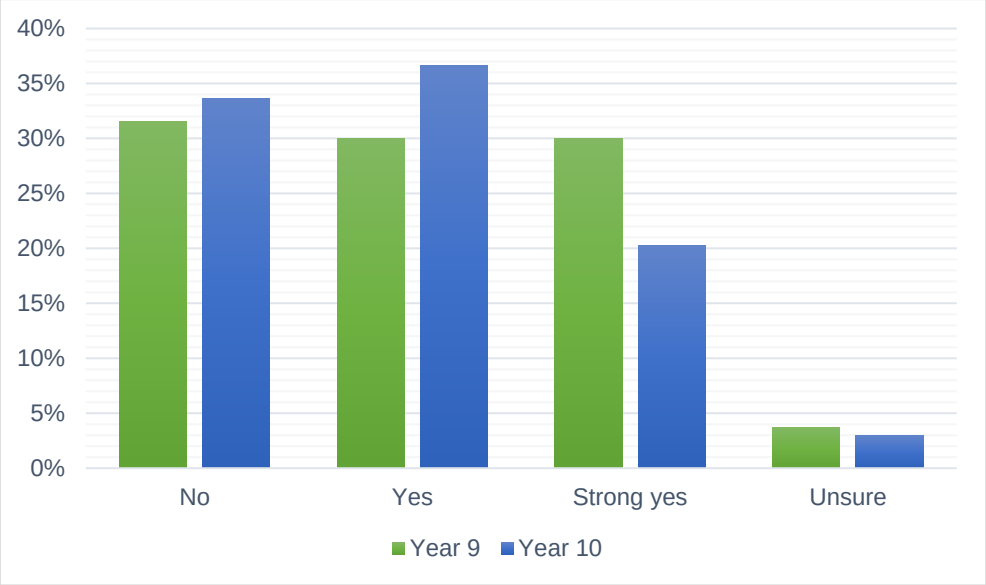

***Figure 6**: Percentages of student responses to post-survey Q4 on whether the Choose Maths day influenced the level of mathematics they wanted to take in Year 11/12. Results are broken down by year group, with Year 9 in green and Year 10 in blue.*

In **Figure 7** we look at which students were most likely to be influenced by the Choose Maths Days, by comparing their answers about subject selection from the pre-survey with their answer about subject selection influence in the post-survey. Out of those students who chose 'yes' or 'strong yes' in the post-survey, the majority (99 students out of 267, or 37%) were those who had said they would do intermediate mathematics, with a further 26% coming from those who were undecided about subject selections in the pre-survey. This was more pronounced among the Year 9 students, where 39% of the 'yes' and 'strong yes' choices were from students who were undecided.

A further encouraging result from these data is that 72% of the students who said they wanted to do elementary mathematics indicated that the Choose Maths Day had influenced their subject selections ('yes' or 'strong yes').

Note that total numbers in **Figure 7** are greater than the number of surveys, since students could choose more than one option in pre-survey Q4.

		147	157	110	15	
Level (pre-survey)	Undecided	38	33	36	7	114
	Advanced	42	44	26	3	115
	Intermediate	57	63	36	4	160
	Elementary	10	17	12	1	40
		No	Yes	Strong yes	Unsure	
		Influenced level of mathematics (post-survey)				

***Figure 7**: Numbers of students by pairings of subject selection (Q4 pre) and influence on subject selection (Q4 post). Grey cells indicate total numbers for each row and column.*

Comments by students who say they were influenced in their subject selection:

- I found out maths was necessary for a lot of careers.
- I want to challenge myself now.
- I feel more confident in taking a higher level of maths, especially [after] hearing the presentations.
- Now I know most people find maths a challenging subject.
- I definitely want to take up maths because I have found out that it can open so many more doors than I thought.
- I haven't decided what level of maths I would like to do but it encouraged me to give it a go.
- It has made me want to try harder and achieve larger goals.
- [I've realised] that maths isn't always boring.
- Before today I was ok with accepting General maths, now I want to strive for Advanced.

4.3 STEM careers

One of the ways that Choose Maths Days seek to influence students' opinions of mathematics is to showcase the range of careers that mathematics can lead to, with the message that the more mathematics we study, the more careers are open to us. This is done through specialised careers talks by Choose Maths outreach officers and by personal stories from people in industry and research who are using mathematics in their work. In this section we will look at the types of careers that students were initially interested in (pre-survey Q5) and the question of whether the Choose Maths Days influenced these ideas (post-survey Q5).

The answers to the pre-survey Q5 about careers were coded into two categories: STEM and non-STEM. We used the list of STEM degrees given in Appendix A of [3]. This includes traditional science subjects, mathematics, computing and engineering, as well as medicine, dentistry, forensic science, veterinary science and conservation science. Careers classified as non-STEM include architecture, physiotherapy, business and commerce, criminology, interior design, nursing, and trades such as electrician, mechanic or carpenter.

Figure 8 gives the results of the pre-survey Q5, separated by year group. Notice that percentages add up to slightly less than 100% since there were missing responses. The 'both' column counts students who listed both STEM and Non-STEM careers. Students who listed more than one possible STEM career (e.g. medicine and engineering) were only listed once in the STEM column (and similarly for non-STEM).

About 51% of the Year 9s and 45% of the Year 10s named a STEM subject or career that they were interested in. The Year 9 students also seem slightly more open to a broad range of careers, with 21% (compared with 17% for the Year 10s) saying they were interested in both STEM and non-STEM careers. Around 10% of students in both year groups were undecided.

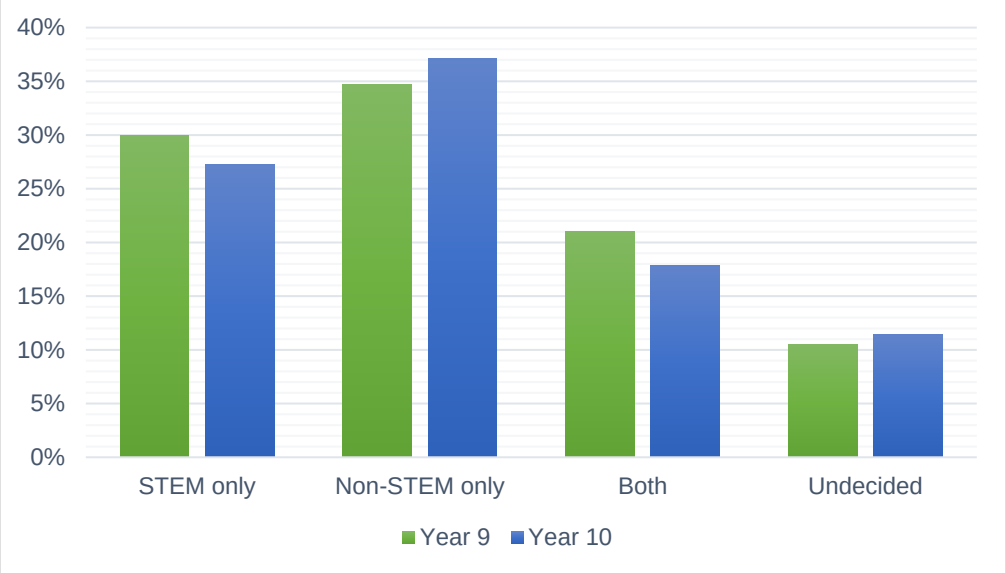

Figure 8: *Percentages of students' responses to pre-survey Q5 about career intentions, classified as STEM, non-STEM, both or undecided. Results are separated by year group, with Year 9 green and Year 10 blue.*

It is interesting to look at the relationship between those students who named mathematics or science as a favourite subject, and those who are interested in STEM careers. In **Figure 9** we look at the numbers of each, broken down by year group. Here 'Not-STEM' means that the student did not list a STEM career in the answer to Q5 on the pre-survey.

There is quite a change between the Year 9 and Year 10 students. More students in Year 10 consider mathematics or science to be a favourite subject than those in Year 9: 70% compared with 60% respectively. Out of those students who consider mathematics or science a favourite subject at school, 64% of Year 9s but only 52% of Year 10s are considering a STEM-based career. This is an interesting finding that would benefit from further research in order to address it before the students make their Year 11/12 subject selections.

Year 9

Careers	Not-STEM	41	52	*93*
	STEM	74	23	*97*
		115	*75*	*190*
		Mathematics or Science	Not Mathematics or Science	
		Favourite subjects		

Year 10

Careers	Not-STEM	69	42	*111*
	STEM	76	15	*91*
		145	*57*	*202*
		Mathematics or Science	Not Mathematics or Science	
		Favourite subjects		

***Figure 9**: Numbers of students choosing STEM careers compared with their favourite school subjects. Grey cells indicate the totals for rows and columns.*

It is perhaps heartening that even among those students who did not list mathematics or science as a favourite subject, 31% of Year 9s and 26% of Year 10s *are* still considering careers in STEM.

Figure 10 gives the results of the answers to post-survey Q5 about whether the Choose Maths Day had influenced their choice of career. (Specific comments are provided on the next page.) In total, 61% said 'no', and 28% said 'yes' or 'strong yes'. (Here, 'strong yes' means that the student indicated that they would now like to pursue a STEM career.) The Year 9 students were more positively influenced than the Year 10s (33% compared with 23%). One possible reason for this difference is that younger students have a less rigid view of their future and are more likely to be interested by a range of options. Coming into the event with a more open-minded view would make them more receptive to the messages of our speakers and workshop providers. However, further research is needed to explore this question.

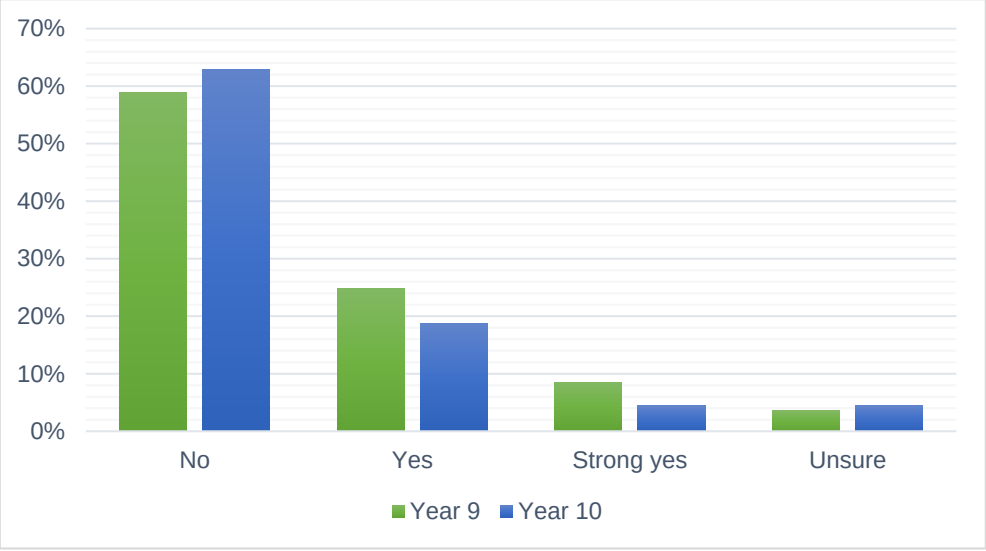

***Figure 10**: Percentages of student responses to post-survey Q5 on whether the Choose Maths Day influenced their choice of career. 'Strong yes' means the student now wants to pursue a STEM career. Results are separated by year group with Year 9 in green and Year 10 in blue.*

Comments by students who say they were influenced in their career choices:

- It made me think about pursuing a career more involving maths.
- It made me consider doing a maths course in uni along with my other course (environmental science).
- It gave me ideas about alternative jobs I could do that I didn't already know about.
- I will think of maths in a different light from now on when doing my maths homework or in maths class.
- It has taught me that maths is required for the career I want to pursue.
- I now feel that I have a wider range of options.
- The activities today changed my mind about my selections, as I was thinking about going into an art-only-related career. It broadened my perspective.
- I gained a lot of knowledge that can help me choosing the right career path.

4.4 The CHOOSE**MATHS** Days

For the purposes of improving the format and content of Choose Maths Days, it is instructive to look at the answers to Q7 of the pre-survey, about what students hoped to get from the event, and Q1 of the post-survey, which asks what students liked most about the day.

The responses to Q7 of the pre-survey were divided into five main categories:

- Careers: responses regarding gaining information about career choices or about learning how mathematics is needed in different careers.
- Y11 course info: responses indicating that the student wants help in making subject selections in Year 11.
- Enjoy mathematics: responses indicating that the student enjoys mathematics and/or would like to learn more about mathematics.
- Increase motivation for mathematics: responses indicating that the student is looking for motivation to continue with mathematics, to gain confidence in mathematics, or to develop strategies for improving at mathematics.
- Day off: responses indicating that the student is only at the event as a way to take a day off school.

There was also a general category of ‘other’, which included responses such as finding out more about courses at university, meeting other people who enjoyed mathematics, getting free food, and learning about the Choose Maths project. This category also included vague responses such as ‘knowledge’ and ‘learning new skills’.

In **Figure 11** we see that more than 40% of students in both year groups chose ‘careers’ as their response. For the Year 10 students, increased motivation in mathematics was also a strong response (21%).

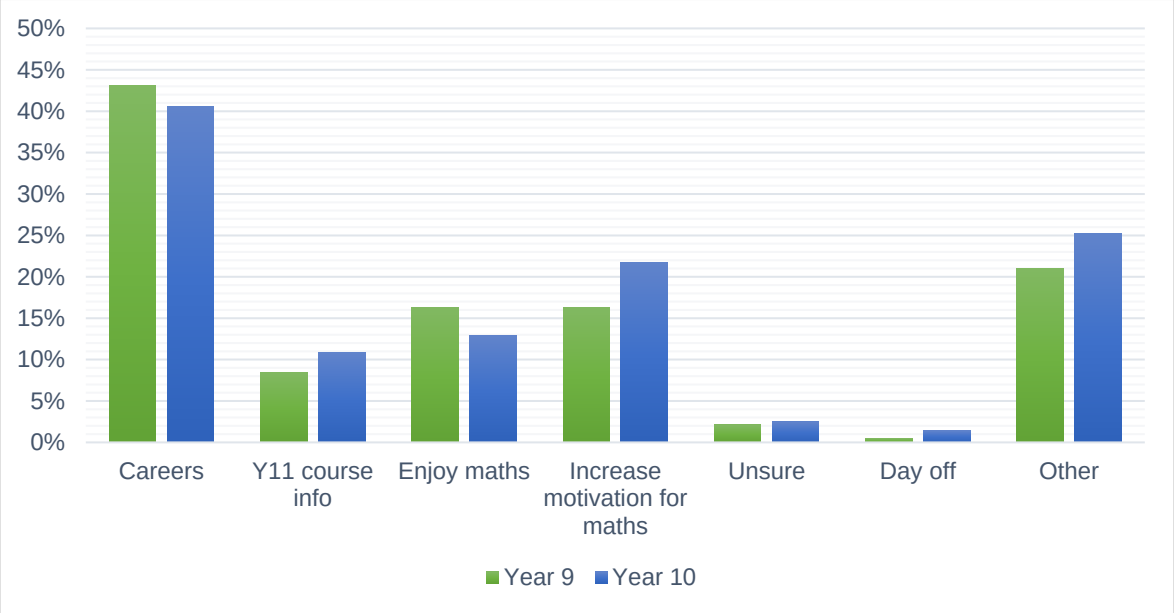

***Figure 11**: Percentages of student responses to pre-survey Q7 on reasons for attending Choose Maths Days, separated by Year 9 (green) and Year 10 (blue).*

Figure 12 shows the post-survey responses about what students enjoyed the most about the Choose Maths Days. (Percentages in this figure add up to more than 100% since students were able to choose more than one option.) It is clear that the hands-on workshops/activities were the favourite part of the day for most students, with very little variation between the year groups. However, it is also worth noting that events typically included 3 or 4 workshops and 3 or 4 speakers, but only one Q&A, so we would expect fewer votes for this activity.

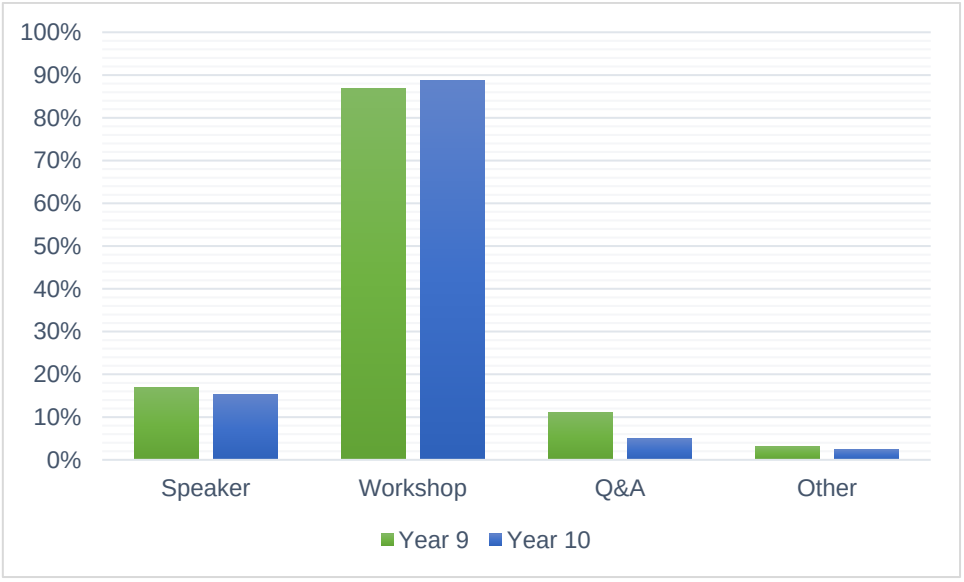

***Figure 12**: Percentages of responses to post-survey Q1 about what students liked best at Choose Maths Days, separated by Year 9 (green) and Year 10 (blue).*

4.5 Variations between universities

Although the conclusions reached above are broadly similar between all the university Choose Maths Day events, there was some variation between the survey results for the different host venues. In this section the six university venues have been randomly assigned a letter from A-F so as to keep results anonymous.

4.5.1 Mathematics enjoyment

Figure 13 shows averages for the pre-survey Q3 compared with the post-survey Q2, which ask for the students' level of enjoyment of mathematics. The orange line is the line of 'no change', so universities above the line had a positive effect on mathematics enjoyment and those below had a negative effect.

The university with the biggest impact on their attendees was A, whose average increased from 3.36 to 4.04 (+0.69). University E also had a strong positive effect, going from 3.62 to 4.11 (+0.49). These were also the two universities that started with the lowest levels of reported mathematics enjoyment. University F started with the strongest reported mathematics engagement (4.19) but this was not changed by the Choose Maths Day.

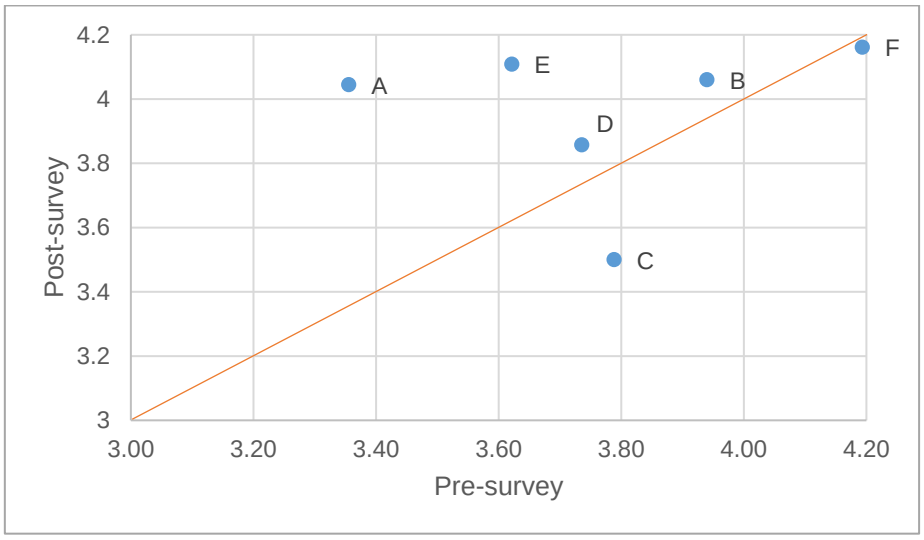

Figure 13: *Comparison of pre- and post-survey mean scores for mathematics enjoyment for each university event.*

It is surprising that students at event A had such a low average in their pre-survey reported mathematics enjoyment, since they had the highest percentage of students reporting mathematics as a favourite subject (64%; the next best was event D with 50%). University E had the lowest percentage of students with mathematics as a favourite subject, with 31%.

4.5.2 Year 11/12 subject selections

In **Figure 14** we compare answers to Q4 (pre and post) about subject selections in Year 11/12 across the different events.

Despite event C seeming to have a negative effect on mathematics enjoyment among attendees (from Figure 13), they were the university with the strongest reported positive effect on students' Year 11/12 subject selections, with 65% of students saying 'yes' or 'strong yes' to Q4 on the post-survey. Students at event D were also enthusiastic about taking a higher level of mathematics in Year 11/12 (64%), but their pre-survey answers showed that most were already planning on choosing the highest level of mathematics in Year 11/12.

The results from event A are interesting: almost none of the students considered advanced mathematics. Out of those event A students thinking of taking elementary mathematics, 56% of them say that they were influenced by the event, compared with 42% overall.

Out of all the universities, the event A students are those with the highest percentage saying the event had an 'extremely high' effect on how positively they thought about mathematics (post-survey Q3).

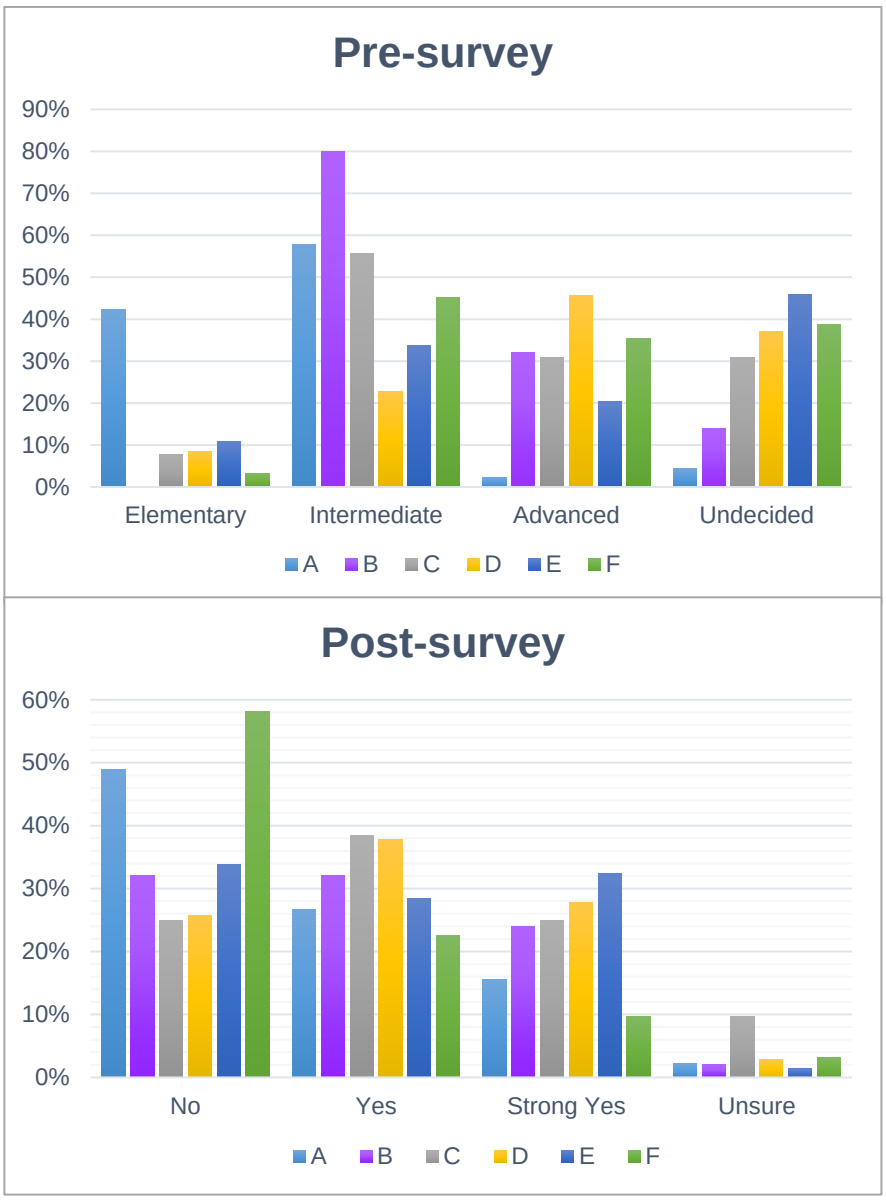

Figure 14: *Percentages of student responses at each university event for Q4-pre and Q4-post about Year 11/12 subject selections and whether the Choose Maths Day affected their choice. 'Strong yes' in the post-survey means students say they will now choose a higher level of mathematics in Year 11/12.*

The analysis in the last two sections show that the different metrics for assessing the success of the day are largely independent. Students may enjoy the mathematics presented and yet not be swayed in their subject selections, and vice versa. They may consider mathematics their favourite subject and yet have low aspirations for the level of mathematics they wish to do in Year 11. It is therefore important to consider answers to all the pre- and post-survey questions in order to measure the success of any given event.

4.5.3 Careers

In **Figure 15** we see that most universities recorded broadly similar percentages of students interested in STEM and non-STEM careers, with two notable exceptions. The events at universities D and F had the lowest proportions of students saying they were interested in STEM degrees and/or careers. It is interesting to contrast this with the pre-survey data for subject selections (**Figure 14**), where universities D and F were the two events with the highest recorded percentages of students saying they wanted to take advanced mathematics in Year 11/12. It is important to find out why students are choosing the highest levels of mathematics in high school if they are not interested in STEM-based careers after school.

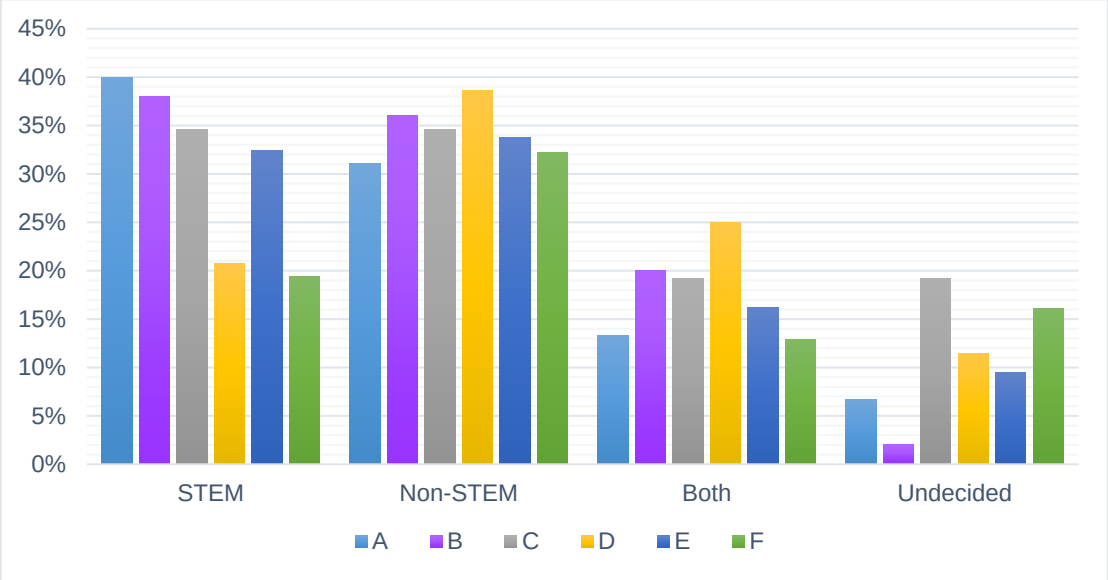

Figure 15: *Percentages of student responses at the different university events for pre-survey Q5 about future careers the students are interested in after school.*

5 Conclusions and Recommendations

Choose Maths Days are events which very positively influence students' perceptions and enjoyment of mathematics, and their aspirations for choosing mathematics in Years 11 and 12. The analysis of this survey data shows that the events are more beneficial for some categories of students than others. We will use our analysis to make recommendations for future Choose Maths Days and for further potential research into the attitudes of female students towards mathematics in school.

5.1 The target audience for CHOOSE**MATHS** Days

In 2018 the Choose Maths Days were targeted equally at Years 9 and 10, with a view to the current Year 9 students potentially being able to attend two such events before their subject selections towards the end of Year 10. Although Choose Maths Days had a positive effect on both year groups – both in terms of improving enjoyment of mathematics and in influencing subject selections – the Year 9 students were more influenced in both aspects. Where there is a question of deciding who to invite for future events, therefore, Year 9 students should be prioritised over Year 10s.

The Choose Maths Days had a greater positive effect on those students who began the day with a low-to-medium level of mathematics engagement, and with those with lower aspirations for their level of Year 11 mathematics. When marketing the event to schools in the future, emphasis should be put on inviting those students who are less engaged with mathematics but who have the potential to engage and achieve, and/or those who are planning to select an elementary level of mathematics in Year 11.

We intend to increase the number of events in 2019, including holding more events in regional and rural schools to complement those held in cities at universities. Events held in schools are more likely to include a broad range of students and to include those who are not already interested in mathematical study or STEM careers.

5.2 Changes to the CHOOSE**MATHS** Day format

The university Choose Maths Days in 2018 apparently did not have a very strong influence on students' career choices. It is important to assess how we can improve the Choose Maths Days for 2019 in this respect.

It would be instructive to look at the selection of careers suggested by the students, inviting speakers who can talk about the most common non-STEM ones and the ways that mathematics is needed for them. For example:

- Art and design careers, such as architecture, interior design, game design, and fashion design;
- Medical and veterinary sciences and caring professions, such as optometry, nursing, physiotherapy, midwifery, dermatology, and paramedics;
- Law-related careers, such as criminology, forensic science, barrister;
- Finance and business careers.

While mathematics and science were the most common 'favourite subjects' of the attending students (across both year groups), the students also named art, English and sport as common favourites. This should be taken into account when designing workshops, showing not only that mathematics is interesting and important, but also how it can be embedded within other disciplines. This would help to emphasise the message that students do not need to label themselves as either a 'mathematics person' or a 'humanities person', but that mathematics is an important skill no matter the choice of career.

The survey responses will inform changes to the survey design in 2019 in order to capture ambiguities and to decrease missing responses.

5.3 Proposals for further research

The analysis of the responses at the different universities has revealed some interesting results which would benefit from further surveys and analysis. For example, at event A, the pre-surveys showed that the students had simultaneously the highest proportion of those who listed mathematics as a favourite subject, the lowest average enjoyment of mathematics and the lowest proportion of those considering taking advanced mathematics in Year 11. What does it mean for a student to list a subject as their favourite, and what relationship does this have towards their plans for further study and careers after school?

The other interesting anomaly in the university data was that the two events where the students had the highest aspirations in their Year 11 mathematics level were also the two events where the students were least likely to want to go into STEM careers. We recommend further research into the reasons behind students' subject selections in Year 11 in order to investigate this finding.

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[1] Koch, I. and Li, N (2017). AMSI CHOOSE**MATHS** Research, 2017, no 1.

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[3] Office of the Chief Scientist (2016). Australia's STEM Workforce: Science, Technology, Engineering and Mathematics, Australian Government, Canberra.

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