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A Qualitative Investigation of Perceived Influences Shaping Adolescents' Plans to Pursue (or not Pursue) Maths-Related Careers

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Students' unrestricted interview responses regarding why they plan to either pursue (or not pursue) maths-related careers are the focus of the present study. Within the Expectancy-Value theory of achievement motivation of Eccles, Wigfield and colleagues, success expectancy beliefs and values are posited to be the main predictors of choices to participate in maths, with indirect influences of task demand, where participation choices are operationalised in terms of high school maths course enrolments. The present study extends consideration of participation choices to maths-related career plans, being a longer-term outcome with clear social relevance. Open-ended qualitative techniques are employed, rather than correlational approaches common within this perspective, to investigate students' reasons for participation in maths-related careers. Findings corroborate influences identified within the Expectancy-Value framework, providing strong support for these factors as sources of students' intentions to pursue (or not pursue) maths-related careers.

The present study investigates reasons why students plan to either pursue or not pursue a mathematics-related career. There is a general consensus that more men are involved in highly maths-related careers than women, evidenced through research emphases directed at understanding boys' and girls' participation in high-school maths within the Expectancy-Value framework of Eccles and colleagues in particular. The purpose of this study was to contrast the explanatory utility of each of the key constructs within the Expectancy-Value framework, theorised as determining academic choices. The present study is the first to temporally extend examination of gendered achievement-related choices within the Eccles et al. Expectancy-Value model, to include plans for participation in maths-related careers, which is an important contribution to extending our understanding of achievement-related choices beyond the high-school years. Expectancy-value theory is one of the major frameworks for achievement motivation, beginning with Atkinson (1957), being further developed by Battle , Crandall and colleagues , and more recently by Feather and Eccles,

Wigfield and colleagues ; . Broadly, these theorists see success expectancies and value for success as major determinants of motivation to perform achievement-related tasks.

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The Eccles, Wigfield and colleagues' formulation of the Expectancy-Value Model links academic choices to expectations of success and to the subjective value of the task, drawing on the theoretical and empirical work of decision-making, achievement and attribution theorists . This model was developed by Eccles and colleagues primarily to investigate enrolment patterns in mathematics, especially to better understand bases of gender differences in secondary mathematics course enrolments. They contended that existing research into academic choices was limited by the lack of an integrative theoretical framework to guide the selection and organisation of the variables influencing achievement-related choices and behaviours, with research proceeding in a piecemeal fashion as individual researchers investigated subsets of the possible causes. Their model was developed with the aim of providing a framework which would provide more precise conceptualisation of the components, link the various pieces together, suggest causal sequences, and outline the relations between beliefs and achievement-related behaviours (Eccles et al., 1983). The most recent statement of the Expectancy-Value model of achievement motivation is presented in Figure 1. Expectancies and values are the most proximal influences on achievement-related choices in the Eccles and colleagues' formulation of the Expectancy-Value model, and these are in turn predicted by cognitive factors including ability perceptions as well as perceived task demands. While acknowledging that there has been little research outside of their own directly addressing the relationship between perceived difficulty and task choice, these researchers suggest that there is evidence demonstrating a link between the two. Eccles et al. (1983) found that there was no direct relationship between perceptions of difficulty and enrolment plans, but rather that task difficulty perceptions influenced enrolment choices through their influence on expectations for success. This model has guided extensive quantitative and longitudinal research, but it is also possible to explore elements of the model through qualitative techniques, as in the present study which is based on interview data.

cultural child's perceptions of child's goals and expectation

milieu socialisers' attitudes general self-schemata, of success

and expectations, S-C ability, perceived

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previous child's interpretation child's affective subjective

achievement- of experience: causal memories task value

related attributions, locus of

experiences control

Figure 1. Current form of the Eccles and colleagues Expectancy-Value model. From Wigfield, A. & Eccles, J.S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology, 25*, 68-81.

The work of Eccles and colleagues on the influence of expectancies and values on achievement motivation has been extensive (e.g., . It has been widely demonstrated by Eccles, Wigfield and colleagues that expectancies and values relate to achievement-related choices operationalised in terms of course enrolment (e.g., Eccles et al., 1983; Eccles et al., 1984), findings which have been supported by other researchers (e.g., . Researchers working within other theoretical paradigms considering achievement behaviour have also included expectations regarding outcomes as key factors in their models. Expectancies for success are distinguished conceptually from ability beliefs which are defined as perceptions of one's current competence at a given activity. Eccles and colleagues have not, however, been able to distinguish empirically between the ability and expectancies constructs in factor analytic work ; , p.74). Marsh and colleagues have established that domain-specific self-concept of ability (highly interrelated with expectancies) predicts coursework selection , and self-concept of ability has also been conceptualised as an important component of several theoretical frameworks predicting future behaviours, such as Covington's self-worth theory , Weiner's attribution theory , Harter's self-concept approach), and the self-concept models of Marsh and colleagues (e.g., .

Values have been defined by Eccles and colleagues as relating to how a task meets individual needs . Four major components of values are proposed, being intrinsic value, utility, attainment value or importance, and cost. Intrinsic value is the enjoyment one gets

from carrying out a given task; utility refers to how a task will be useful to an individual in the future; attainment value refers to the importance of doing well on the task; and cost is what the individual has to sacrifice doing to carry out the task, as well as the effort required to complete it. Most of the empirical work has been carried out with the first two of these constructs . Intrinsic value is described as similar to the construct of intrinsic motivation as defined by Deci and colleagues ; and by Harter , being concerned with engaging in a task out of interest or enjoyment. Intrinsic value refers to the enjoyment inherent in task engagement, where task value arises out of the *process* of performing a particular activity perceived to be worth doing for its own sake, irrespective of what may or may not come if it. The activity which the student intrinsically values becomes 'autotelic' (a goal within itself), labelled the 'flow' experience by researchers such as Csikszentmihalyi . In contrast, utility value has some resemblance to extrinsic motivation , in that it taps more instrumental reasons for engaging in a task. These constructs have however developed from different intellectual roots, despite having some overlap in operationalisation .

The present unrestricted interview investigation was intended to explore whether other important influences were operative in students' plans regarding participation in maths-related careers, and to assess the utility of the Expectancy-Value framework in explaining these choices. Based on findings of research conducted utilising the Expectancy-Value framework, anticipated students' responses shaping their decisions to either pursue or not pursue maths-related careers were mainly in terms of success expectancies, perceived maths ability, and maths-related values. Students planning to pursue maths-related careers were expected to cite reasons relating to their expectations of being successful in maths, their high mathematical ability, their interest in maths, perceiving maths as useful, regarding it as important to do maths and/or not having competing interests or costs involved in pursuing maths. Students planning *not* to pursue maths-related careers were expected to give explanations relating to expectations of not succeeding in maths, their low mathematical ability, being uninterested in maths, not perceiving maths as useful, not needing maths or regarding maths as unimportant and/or having competing interests or costs involved in pursuing maths.

METHOD

Design

The present study is a subset of a much larger longitudinal study, involving three sequential cohorts (n=428 cohort 1, n=436 cohort 2, n=459 cohort 3), together spanning grades 7 to 11. The large study involved repeated administration of a battery of surveys and tests assessing students' attitudes and achievement related to both maths and English. An intensive interview component was carried out with selected students from cohort 3 in grade 9, which was the first year of that cohort's involvement in the study. Interviews were conducted with six groups of students identified on the basis of their measured mathematical performance and perceived talent self-ratings. These six groups were composed of girls having high mathematical performance and high self-perceptions of talent, boys having low performance and high talent perceptions, and girls having high performance and low talent perceptions. Cross-sex parallel comparison groups were also included for each of these three conditions, resulting in a total of six groups. This interview phase addressed questions relating to students' reasons for planning to pursue (or not pursue) a maths-related career, which are the subject of the present study; in addition to questions about the development of students'

talent perceptions, and explanations for greater male participation in high levels of maths, which are not included in present analyses.

Participants

Participants (N=60) were selected from the larger cohort of 459 Year 9 students from three coeducational government schools in an upper-middle class area of metropolitan Sydney, of comparable socioeconomic status (based on socioeconomic index for areas, Australian Bureau of Statistics, 1995). Interviewees were selected from the large-scale extensive study according to their perceived mathematical talent self-ratings, and their measured mathematical performance on standardised tests. The composition of the six groups is illustrated diagrammatically in Table 1.

Table 1

Interviewee Group Composition

	high maths talent perceptions	low maths talent perceptions
high maths performance	10 boys (group 1) 10 girls (group 2)	10 boys (group 5) 10 girls (group 6)
low maths performance	10 boys (group 3) 10 girls (group 4)	

Materials

Mathematics Achievement. Students' current performance in mathematics was assessed as part of the large-scale study at the beginning of the school year, being measured on a standardised Progressive Achievement Test (Form 2B, ACER, 1984). Alternate items (28 items) were selected so that the test could be administered in 20 minutes. Internal consistency for the test as a whole was Cronbach alpha .80, indicating satisfactory reliability for the mathematics test.

Perceptions of Talent. Measures of students' talent perceptions were obtained in the main study, and occasion 1 data from cohort 3 were used in the selection of grade 9 interviewees. Full details of the formation and validation of the talent construct are reported elsewhere . Students were selected as 'high' versus 'low' on each of the perceived talent and maths achievement measures according to whether their scores fell in the top and bottom thirds for the relevant construct , yielding 47, 38, 15, 10, 15, 14 students respectively for each of the prespecified interview groups (see Table 1). It was decided to use the minimum cell size (n=10) as the number of students to select from within each cell. Interviewees were then randomly selected from within each of the remaining five cells.

Interview Protocol. Intentions whether or not to pursue a mathematics-related career were assessed via an initial question in which students were asked whether they would pursue a maths-related career. They were then asked why or why not. In the event of them not

volunteering a reason, follow-up probes investigated whether interest, perceived ability, money or status, or perceived prejudice were determinants of this. These probes were included on the basis of 'interest' relating to the Expectancy-Value 'values' construct, 'ability' to the Expectancy-Value 'ability perceptions' construct, while 'money' and 'status'/ 'prejudice' were included as plausible motives so as not to bias probes solely towards eliciting Expectancy-Value explanations.

> Will you pursue a maths-related career?
>
> If YES, why? (interest, ability, money/status)
>
> If NO, why not? (lack of interest/other interests, uncertain if I have the ability, money not important, too much prejudice to contend with)

Procedure

Interviews were conducted mid-year following first semester exams, but before students had received their mid-year examination results, in order that reaction to recent results not affect their interview responses. Information and consent forms were sent to parents of targeted interviewees two weeks before scheduled interview dates, resulting in 100% returning consent. Interviews were carried out by two people, myself and a trained male research assistant. The male interviewer interviewed all the boys and I interviewed all the girls. This decision was made in order to control for the gender interface during interviews, particularly in view of the nature of subsequent interview questions related to sex-typing of mathematics, not the subject of this paper, about which boys might not have felt free to be honest with a female interviewer.

Individual interviews were conducted with a duration of approximately 20 minutes each. Interviewees were first assured of the confidentiality of their responses and invited to select an alias name for interview and transcription purposes. They were told that the purpose of the interview was to find out in greater depth about their attitudes expressed in the mathematics survey earlier in the year, and asked if they would permit the interview to be taped. It was explained that the purpose of the taping was because their responses were very important, and because we wanted to transcribe the interview both for analysis purposes, and also as a validity check so that they could comment on and change sections of the transcript if necessary. This last also doubled as an ethical safeguard, in case students revealed something deeply personal that they might later want to retract, for example. All interviewees agreed to the taping of interviews.

Analyses

Interviews were initially transcribed and sent to interviewees for comment. Following this, responses to each question were collated within each of the six interview groups, and subjected to thematic analysis. Initial descriptive coding was followed by pattern coding, with common themes for students planning either to pursue or not pursue a maths-related career identified. Example passages from transcripts were selected for illustrative purposes as typifying certain themes, and exceptions to themes were also identified to describe divergent processes. These interview excerpts permit a strong sense of participants' views of themselves and related influences, providing expression of participants' voices . Although responses were collated within each interview group initially, differences between groups were not anticipated.

Issues of Reliability and Validity

Issues of reliability and validity are relevant to qualitative as well as quantitative research. In this study, reliability was addressed by standards of qualitative inquiry. "That is, rather than demanding that outsiders get the same results, one wishes outsiders to concur that, given the data collected, the results make sense - they are consistent and dependable" , p. 172). Strategies to enhance consistency and dependability in the present study include the descriptive clarity of codes used, coding across the full set of transcripts for each question in the interview protocol to permit continued focus on each set of codes and minimise coder 'drift', keeping detailed records of decisions made in case classifications, and rereading of transcripts and applied codes in order to check coding consistency within and across cases. Although interrater consistency was not assessed, it is considered that peer examination of the objective application of coding categories, in addition to the strategies for enhancing consistency and dependability just described, adequately address issues of reliability in coding. Transcripts were also exhausted by the application of coding categories, with no responses by interviewees omitted or uncoded. It is considered, therefore, that coding categories were reliably and exhaustively applied in the present study.

Within the qualitative tradition, credibility of conclusions is typically assessed by ensuring they represent the multiple constructions of reality provided by informants . Despite interviewees each being provided with a copy of their interview transcript for verification purposes, consideration of this data source as the only basis for evaluating credibility is problematic , p. 71). Although the interviewee check of data for analysis was a necessary first step, it was also necessary to check the credibility of inferences drawn from these data. Strategies to enhance internal validity were first, explicating researcher biases; and second, peer examination . In relation to the former, research questions were approached from the perspective of the Expectancy-Value framework , with interpretation of and inferences from interviewee responses occurring within the understandings provided by that perspective. In relation to the latter, two colleagues were asked to comment on emerging interpretation of data, the first being familiar with the theoretical perspective from which data were approached, and the second being familiar with qualitative, and in particular, case study methodology.

External validity, or generalisability, is an important concern in qualitative research , p. 226). Within the present study, in which random sampling techniques were employed to select interviewees within each of the six conditions identified as of theoretical interest, confidence in inference is enhanced. It is unlikely, therefore, that emergent patterns for each group would be absent in the general population represented by each. Following guidelines put forth by Merriam , interpretations and inferences were assessed and reported in detail, such that readers can determine transferability of findings and conclusions with respect to their similarity to other contexts. In addition, the typicality of the case is clearly established, through definitive and replicable interviewee selection criteria, such that readers have a strong foundation for comparison.

RESULTS

Determinants Of Participation In Mathematics-Related Careers

Many of the respondents were unsure what their intended careers might be, as evidenced by numbers indicating they might but might not pursue a maths-related career (indicated by the 'maybe' row in Table 2). Table 2 shows numbers of boys and girls within each group planning to pursue maths-related careers. Among high-achieving students with high talent

perceptions (groups 1 and 2), more girls than boys planned to have a maths-related career, with equal numbers of boys and girls intending to have a career unrelated to maths, and approximately half the students having high performance and high perceptions being unsure whether they would participate in a maths-related career. Among students with low performance but high talent perceptions (groups 3 and 4), many more boys than girls intended pursuing maths-related careers, and many more girls than boys intended pursuing non-maths-related careers. Among students having high performance but low talent perceptions (groups 5 and 6), most students stated they would not pursue a maths-related career, with two boys and no girls planning to pursue a maths-related career. Overall, twice as many boys as girls stated they planned to pursue a maths-related career (see Table 2).

Table 2

Numbers of Interviewees Planning to Pursue Maths-Related Careers

	G1-boys	G2 - girls	G3 - boys	G4 - girls	G5 - boys	G6 - girls	Total boys	Total girls
Yes	1	3	5	1	2	0	8	4
Maybe	6	4	4	2	1	5	11	11
No	3	3	1	7	7	5	11	15

Reasons for Planning to Pursue a Maths-Related Career

Reasons for students planning to pursue a maths-related career that were of theoretical interest related to the three key constructs in the Eccles et al. Expectancy-Value framework, focused on throughout the present study . These key constructs are self-perceptions of ability or talent, task-perceptions (effort required and task difficulty), and task values (interest and utility perceptions). The most common reason given for students planning to pursue maths-related careers was maths being involved in students' chosen career (6 responses), with maths therefore being instrumental to students participating in their career of choice. This relates to Eccles et al.'s subjective attainment value construct which assesses the extent to which maths is important for students' planned careers. The next most frequent response (4 responses) was self-perceptions of being good at maths, while there was only one response relating to each of interest in maths and task difficulty, and one miscellaneous reference to parental expectations. Numbers of responses for boys and girls within each of the six interview groups for these emergent themes are shown in Table 3.

Table 3

Number of Responses to Emergent Reasons for Pursuing (or not Pursuing) a Maths-Related Career for Interview Groups

		G1 boys	G2 girls	G3 boys	G4 girls	G5 boys	G6 girls
Reasons for pursuing maths-related careers	Happens to be in chosen career	1	2	2	1		
	Good at maths		1	3			
	Interested in maths					1	
	Maths is easy					1	
	Father expectations		1				
Total responses		1	4 [a]	5	1	3 [a]	0
Reasons for not pursuing maths-related careers	Not good at maths				1	3	1
	Dislike maths			1		2	2
	Have other interests	2	3		6	3	3
	Maths is too hard				1		
Total responses		2	3	1	8 [a]	8 [a]	6 [a]

a Note. These totals differ from those in Table 2 since students were permitted to provide more than one reason.

Maths Being Instrumental to Career of Choice. Maths being instrumental to participation in students' career of choice was the most common reason given for planning to pursue a maths-related career. Six students stated that the career they were interested in for reasons other than its mathematical content, happened to involve maths. This reason resembles

Eccles et al.'s subjective attainment values construct , which assesses the extent to which maths will be useful to students' career plans in the future. Although the Eccles et al. subjective attainment values construct taps the 'instrumental' aspect evident in students' interview responses in the present study, it does not capture the 'incidental' aspect. Students' open-ended responses here related to maths being instrumental to their career of choice, although they were interested in these careers for reasons other than their mathematical content. This reason appears to be related to having high mathematical self-perceptions, being mentioned by students from groups 1 to 4 (boys and girls with high perceptions of mathematical talent, and high and low measured performance), but no students from groups 5 or 6 (low talent perceptions and performance).

Both Fred and David are examples from the two boy groups (1 and 3 respectively), whose responses reflect career choices based on intrinsic interest:

> Int: Do you think you will pursue a career where there is a lot of maths or maths involved?
>
> Fred: Oh, I think because I would like to have a business ... and you need maths.
>
> Int: Do you think you'll pursue a maths-related career?
>
> David: Yes. Flying, you need good maths, like to work things out, like height you need such-and-such a thing ... I do gliding at the moment. I'm pretty serious, I've always wanted to fly and I enjoy it when I do get to.
>
> Int: Is it an interest in maths that makes you want to fly?
>
> David: Not really *[laugh]*, it's just a love of flying itself.

In both these cases the maths-relatedness of the careers is clearly not the reason the boys wish to pursue the career mentioned. Fred recognises the relevance of maths to running a business, and David recognises maths is needed to be a pilot. David in particular makes it clear that the maths is quite incidental to interest in the career.

Ariel from the girl group 2 (high performance and perceptions) gives a similar response to the boys, in that her intended career reflects an intrinsic enjoyment of the job itself:

> Int: Do you have intentions of pursuing a maths-related career?
>
> Ariel: I was wanting to be a vet and stuff like that so that's sort of maths a bit, like it involves maths, like medicine sort of stuff like that, 'cause I really like animals and stuff like that, so I'd be something like a vet.

Laura's response (also from group 2), while reflecting intrinsic interest in studying medicine, reveals this interest comes from a desire to help others, rather than personal fulfilment. She also makes reference to her father's expectations for her to study medicine.

> Int: Do you think you might pursue a maths-related career?
>
> Laura: Yes... I think it's because... well my dad wants me to study medicine. I never really knew what I wanted to do, but I'd like to study medicine. 'Cause my dad wants me to study medicine 'cause he couldn't do it, 'cause his parents couldn't afford it.
>
> Int: Does medicine interest you personally?
>
> Laura: Yes, I think because I've been sick a lot and I know what it feels like to be sick.

Laura's response reflects the desire to nurture and help others often attributed to girls and women. In fact, one interviewee from group 6 (girls with low talent perceptions and high performance) in response to a different question, made the comment below, illustrating exactly this point.

> Mandy: Women tend to want to sort of help people and care for them and maybe men think that they have to support the family. They might have to have a good job which is really complicated and to earn a lot of money.

The instrumentality of maths to students' chosen career, relating to their 'subjective attainment value' of maths within the Expectancy-Value framework , was the most frequent reason given by respondents planning to pursue maths-related careers, being cited by half of the twelve students. These students were not interested in maths *per se*, but were interested for other reasons in careers which happened to involve maths. For girls, a theme that emerged relating to their career interests, was wanting to help and nurture others.

Being Good at Maths. Being 'good at maths' relates directly to 'perceived maths ability' in the Expectancy-Value framework. This was the second most common reason given for intending to pursue a maths-related career, with 3 of the total 4 responses coming from group 3 (boys with high talent perceptions and low performance). Group 3 responses tended to simply reflect positive self-perceptions of mathematical ability, as illustrated by Stefan:

> Int: Do you think you will pursue a maths-related career?
>
> Stefan: Um... I like engineering stuff. My brother's friends said that if you are good at maths and science you could do engineering.

The group 2 response (girls with high talent perceptions and high performance) showed Tamara perceived herself as good at maths in relation to her other school subjects, illustrative of some tendency for girls' self-perceptions to be contextualised against their self-perceptions in other academic subjects:

> Int: Do you think you might pursue a maths-related career?
>
> Tamara: Um... yes. Probably.

Int: Okay. Why do you think you might?

Tamara: Because I'm better at maths than any other subjects.

Maths Interest and Low Perceptions of Task Difficulty. Maths interest maps to the 'intrinsic values' component of the Expectancy-Value framework, posited to directly impact on achievement-related choices in the form of maths participation. This was, however, mentioned by only one respondent as the reason for planning to pursue a maths-related career. Steve from group 5 (low talent perceptions and high performance) planned to participate in a maths-related career because he found maths intrinsically interesting:

Int: Do you think, Steve, that you will pursue a maths-related career?

Steve: Um... maybe engineering.

Int: Yeah? Why's that?

Steve: Um... it's interesting.

Int: Okay. Is it interesting because there's maths involved?

Steve: Yes. Maths is fun.

Int: You like maths do you?

Steve: Yes.

Int: Why is that, why do you find it fun?

Steve: It's pretty amazing.

Int: Is it? Just answers you can come up with, and ways of working things out?

Steve: Yes.

Task difficulty is another component of the Expectancy-Value framework, although Eccles, Wigfield et al. believe this does not directly impact on choice outcomes, rather being mediated by expectations of success (e.g., Eccles et al, 1983). In support of this, only one group 5 respondent (high performance and low talent perceptions) stated he would pursue a maths-related career (accountancy) because it would be an easy job, although there may be features about accountancy other than its maths-relatedness that led William to this conclusion:

Int: Can you see yourself, William, pursuing a maths-related career?

William: I think an accountant.

Int: Why's that...?

William: ... probably should be an easy job.

Reasons for Planning to Not Pursue a Maths-Related Career

Reasons given for planning not to pursue a maths-related career again reflected the three key Expectancy-Value constructs of self-, task- and values perceptions (see Table 3). Overwhelmingly, the most common response was that students were interested in areas other than maths (from 17 of the 26 students). Although related to lack of interest in maths, this response is qualitatively different, in that it reflects lack of interest in maths *relative* to other subjects, and so does not preclude liking maths. Next most common were low self-perceptions of mathematical ability and disliking maths (5 responses each), with one reference to maths being too hard.

Having Interests Other than Maths. Two-thirds of the students raised having interests in areas other than maths as a reason for not wishing to pursue a maths-related career. Interests other than maths that were cited by boys showed no particular pattern, being journalism, music and business. In contrast, the ten alternative interests raised by girls related mostly to the arts (music, fashion (n=2), 'something creative', acting, and dance), with marine biology, sport and medicine also mentioned.

Frank from group 1 (high talent perceptions and high performance) is an example of a boy who does not consider the possibility of a maths-related career, because he already knows what he wants to be:

Int: Can you see yourself pursuing a maths-related career?

Frank: Not really.

Int: Why is that?

Frank: 'Cause I'm interested in being a sportsman.

Int: Okay. What sport do you do?

Frank: Baseball.

Int: That's a pretty good sport. So you might pursue a sports career do you think?

Frank: Yeah.

Int: Okay... so do you actually have a lack of interest in maths or do you feel you have lack of ability in maths and that's the reason?

Frank: Just a lack of interest.

Agatha (group 2, high talent perceptions and high performance) is less decisive about what she wants to do, but knows she wants to do something related to sport:

Int: Do you think you will pursue a maths-related career?

Agatha: I don't know, I have no idea what I want to do.

Int: Okay. When you do decide what you want to do, what will it depend on?

Agatha: I want to do something to do with sports because I like sports, like I want to do sports medicine or something...

Int: So what you decide will be because you're interested in it?

Agatha: Yeah... you'd have to like it otherwise it gets boring.

Sarah is an example from group 4 (high talent perceptions and low performance), illustrating the pattern that emerged of female interest in the arts, having interests apart from maths that she wishes to pursue:

Int: Do you think you might pursue a maths-related career?

Sarah: No.

Int: Why not?

Sarah: I like fashion and art and all that.

Int: So basically you're more interested in other things than maths?

Sarah: Yes.

These students do not wish to pursue maths-related careers at this point in time in their schooling, not because they are not interested in maths necessarily, but because they have competing interests that they wish to pursue. For girls, these competing interests were typically of a creative nature. This explanation relates to the 'cost' values component of the Eccles, Wigfield and colleagues' Expectancy-Value framework, which refers to what the individual has to give up in order to participate in maths. Students' other interests can be considered competing options within this perspective.

Not Being Good at Maths. The next most frequent reason given for not planning to have a maths-related career was not being good at maths (5 responses). This was given as a reason most frequently by boys with low talent perceptions and high performance (group 5) as compared with only one student from each of groups 4 and 6 (girls with high talent perceptions and low performance, and girls with low talent perceptions and high performance). An example from group 5 is Tony, who despite quite liking maths does not consider himself good at it:

Int: Can you see yourself, Tony, pursuing a maths-related career? Can you see yourself doing a job where there's maths involved?

Tony: No.

Int: No? *[long pause]* What, you just don't like maths is that why?

Tony: I think maths is okay but I'm not really that good at it.

Jane (group 4) has no intention of pursuing a maths-related career because she does not consider herself good at maths relative to other school subjects. This is another example of girls' maths-related self-perceptions being contextualised against their self-perceptions in other academic domains.

Int: Do you have any intentions of pursuing a maths-related career?

Jane: No.

Int: Definitely no?

Jane: No, I don't think so.

Int: Okay. Why not?

Jane: Because it's not my best subject and I don't know what I'm going to do but I don't think it would be maths.

Holly (group 6) combines two responses, perceiving herself as not good at maths, as well as having no enjoyment of it. Her career plans are, typically for girls having interests apart from maths that they wish to pursue, related to the arts.

Int: Do you think you might pursue a maths-related career?

Holly: No.

Int: Are you sure about that?

Holly: Yep.

Int: Okay. Why's that?

Holly: Because I'm not very good at it and I don't enjoy it at all, it's not what I want to spend my life doing.

Int: Do you know what you want to do yet?

Holly: Yep, I want to be an actress.

Disliking Maths. Disliking maths was a response given equally as often as not being good at maths (5 responses) for not planning to have a maths-related career. Joe (group 3, high perceptions low performance) is not interested in maths because he does not find it exciting:

> Int: Do you think you'll pursue a maths-related career?
>
> Joe: I don't really think so, no.
>
> Int: No? Why is that?
>
> Joe: I don't find it very interesting *[laugh]*... It's not a very exciting subject.

Paul is an example from group 5 (low perceptions high performance) who states that he hates maths because he perceives it to be factual, uncreative and not useful:

> Int: Do you think you'll pursue a maths-related career?
>
> Paul: No.
>
> Int: Why not?
>
> Paul: I just hate it because I'm more into - maths is like all facts, I'm more into like an ability to speak. I like arguments, trying to get yourself out of things. I don't like maths, I don't see a real point in maths. They say it's exercise, gymnastics for the mind. Like we are doing surds now and I asked the teacher 'where in my life am I going to use surds?' and she said 'never'. Then I don't see why I am actually doing it.

Jessica (group 6, low perceptions high performance) is not interested in maths by comparison with other school subjects she enjoys:

> Int: Do you think you might have a maths-related career?
>
> Jessica: Not really.
>
> Int: Okay, and why not?
>
> Jessica: Because I don't take that much interest in maths, it's not my favourite subject.
>
> Int: What is, what is your favourite subject?
>
> Jessica: I like doing art, music and history.

It appears that these boys do not find maths interesting in its own right, while Jessica's lack of interest in maths is relative to her greater interest in other creative subjects that she enjoys.

Finding Maths Too Hard. Finding maths too hard is considered distinct from not being good at maths, since the former is a 'task' and the latter a 'self' related feature. This response was given by Amy in group 4, who also makes reference to being more interested in things other than maths:

> Int: Do you think you will do a maths-related job?
>
> Amy: No.
>
> Int: Definitely not?
>
> Amy: Nope.
>
> Int: Okay. Why not?
>
> Amy: As a job for me I don't think I can do it, like it's a bit hard for me...
>
> Int: Okay. All right. Would you be interested in it though or would you be interested in other things?
>
> Amy: More interested in other things.

DISCUSSION

Of the students who stated they either planned to, or planned not to, pursue a maths-related career, responses all reflected key elements of the Expectancy-Value framework focused on in the present study, with one addition relating to father expectations. Self-perceptions of ability, task difficulty and values were all reasons raised by respondents. The most common reason for planning to pursue a maths-related career was that careers students were interested in happened to involve maths. That is, features of their intended careers that attracted them were independent of their maths-relatedness. This relates to Eccles et al.'s subjective attainment value construct which assesses the extent to which maths will be useful in students' planned careers , although that construct does not capture the 'incidental' aspect of student-described maths instrumentality. Self-perceptions of mathematical ability were the next most common reason for pursuing maths-related careers, with single responses reflecting intrinsic value and task difficulty. The idiosyncratic father expectations response aside, all reasons given by participants were covered in the Expectancy-Value framework. Values emerged as the most frequent determinant of maths-related career plans, particularly subjective attainment value, followed by ability perceptions, with task difficulty perceptions infrequently mentioned.

The most common reason for planning not to pursue a maths-related career was that students were interested in areas other than maths. Although related, this is distinct from lack of interest in maths, since having interests other than maths does not preclude also being interested in maths. These competing interests relate to the 'cost' component of values as conceptualised by Eccles, Wigfield and colleagues , which refers to what the individual has to give up in order to participate in maths. Lack of interest in maths, the 'intrinsic values' component of the Expectancy-Value framework, was the next most frequent

explanation, along with low self-perceptions of mathematical ability. There was only one reference to maths being too hard, the 'task difficulty' component of the model.

Students' explanations for why they planned to pursue (or not pursue) maths-related careers corroborate predictive factors in the Expectancy-Value model of Eccles, Wigfield and colleagues . All responses but one (father expectations) reflected key Expectancy-Value self-, task- and values perceptions. Self- and values perceptions are posited to be the most immediate influences on students' plans for mathematics coursework participation, and the present analysis has extended this proposition to maths-related career participation. Task difficulty features merited only a single mention, supporting notions that difficulty perceptions do not directly impact on academic choice outcomes .

This study has corroborated self- and value perceptions as key predictors of academic choice outcomes, as in the Expectancy-Value model of Eccles, Wigfield and colleagues , through eliciting spontaneous student explanations regarding why they planned to either pursue, or not pursue, maths-related careers. As in the model, values were found to be the strongest influence, followed by self-perceptions of mathematical ability. Value perceptions are proposed to be the most indicative of choice outcomes, particularly intrinsic value (, with the extent to which students are interested in and enjoy a subject being the primary influence on whether they elect to participate in its higher levels, both in senior high and planned careers. It is worth noting that for planned careers, intrinsic value was mentioned only once as a determinant of maths-related career plans; while the identified 'maths being instrumental to career of choice' theme, relating to the Eccles, Wigfield and colleagues' 'subjective attainment value' construct, was by far the most common response. Further work on notions of maths being instrumental, yet incidental, may therefore be a fruitful area of expansion for their 'values' factor. In contrast to values, self-perceptions are proposed to be the most influential predictors of outcomes in situations where there is no choice, such as performance . In support of their argument that values impact more strongly on choice outcomes than self-perceptions, ability-related explanations were less frequent than values-related explanations, for students' plans to pursue (or not pursue) maths-related careers. Task difficulty features merited only a single mention as a reason for each of pursuing and not pursuing a maths-related career, supporting notions that difficulty perceptions do not directly impact on academic choice outcomes . Data therefore corroborate proposed predictive influences in the Expectancy-Value model on students' choices to either pursue, or not pursue, maths-related careers. This study provides robust support for predictive factors in the model, using student free-response data elicited through interview techniques. In fostering students' plans for participation in maths-related careers, maths values, and to a lesser extent self-perceptions, are therefore of most concern.

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References