Exploring the Interplay of Perceived Subjective Task Values, Parental Influences and Cultural Stereotypes in Shaping Girls' Mathematical Education and Career Aspirations

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STATEMENT of ORIGINALITY

I certify that the intellectual content of this thesis is the product of my own work, and that all assistance received in preparing this thesis and all sources have been acknowledged.

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ABSTRACT

Mathematics is a foundational discipline for all STEM careers which has been identified as a 'critical filter' to a range of high-status, high-income fields of education and careers. Nevertheless, participation in mathematics has declined over the last two decades, and gender disparity - particularly the underrepresentation of girls in STEM - persists within the education system. In Western secondary school contexts, Caucasian and Asian boys are often considered to be advantaged in mathematics, with stereotypes such as "boys = mathematics" and "Asian = mathematics" being pervasive. However, it is unclear whether gender stereotypes still hinder Asian girls, or whether the 'Asian advantage' is distributed among girls and boys.

Previous studies have emphasised the importance of examining the intersection of gender and ethnicity in understanding students' mathematics-related education and career aspirations. Yet, there remains a lack of empirical evidence to comprehensively understand students' mathematical motivation across cultural groups.

This mixed-method study aims to investigate how Asian Australian secondary school girls' mathematical education and career aspirations are influenced by their perceived subjective task values, parental and cultural influences using the lens of SEVT. The study is located within the larger 'umbrella' - NSW DoE-funded 'PERFORM' project (CIs Holmes, Watt, Anderson, Berger, Mackenzie, Reid O'Connor). Participants (n = 177) in this study are grades 7 to 10 Asian Australian girls from a single-sex academically selective school in NSW. Quantitative and qualitative data were collected through student online questionnaires and focus group interviews.

Findings revealed that the strongest positive correlation was found between girls' mathematical aspirations and intrinsic value. Mathematics anxiety negatively correlated with all aspiration-related constructs and positive values. Both student-perceived parental support and expectation demonstrated moderately positive correlations with student-perceived cultural stereotypes. Mean-level differences at Stage and cultural levels were compared using MANOVA. Stage 5 girls at this school tended to enrol in higher level of HSC mathematics and perceived higher Stage 6 mathematics capability than Stage 4 girls. Girls who spoke an Asian home language intended to enrol in higher level HSC mathematics and perceived higher parental expectations than English home language speakers.

CHAPTER 1

INTRODUCTION

1.1 Background

1.1.1 The Underrepresentation of Girls and Young Women in Mathematics and Mathematics-intensive STEM Fields

Participation in mathematically intensive STEM studies has declined in Australia and other Western countries over the last 20 years in high school and tertiary institutions (Dobson, 2012; Watt et al., 2019), highlighting the significance of encouraging the learning of mathematics and mathematics-intensive subjects in educational settings (Meisels, 2010). People think about what they enjoy doing and what they are good at throughout their lives (Wan et al., 2021), and these motivation-relevant questions are particularly important in secondary schools because they can influence whether or not students engage in certain subjects, and eventually shape students' future educational and career aspirations (Cai et al., 2018; Wan et al., 2021). Mathematics is a foundational discipline for science, technology, engineering and mathematical (STEM) careers (Hsieh et al., 2021; Watt et al., 2017). To increase economic growth and industry innovation, the need for STEM-skilled workers has become progressively recognised in modern society (Office of the Chief Scientist, 2016). However, the persistent shortage in STEM fields is an ongoing worldwide concern, resulting in various workforces failing to fulfil the demand (Lloyd et al., 2018; Watt et al., 2019).

According to the Office of the Chief Scientist (2016), less than 20% of STEM-qualified workers in Australia are women. The gender imbalance in STEM field and the lack of STEM-capable workers is predicted to be detrimental to our economic and social development (Office of the Chief Scientist, 2014). Although there are more girls and young women achieving and participating in biological and health sciences than boys and young men (Office of the Chief Scientist, 2016), a low proportion of girls enrol in advanced mathematics and mathematically intensive subjects (such as physics, information technology and engineering) in many countries (Australian Industry Group, 2015; National Science Foundation, 2017; OECD, 2010). Such gender disparity and underrepresentation of girls in STEM persist in the Western education system, including Australia (Toh & Watt, 2024; Watt et al., 2017) and the U.S. (Matthews & Wigfield, 2024; Starr et al., 2022), due to various factors including interpersonal discrimination, societal gender inequality, and cultural stereotyping of mathematics.

The disproportion of girls and marginalised groups in mathematics-intensive STEM fields is a still ongoing concern (Hsieh et al., 2021). It is reported that of those who had a STEM degree, over 50% of Australian young women held a natural science undergraduate degree, while about 15% of them had a degree in information technology or engineering (Australian Government Department of Education and Training, 2014). For postgraduate programs, women in Australia remain underrepresented, with only approximately 11% of them achieving a chemical science and 5% had physical science of doctoral degrees (Dobson, 2012).

1.1.2 How do parental and cultural stereotypes influence adolescents' mathematical choices?

Many studies have shown that students' mathematics educational and career aspirations are associated with factors including parental involvement (e.g. expectations and support), prior knowledge, gender, socioeconomic status as well as cultural background (e.g. Gemici et al., 2014; Gore et al., 2015; Riegle-Crumb et al., 2011). Parents are primary socialisers who are responsible for developing students' autonomy and decision-making ability (Ryan et al., 2015), whose influence plays a crucial role in students' mathematics educational and career aspirations.

Students' learning and experiences are strongly influenced by not only identity aspects including their gender but also their race/ethnicity (Coll et al., 1996). Previous studies have studied how gender shapes girls/women and boys/men in choosing STEM disciplines (Lloyd et al., 2018; Watt et al., 2012). For instance, boys are more likely to aspire to mathematics-related careers (Watt, 2008), while girls often prefer careers that involve social interactions as they are more inclined towards helping others (Jirwe & Rudman, 2012; Vida & Eccles, 2003). For example, Su et al.'s (2009) meta-analysis revealed a substantial gender difference in career interests especially on a Things-People dimension. They discovered that men demonstrated more realistic and investigative interests and are more inclined to 'things', whereas women tend to have more artistic, social and conventional interests and prefer 'people'-oriented careers (Su et al., 2009).

One of the ubiquitous reasons for the disparity between girls and boys in mathematics and science is stereotypes about gender and race (Bench et al., 2015). Stereotypes are defined as beliefs about the characteristics, attributes, and behaviours of members in a particular group (Hilton & von Hippel, 1996). It has been found that the "male = mathematics" stereotype is negatively related to girls' attitudes towards mathematics but is positively associated with boys' (Nosek et al., 2002). Moreover, Cvencek et al. (2015) found that students in the United States have been aware of "Asian = mathematics" since grade 5, indicating stereotypes being "in the air" (Steele, 1997). Although scholars have long emphasised the importance of cultural diversity in educational psychology, there remains insufficient empirical evidence to fully understand students' motivation across cultural groups (Matthews & Wigfield, 2024). In addition, while Caucasian and Asian male students are often considered to be talented in mathematical STEM, there is not enough attention as to whether traditional gender stereotypes still hinder Asian female students, or whether the 'Asian advantage' is equally distributed between Asian females and males (Hsieh et al., 2021; Lee-Poon

& Simpkins, 2024). Gender is a social category that does not operate in isolation from other categories (Maccoby, 1988), and ‘intersectionality’ is important in gender research. Other important social categories to take into account include cultural background, socioeconomic status (SES) as well as more proximal contextual influences such as single-sex, academically selective schooling. The intersection between gender and ethnicity has been recently demonstrated in the domain of mathematics in the United States (Lee-Poon & Simpkins, 2024).

Compared to other minority groups, Asian students tend to achieve higher academic success, especially in mathematics, as demonstrated by outstanding results, high participation rate in gifted programs, and admission into prestigious universities (Chen & Stevenson, 1995). Nevertheless, Asian immigrants are a highly diverse population consisting of over 50 different ethnic groups (Chow, 2011), and exhibit a wide variety of languages, religions, traditions, differences in social classes, and values (Henfield et al., 2014). Therefore, within-group differences among Asian students must be acknowledged to better understand their education and career development processes (Mun & Hertzog, 2019). In this study, Asian Australian students are referred to as a pan-ethnic group of students with origins in East, South and Southeast Asian countries (Mun & Hertzog, 2019).

In 2005, Hyde conducted her review of 46 meta-analyses regarding gender differences in different aspects (e.g. verbal and mathematical ability). She found that 78% of effect sizes for gender differences were small or close to zero. Moreover, Pahlke et al.’s two studies (2013, 2014) showed that the differences between secondary school girls’ and boys’ mathematics and science achievement in single-sex and coeducational schools were either modest or zero in both Korean and American school settings, indicating the equal mathematical capability between girls and boys regardless of the school environment. Nevertheless, even though ‘the gender similarities hypothesis’ has been well-supported by numerous studies and there is no substantial evidence showing a gender difference between girls’ and boys’ mathematics performance from kindergarten to university, the gender stereotype that boys outperform girls in mathematics is prevalent (Nollenberger et al., 2016). Such stereotypes contribute to girls and women being less engaged than boys and men in mathematics and mathematically intensive sciences (Thompson, 2014). In addition, girls tend to opt out of higher-level mathematics and mathematics-intensive sciences when they perceive a choice to do so (Watt, 2016). The term “STEM leaky pipeline” is widely referred to in regard to girls/women and others from marginalised backgrounds progressively disengaging from STEM as they progress through different levels of education (Liu et al., 2019). Mathematics has been identified as a ‘critical filter’ (Sells, 1980) to a range of high-status, high-income fields of education and careers. The gender disparity in mathematics participation has been precisely targeted as this can therefore limit girls’ opportunities (Watt et al., 2017).

1.1.3 How does an academically selective setting influence adolescents' learning in mathematics?

When examining gender differences in mathematical ability, many biological theories highlight that differences in achievement among female and male students can be found in gifted populations (Ben-Zeev et al., 2005). In 1980, a study showed that boys outperformed girls on a mathematics test within a group of grades 7-8 gifted and talented students. The authors then concluded this as "superior male mathematical ability" because the participants shared almost the same affordances (e.g., same mathematics class, learning environment, being gifted), except for the biological difference (Ben-Zeev et al., 2005; Eccles & Jacobs, 1986). The study sparked arguments because students can experience the same settings differently, especially when girls have already encountered stigma in mathematics (Steele, 1997). Many studies showed girls' mathematics performance can be affected by environments as stereotypes can be evoked by implicit environmental cues (Ben-Zeev et al., 2005). For example, Spencer et al. (1999)'s experiment demonstrated that high-achieving female university students significantly underperformed compared to their male counterparts on a standardised mathematics test when the female students were told that the male students performed better than them in past exams. Interestingly, both female and male students performed equally well when the stereotype threat was removed. In addition, Inzlicht and Ben-Zeev's study (2000) discovered that when female university students were randomly placed in a single-sex group (3 female participants) or in a minority condition (1 female and 2 male participants) to undertake standardised mathematics and verbal SAT tests in the U.S., female students who were in the minority condition achieved similar verbal results but showed lower mathematical performance than female students in the same-sex groups, proving that in an immediate social environment, minority status can lead to intellectual deficits in stereotypical domains, such as mathematics (Inzlicht & Ben-Zeev, 2000).

Stereotypes also happen within gifted populations. There is a noticeable overrepresentation of boys in the gifted population and mathematics and mathematically intensive STEM fields (Preckel et al., 2008), yet girls have made up 51% of the U.S. gifted student group with a steady ratio for the past 15 years (Boston & Cimpian, 2018). Numerous studies found that the gifted individuals within a stereotyped group often experience the most biased perceptions and suggestions questioning their potential lack of ability (Dweck, 2006; Snyder et al., 2014; Spencer et al., 1999). This might explain why fewer mathematically gifted female students enter the STEM field than their male counterparts (Lubinski & Benbow, 1992), and why gifted girls generally show lower mathematics-related competence beliefs, lower interest in mathematics and less performance goal orientation than gifted boys do (Preckel et al., 2008). Lubinski et al.'s (2014) 40-year follow-up study of students with the top 1% mathematical reasoning ability demonstrates that female and male students showed equally high satisfaction with their career success and emotional well-being, indicating minimal non-cognitive difference in social-emotional and personality characteristics between gifted and non-gifted students (Zeidner et al., 2011). Their study also found that even though men and women were equally represented in finance, medicine and law, women were less likely to be chief executives and to be employed in STEM fields (Lubinski et al., 2014).

According to Bronfenbrenner’s (1977) ecological systems model of development, an individual’s development is influenced by a network of interrelated environmental systems at different levels, ranging from the micro level (e.g. family) to more meso- and macro levels (e.g. a more comprehensive socio-cultural setting) (Yim, 2022). Selective schools are a highly competitive sector within the New South Wales public education system which are designed to cater to high-achieving and academically gifted students' learning needs (NSW Department of Education, 2018). Therefore, individuals tend to compare themselves to others to gather relevant information about themselves (Festinger, 1954). Previous studies revealed that individuals’ future educational and career aspirations could be predicted by their subjective task values (STVs) (e.g. intrinsic value) as well as different backgrounds or school settings (e.g., Gaspard et al., 2020; Musu-Gillette et al., 2014). In a competitive classroom setting, students evaluate their academic achievements by comparing them with peers (Ravenscroft, 1997). However, the big-fish-little-pond effect (BFLPE) explains how students who study in an academically selective school can have a lower academic self-concept and lower subjective task values than in a comprehensive school (Seaton et al., 2011; von Keyserlingk et al., 2021).

1.2 Rationale for This Study

Secondary school is a pivotal time for students to decide whether to focus on mathematics-intensive STEM educational and career pathways in the future (Maltese & Tai, 2011; Watt et al., 2012). Prior studies have pointed out the predictability of adults’ professional trajectories through their preceding educational and career aspirations (Ashby & Schoon, 2010; Farmer et al., 1999). Riegle-Crumb and King (2010) have mentioned that secondary school subject selection reflects gender and ethnic disparities in mathematics and mathematics-intensive sciences at university, indicating the importance of understanding secondary school students’ academic and career preferences. Situated Expectancy-Value Theory (SEVT) was initially developed to investigate why girls were less likely to choose and remain in higher level mathematics and science courses, majors and careers relative to boys (Eccles et al., 1983). It therefore is the theoretical framework in this present study to understand what shapes selective school Asian girls’ mathematics educational and career aspirations. Situated expectancy-value theory (SEVT; Eccles & Wigfield, 2020) proposed that individuals choose to engage in a task based on its perceived value and their expectations for success. It is situative and culturally bound, with parents' expectations and beliefs having a major influence on children's academic beliefs and future aspirations (Eccles & Wigfield, 2020; Starr et al., 2022).

1.3 Structure of This Study

This study aims to understand how grades 7 to 10 Asian Australian girls' mathematical educational and career aspirations are shaped by their mathematics self-concept, subjective task values, and perceived parental and cultural influences; and to investigate potential differences across Stage levels and cultural groups using the theoretical lens of situated expectancy-value theory (SEVT). There are six Chapters in the thesis. Chapter 1 provides a context and rationale to explain the impetus for the study. Chapter 2 reviews the situated expectancy-value theory and details how gender socialisation, parental and cultural influences can shape individuals' mathematical education and career aspirations. A conceptual diagram and three research questions with associated hypotheses are also included in Chapter 2. Chapter 3 describes the methodology including context, participants and research design. Chapter 4 presents both quantitative and qualitative results. Chapter 5 discusses these results in relation to the three research questions and links them back to the reviewed literature. Chapter 6 revisits the purpose of the study, core contributions, study limitations and implications for future research and practice.

CHAPTER 2

LITERATURE REVIEW

2.1 Theoretical Framework

2.1.1 Situated Expectancy-Value Theory

Situated expectancy-value theory (SEVT) was first developed to investigate the gender difference between girls and boys regarding their mathematics enrolment choices (Eccles et al., 1983), and mathematically intensive subjects such as engineering and physics (Eccles, 2005; Eccles & Wigfield, 2020). The theory describes that student engagement in an activity can be predicted by the expectancy an individual has for succeeding at it and ability self-concept, as well as the positive and negative values that individuals attribute to the activity (Wigfield et al., 2021). Eccles (Parsons) et al. (1983) defined expectancies for success as an individual's prediction about how well she or he would perform on any specific task or activity in the short term or far future, for example, their performance in this year or next year's mathematics class; self-concept of ability refers to a more consistent and comprehensive estimation of one's overall capability within a specific domain (Eccles & Wigfield, 2020). However, the two are typically combined and referred subsequently to as perceived talent. According to SEVT, both mathematical self-concept of ability and subjective task values (STV) directly influence individuals' decisions to participate in an activity supported by a wealth of empirical evidence. This shows that both STVs and self-concept of ability are important predictors of choice outcomes such as secondary school course enrolment (Simpkins et al., 2006) and future mathematics career intentions (Toh & Watt, 2022; Watt et al., 2017).

The overall subjective value of a given task can be different for each learner (Eccles & Wigfield, 2020), influenced by individuals' perceived socialiser beliefs, prior experiences, and cultural values, norms and characteristics (Wigfield & Eccles, 2024). The model of SEVT includes constructs from a range of psychological theories, such as personality theory, family socialisation theories and identity theories (Eccles & Wigfield, 2020). This extensive framework has guided comprehensive research over 40 years (Eccles & Wigfield, 2023), including both long-term developments of beliefs that influence one's motivational achievement decisions, as well as the more immediate psychological processes over a shorter period (Eccles & Wigfield, 2020). There are four major constructs that comprise the overall value of a given task: intrinsic value (interest and enjoyment), attainment value (personal importance of doing well on a task), utility value (how useful a task is to current and future career goals) and costs (negative values that reduce someone's likelihood to do a task) (Eccles, 1984; Eccles & Wigfield, 2020). Over the past decade, scholars have found that utility value interventions positively improved secondary school students' interest and academic performance in mathematics and science in both short-term and long-term periods (e.g. Hulleman & Harackiewicz, 2009; Rosenzweig & Wigfield, 2016). Utility value has been discovered to exhibit the highest level of malleability among all the STV components and is most likely to be regulated by interventions (Harackiewicz et al., 2014). Initially, Eccles (Parsons) et al. (1983) mentioned three types of costs: (1) Effort cost - the perceived effort and worthiness to complete a task; (2) Opportunity cost - the extent to which committing a task hinders one's ability or time to do other valued tasks; and (3) Emotional/Psychological cost - emotional or psychological burdens of undertaking a task, including anticipated anxiety and costs of failure. New dimensions and measures of costs such as social cost, have also been developed for studying adolescents' (Watt et al., 2019), and university students' motivation (Perez et al., 2014). Overall STV is conceptualised as a net value since individuals experience both benefits and costs of a certain task (Wigfield & Eccles, 2024). In addition, both positive values and costs can have positive and negative influences on a relevant task's overall value to increase or decrease an individual's motivation. For instance, the more difficult something is to achieve (more costs), the greater its value (Wigfield & Eccles, 2020).

But what factors shape these values? In alignment with Bronfenbrenner's ecological model of human development (1977), Eccles and Wigfield (2023) hypothesised that the broader cultural setting (mesosystem) in which individuals live, is made up of various features, physical contexts, and belief systems that influence individuals' proximal, everyday surroundings. For secondary school students, their mesosystem contains the interactions between their family, school, and peers (Yim, 2022). One major limitation in cross-cultural research is that scholars often generalise an ethnic group without considering variations that may exist across different contexts (Martin & Hau, 2014). Martin and Hau (2014) compared Asian secondary school students' motivation and engagement in different cultural contexts: Australia, Hong Kong and Mainland China. They found that there were no differences in the 'kind' of factors that motivated and engaged the students in the three contexts, but the 'degree' that how they were influenced were different. Asian Australian students reported higher motivation and engagement than their Hong Kong and Mainland China counterparts, emphasising the importance of disaggregating Asian students' data by nations (Martin & Hau, 2014). Whether or not students' mathematics-related educational and career aspirations differ across their Asian subgroups will be explored in the present study.

2.1.2 Social Comparisons and Individuals' Motivational Beliefs

It may be inevitable for students to compare with their peers when they are in a competitive educational environment. High-achieving students' academic self-concept (ASC) and STVs are strongly influenced by the big-fish-little-pond effect (BFLPE), causing them to exhibit lower ASC compared to students in a comprehensive school

(Fang et al., 2018). BFLPE is a form of the internal/external frame of reference model (I/E model), in which students compare themselves to others through social/external comparison or compare their own performance across different domains (dimensional/internal comparison) (Marsh et al., 2014; Möller & Marsh, 2013).

Extensive research has shown that social comparisons (BFLPE) can be detrimental to an individual's learning (Marsh et al., 2014). For example, von Keyserlingk et al.'s study (2021) discovered significant negative effects on individuals' self-concepts and STVs when they compared with their high-achieving peers. In the high-achieving and competitive learning environment of selective schools, we could expect high social comparisons (BFLPE) among the girls in the present study. A counterbalancing positive effect – reflected glory effect - can counteract BFLPE if students' perceived school/group status is high (e.g., attending a selective school) (Marsh et a., 2000). For example, Wolff et al. (2021)'s study integrated BFLPE, I/E and reflected glory effects, to investigate German secondary school and university students' academic self-concept formation. Their study found that the reflected glory effect significantly outperformed BFLPE. On the other hand, Marsh et al. (2000)'s four-year longitudinal study discovered that the inclusion of perceived school status (in their context, attending a prestigious school) negatively affected the effect of school achievement and academic self-concept among secondary school students in Hong Kong even though the effect of school status was positive, indicating cultural differences need to be taken into account.

2.1.3 Consideration of Contextual Factors

Previous studies have repeatedly shown that expectancies of success or self-concept of ability and different kinds of positive values predict mathematics-related course enrolment, subsequent achievement and future career choices (Watt et al., 2019). Although cost values have more recently started to be empirically examined (for example, Flake et al., 2015; Gaspard et al., 2015; Perez et al., 2014; Watt et al., 2019), they are less researched compared to the positive values (Eccles & Wigfield, 2020; Watt et al., 2019). Furthermore, Matthews and Wigfield (2024) mentioned that the majority of SEVT-based studies have concentrated on the formation and function of students' expectancy of success and STVs, with insufficient attention given to the model's cultural, contextual and socialisation factors. For example, when measuring intrinsic values, scholars usually focus on the level of interest and enjoyment in a particular activity, yet little is known about the developmental process of intrinsic value in a situative context (Eccles & Wigfield, 2020). Further, most SEVT-based research has employed survey methods, limiting further probing of the observed relations (Eccles & Wigfield, 2020). This study will apply both survey and focus group methods to investigate how various values including costs can influence grades 7 - 10 Asian Australian girls' mathematics education and future aspirations.

2.2 Students' Mathematics-related Educational and Career Aspirations

2.2.1 The Underrepresentation of Girls in Mathematically Intensive Fields

There is an ongoing worldwide shortage of STEM-qualified workers which is anticipated to have detrimental effects on Western society and economies (Office of the Chief Scientist, 2014). Differentiating mathematics and mathematics-intensive sciences from life sciences, when studying STEM engagement, is imperative to obtain an accurate understanding of gender differences in different STEM-related subjects (Dicke et al., 2019). In the United States, for example, there has been a drop in the enrolment of several mathematics-related disciplines since 2000 (National Science Board, 2014). Only around 25% of tertiary students study science, mechanical and electrical engineering and architecture fields across OECD countries, and participation is particularly low among young women (OECD, 2010). Further, less than one-third of women work in the science and engineering workforce in European nations (European Commission, 2009). Within the Australian context, enrolment in grade 12 mathematics and all main science subjects is dropping, with science hitting its lowest participation rate in the past two decades, for example, Biology (-10%), Chemistry (-5%) and Physics (-7%) (Kennedy et al., 2014). In 2020, the number of student enrolments in higher mathematics (NSW mathematics extension 1 & 2) first dropped below 10% and remained between 8-9% in the following three years (Marchant & Kennedy, 2024, 2025). While the gender gap in grade 12 intermediate mathematics participation (NSW mathematics advanced) has nearly disappeared (Marchant & Kennedy, 2024), girls who enrolled in higher mathematics declined below 6% in 2023, compared with 11% for boys (Marchant & Kennedy, 2025). A comparable situation of lower female than male STEM participation and enrolment has been reported in Australia (AWPA, 2012). Despite being the majority in life and medical sciences, Australian girls and young women are still the minority enrolments in mathematics-intensive disciplines. For example, in Australia, only 32% of students in upper-secondary school physics are girls, and less than one-fifth of girls are enrolled in engineering (Department of Education and Training, 2018). When asking secondary school grades 11 and 12 students their future study intention for STEM at university and future STEM career intentions, only 26% of girls would study STEM-related courses and 21% of them would pursue a STEM-related career compared with 49% and 42% of boys respectively (Marchant & Kennedy, 2024; YouthInsight, 2021). Simultaneously, there are predictions of increasing demand in various STEM fields over the next decades, with an anticipated 12% needed increase in engineering, an 8% and 9% increase in physical sciences and business analysis and programming respectively (PwC, 2015), emphasising the need to guide and understand students' educational and career aspirations.

Girls and women are underrepresented in mathematically intensive fields (Wang & Degol, 2016). Students in academically selective schools represent a potential source of talent for STEM fields (Boston & Cimpian, 2018), yet the persistent issue of academically gifted and capable female students opting out of the STEM leaky pipeline has raised continued discussions and investigations (Guo et al., 2017). Dropping mathematics and mathematics-related science subjects in secondary school will make it challenging for students to pursue STEM-related educational and career aspirations later on. But, being competent in mathematics and science does not necessarily mean individuals will enjoy STEM-related tasks or pursue STEM-related careers (Wang et al., 2015). Researchers have concentrated on the connections between students' motivational beliefs (e.g. STVs), academic achievement and educational and career aspirations (Guo et al., 2015; Parker et al., 2012). However, many relevant studies only focused on motivational beliefs in general science, neglecting both educational and career aspirations that are often domain specific. Guo et al. (2017) integrated dimensional comparison theory and SEVT to investigate whether motivational beliefs (academic self-concept and STVs) can predict secondary school students' educational and career aspirations in four science subjects (physics, chemistry, earth science and biology). Among 18,000 participants (49% girls), in four OECD countries. One of their findings was that when students perceived high self-concept and intrinsic value in biology (requiring comparatively more verbal skills), they were less likely to aspire for physics (more mathematically intensive) and vice versa. Although their study did not explicitly investigate the level of mathematics in each examined science subject, previous research supports the difference between mathematically intensive versus health sciences (e.g., Helm et al., 2016). Similarly, Wang et al. (2013) found that high ability students whose mathematics skills are higher than verbal skills are more likely to aspire to STEM careers, while gifted students with higher verbal ability tended to aspire to non-STEM careers. This finding aligns with the I/E model pattern where self-concepts within domains can be positively affected when high achievers compare their own domain-specific achievements (Wolff et al., 2021).

2.2.2 How Does Gendered Socialisation Influence Individuals' Career Preferences?

Adolescents with high aspirations are more likely to enter prestigious occupations (Schoon & Parsons, 2002). Their aspirations can be influenced by a variety of factors including gender, culture, SES, motivational beliefs, socialisers and stereotypes (Gutman & Schoon, 2012; Watt et al., 2012). Specifically, career-related values and expectancies of success differ between adolescent girls and boys (Kerr & Gahm, 2018). For example, Gilligan (1982) found that girls and women tend to show care and value life balance and relationships, whereas boys and men tend to value high salaries and high-prestige jobs. Although academically gifted girls and boys have equally high academic performance and career aspirations during secondary school (Kerr & Sodano, 2003; Napier et al., 2024), studies indicate that girls may lower their career aspirations, especially if they are aspiring for highly prestigious careers that are traditionally associated with men (Lawson et al., 2018). Researchers emphasised that girls are often brought up in settings where socialisers (parents and teachers) hold different educational and career expectations towards girls and boys (Kerr, 1994; Kronborg, 2010), and girls may not even be aware of how these expectations influence their choices (Napier et al., 2024), highlighting the more consistent sociocultural impact on gender differences (Wang & Degol, 2017). In addition, benevolent forms of sexism towards girls and women are often overlooked and may not even be considered as harmful as they are subtle views and behaviours such as chivalry-based behaviour that men offer protection to women (Glick & Fiske, 1997; Wang et al., 2013). For instance, a number of studies demonstrated that parents and teachers often underestimate girls' mathematics abilities, even though both girls and boys obtained similar results (Bleeker & Jacobs, 2004). They are less likely to encourage girls to pursue mathematics and science, and attribute girls' success in mathematics to hard work, while attributing boys' success to ability (Tenenbaum, 2009; Tiedemann, 2000). Female students are often perceived as more compliant, indicating the "compliant girl" stereotype still exists and influences girls' everyday life (Jones & Myhill, 2004).

Many studies have shown that students' expectancy of success and subjective task values (STVs) predict their future STEM-related educational and career choices and, these outcomes differ based on cultural context (Simpkins et al., 2006; Watt et al., 2012). For example, interest (or intrinsic value) played an important role in predicting Australian relative to North American students' career aspirations, whereas success expectancies and self-concept were the most important among American and Canadian participants, interpreted by the researchers in light of the stronger standardised testing regime in North America at the time (Watt et al., 2012). These samples were highly homogenous, as most of the participants shared the same Caucasian descent and middle-class socioeconomic background. Interestingly, Lee-Poon and Simpkins' latest study (2024) of Latinx and Asian American students' mathematical value trajectories, showed that many Asian American students displayed especially high subjective task values at the beginning of secondary school in grade 7, but these values gradually decreased in their later studies in grade 10, compared to Latinx students whose subjective task values were relatively stable. The present study is focused on the Australian context in particular Asian Australian girls, to assess potential similarities or differences from published findings from mainly homogenous Caucasian samples which predominate the literature (Kitayama et al., 1997), including in Australia, to explore how cultural differences influence students' mathematical values (e.g., individualism versus collectivism) (Eccles & Wigfield, 2020).

Racial stereotypes are prevalent in Western countries (Bobo, 2001). It is valuable to investigate racial stereotypes regarding intelligence and academic performance, as students from the stereotyped groups can be harmed (Steele, 1997). On the other hand, Asian students are often labelled as "model minorities" or "Asian = Maths" as they are considered to be hardworking and good in school, especially mathematics (Cvencek et al., 2015). Yet, "positive stereotypes" can also lead to negative effects, such as feeling shame and developing a negative self-image for students who feel themselves not to meet the stereotype (Lee, 1994). Matthews and Wigfield (2024) pointed out that when studying girls' mathematics participation, previous motivation research mainly focused on gender stereotypes, leaving other cultural components, such as structural racism and discrimination underemphasised.

Researchers often assume that individuals who seek employment opportunities outside STEM fields prefer occupations that require lower educational prerequisites or are less prestigious. However, the non-STEM careers students aspire to may be equally prestigious but require lower mathematics and science involvement. For example, girls who opt out of mathematics could aspire to prestigious, non-science fields such as law (Farmer, 1997). Mathematically gifted girls are more likely to pursue non-STEM careers and are more likely to achieve in non-STEM careers than their male counterparts (Park et al., 2007). Wang et al. (2013) suggested this stems from girls' equally high mathematics and verbal skills while boys' mathematics skill is comparatively higher than their verbal ability, leading to girls being afforded a greater variety of career options (Wang & Degol, 2017). Watt et al. (2012) directly tested the assumption and discovered that mathematics-related beliefs (expectancies and values) did impact aspired level of education, but not aspired career prestige - girls who aspired to mathematics-related careers aspired to similarly prestigious careers as boys. This study will use contemporary data with a different demographic, to explore whether Asian Australian girls from a single-sex selective school aspiring to non-mathematical careers are aspiring to less prestigious careers or not.

2.3 Students' Perceived Parental and Cultural Influences

2.3.1 Parental influences and Student-Perceived Parental Expectations and Support

Parental involvement is a complicated construct that is pivotal for students' academic and non-academic outcomes (Seginer, 2006), including academic achievement (Chen, 2008) and life satisfaction (Siddall et al., 2013). It plays a crucial role in shaping their children's values towards mathematics and mathematics achievement (Georgiou et al., 2007). Parental involvement has been conceptualised as a social capital which is often described as the investment of parents to provide resources and support towards their children in specific domains (Wilder, 2023). Introducing students to a wide variety of STEM career opportunities such as mathematically intensive STEM from an early age is beneficial for their future STEM education and career development. Therefore, recognising the influence of the awareness of parents' knowledge of STEM fields is important (van Tuijl & van der Molen, 2015).

Parents with higher educational qualifications are more likely to aspire for their children to pursue similar or more advanced qualifications than they themselves achieved, emphasising the pivotal role of aspiration as an initial step towards achievement (Gil-Flores et al., 2011; Holmes et al., 2018; Homel & Ryan, 2014). The term ‘science capital’ refers to the range of family behaviours, resources, skills and knowledge associated with STEM education. Families with higher science capital tend to engage more in mathematics and science-related activities, discuss STEM-relevant topics, and provide their children with more STEM-relevant material as well as enrichment opportunities (Archer et al., 2014). Higher level of ‘science capital’ is often linked to families with middle to high SES backgrounds (Holmes et al., 2018).

Many studies have identified the importance of parental expectations in shaping students’ mathematics-related educational and career aspirations for students (e.g., Lazarides & Watt, 2017; Simpkins et al., 2015). Parents act as powerful role models, showing their children which activities and interests are worth pursuing. Their own competencies and interests (for instance, in mathematics) can determine how they interact with their children, influence the opportunities they provide, and guide how they help children understand their own mathematics experiences (Eccles & Wigfield, 2020; Nishen et al., 2024)., In fact, when students perceive maternal or paternal overestimation of their ability in mathematics, it promoted their intrinsic value in all year groups (grades 7 to 10), and utility value in (grades 9 and 10) (Gniewosz & Watt, 2017). This emphasises that both mothers’ and fathers’ beliefs in mathematics are important to students’ STVs, even though mathematics is stereotypically thought to be a masculine subject, perceived parental overestimation can be beneficial (Gniewosz & Noack, 2012).

Parents can influence students’ achievement in STEM by emphasising the values they hold towards STEM field (Šimunović et al., 2018). Those values and beliefs relate to students’ STVs (e.g., Eccles & Jacobs, 1986; Frenzel et al., 2010). Parental utility value for STEM predicts students’ utility and attainment values (Šimunović et al., 2018). Parents who view mathematics as crucial for their children’s future encourage their children more to participate in school and extracurricular mathematics activities (Wigfield et al., 2016). They can also influence their children’s perception of the importance and usefulness of mathematics through daily communications (Guo et al., 2017; Harackiewicz et al., 2012). Longitudinal research has shown that utility value is a significant predictor of students’ mathematics and mathematically intensive science major enrolments (Simpkins et al., 2006). For girls especially, Watt et al. (2012) found that importance (attainment and utility) value positively predicted their aspired level of education and mathematics-related career choices in Australian and American samples, highlighting girls are engaged by socially meaningful tasks (Eccles & Vida, 2003). As students’ utility value can be modified through external interventions (Harackiewicz et al., 2014), parents can convey the utility value of learning mathematics to girls by making connections between mathematics and its importance to our society (Eccles & Vida, 2003).

2.3.2 Student-Perceived Asian Parental Influences in Western Contexts

Parental involvement varies across different cultures and societies (Hong & Ho, 2005). For example, Caucasian parents generally display higher school involvement discussing current experiences more frequently and having higher contact with school than parents from other ethnic groups (Schneider & Coleman, 1993; Muller 1993). In addition, Caucasian parents are more likely to know the parents of their children's friends (Muller, 1993). Asian-American parents, on the other hand, have less communication with schools. According to Pearce and Lin (2007), 58% of Chinese American adolescents reported that their parents never presented at any school event. This may be due to potential language barriers or cultural differences resulting in parents from other ethnic groups feeling reluctant to communicate with teachers or participate in school events (Lareau & Horvat, 1999).

However, Chinese parents in both Chinese and Western societies tend to provide extensive direct and indirect assistance and support to promote their children's learning (Ng & Wei, 2020). There is a prevalent belief that Asian immigrant parents have higher educational expectations for their children than Caucasian parents, leading Asian immigrant students to have greater educational achievement (Yan & Lin, 2005). For instance, it is typical for Asian American parents to help and provide their children with extra homework at a very young age (Lau et al., 2011; Ng & Wei, 2020), whereas Caucasian parents are less inclined to assist with homework (Stevenson et al., 1993). Moreover, Caucasian parents appear to value children's general cognitive development more than their academic achievement and emphasise the role of innate ability more than the role of effort (Ng et al., 2017). An early childhood study showed that Caucasian mothers read to their children more often and took them on excursions more than Chinese and Japanese parents (Stevenson et al., 1993). Asian American parents also set higher expectations and participated more actively in assisting their children's mathematics learning than Caucasian parents (Wang, 2004).

In the Australian context, Mok (2020) found that Asian Australian parents view mathematics as a skill which can be acquired through consistent effort and practice, rather than an inborn talent. This redirects attention from innate ability or ethnicity to beliefs about mathematics (Mok, 2020). Because Asian immigrant parents value effort over innate ability (Ng et al., 2017), they then hold high academic expectations towards their children regardless of if they are gifted or not (Yang, 2007).

While attributing Asian immigrant students' academic performance to their ethnic background is often overly simplistic, disregarding cultural influence can be equally simplistic as Asian students consistently outperform other students in Australian schools on international assessments of TIMSS and PISA (Mok, 2020). Cultural beliefs associating effort with educational success may help explain the high academic achievement among Asian immigrant students (Chen & Steveson, 1995). Ng and Wei

(2020) highlighted that Asian-American parents' educational practices are primarily influenced by two main sets of beliefs. The first set focuses on the significance of learning and achievement, with an emphasis on effort as instrumental in promoting learning. The second set states that parents should devote their full effort to training their children in proper behaviour as an expression of love and responsibility. These beliefs are rooted in Confucian ideologies (Leung, 2006), within which, diligence, persistence, and modesty are the foundation of one's development, and have a profound impact on education (Mok, 2020).

Due to the collectivist cultural orientation, Asian immigrant parents often exhibit parenting approaches that are linked to an authoritarian parenting style (Ng & Wang, 2019), characterised by high demand and low responsiveness where parents apply strict discipline but are less sensitive to their children's emotional needs (Ang & Goh, 2006). The authoritative parenting style, on the other hand, is defined by a combination of high demand and high affection, which helps children cultivate independence and self-regulation, aligning with the individualism-oriented culture in Western culture (Rudy & Grusec, 2006). While the authoritarian parenting style is often considered to be less ideal for raising competent children (Xu et al., 2005), researchers stress the significance of considering children's development stages, the cultural context they are involved in, and the meanings of these cultural contexts to families and their children (Huang & Gove, 2015; Olla et al., 2018). For example, Senko et al.'s study (2023) of Thai and American university students' academic goal settings found that controlling goals (i.e. the desire to please parents) did not have harmful effects and even predicted desirable outcomes among Thai students. The distinct parenting styles that parents exhibit, results in individuals having different aspirations. For example, Western cultures provide individuals with more autonomy, allowing them to make choices to maximise self-fulfilment and self-actualisation (see Watt et al., 2012), whereas career choices made by young professionals in Asian countries are often based on their community considerations or the reputation of the company (Wigfield et al., 2004). When choosing university majors, Asian American students also experienced high degrees of educational channelling by parents and other socialisers (e.g., friends and teachers) (McGee et al., 2017). Asian students tend to aim to satisfy their parents' expectations because of the emphasis of filial piety and parental deference in Asian culture (Kodama & Huymh, 2017).

Many Asian American parents view education in a more functional way for upward mobility, indicating high academic expectations towards their children (Ng & Wei, 2020). To explain this, Asian immigrant parents' dedication to their children's education is not solely a result of their cultural background, but also their experiences and perspectives living in Western countries (Dhingra, 2018). Because of this, they promote their children's education based on a combination of immigrant optimism and pessimism (Kao & Tienda, 2005). Immigrant parents are optimistic as the exam system in Western countries is more open and provides more opportunities compared to the hierarchical, exam-oriented Asian education system (Lee, 1994).

Simultaneously, they are pessimistic about their children experiencing discrimination and racism, leading them to promote mathematics and science education because they are financially rewarding, and provide objective performance measures which potentially minimise the likelihood of discrimination (Louie, 2004), compensating for the disadvantages and ensure their children's opportunities for social mobility (Chao, 1996; Schneider & Lee, 1990). For example, Asian American students seek advanced education to counteract their marginality as racial minorities (Xie & Goyette, 2003). In Australia, due to the academically enriched environment, students from selective secondary schools consistently achieve high results in the final grade 12 HSC (High School Certificate) examinations, offering them more opportunities to choose courses at universities. These selective schools are often Asian Australian dominant, reflecting parents' emphasis on education as the primary pathway to social mobility (Ho, 2017). In addition, some studies found that Asian parents promote the importance of mathematics and science equally to both girls and boys (Campbell, 1991) and are more active in engaging in supplemental education than other ethnic groups (Byun & Park, 2012).

2.3.3 Student Perceived Gender and Cultural Stereotypes from Asian Immigrant Parents

While numerous studies have demonstrated a positive correlation between parental expectations and students' mathematics and mathematics-intensive science performance (Chen et al., 2022; Mau & Li, 2018), the gender stereotypes that parents hold in mathematics and mathematics-intensive sciences still persist (Starr et al., 2022). Parents' gender stereotypes can be conveyed in daily conversations, support and interactions (Jacobs & Eccles, 1992). Their gender-biased beliefs about girls' and boys' performance in mathematics can influence students' mathematics expectancies and performance (Wang & Degol, 2016). Parents and educators are, therefore, important socialisers for mathematical gender disparity (Eccles & Wigfield, 2020). Previous studies have shown that parents on average are inclined to hold more positive beliefs about boys' than girls' mathematical performance, for example, they believe that boys outperform girls in mathematics and perceive mathematics as more important for boys than girls (Eccles et al., 2000; Jacobs & Eccles, 1992). Moreover, Lazarides and Watt's study (2017) found that girls perceived lower mothers' beliefs regarding their mathematical competence even though they obtained similar achievements as boys. As a result, girls generally have lower intrinsic value and career preferences towards mathematics (Watt et al., 2012).

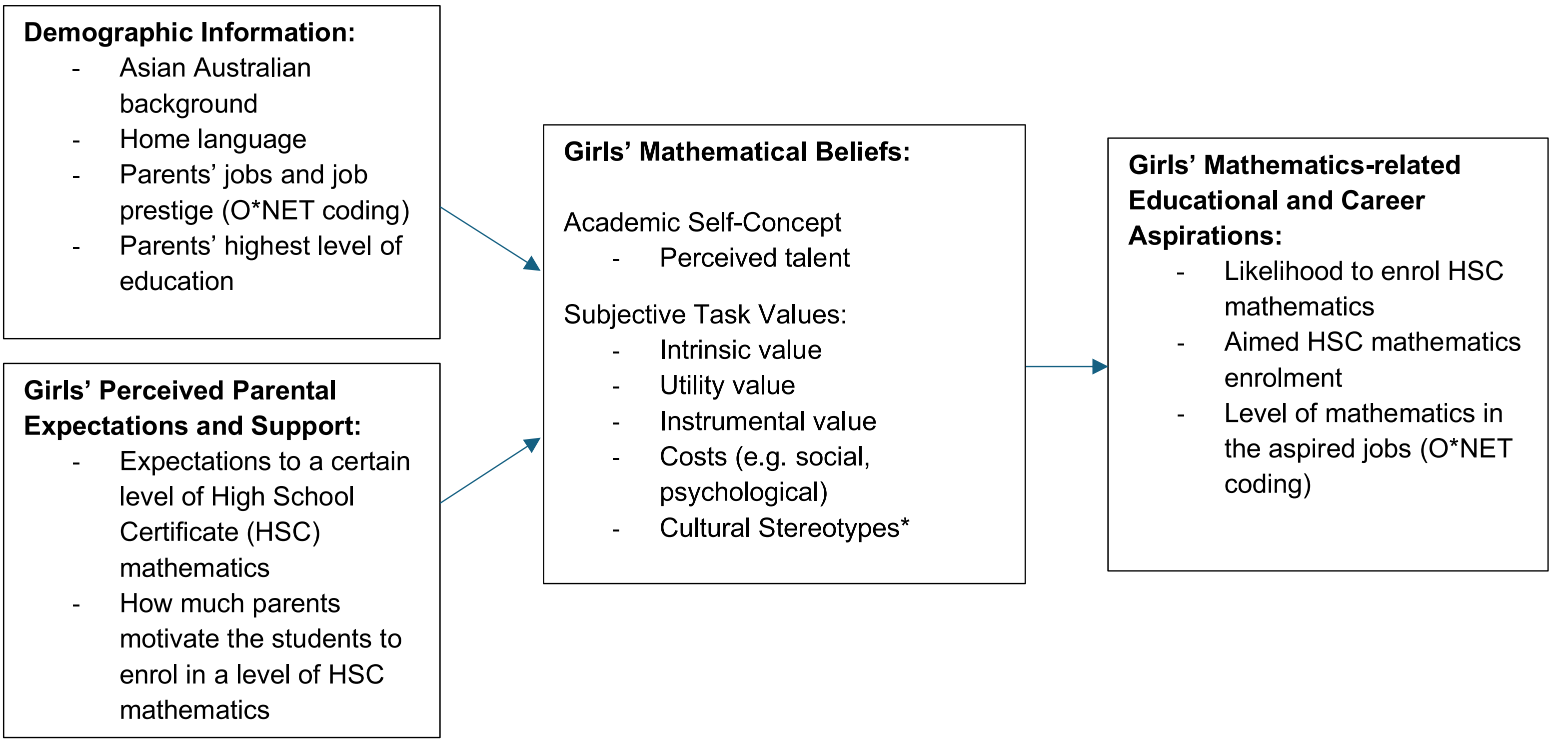
Moreover, girls and women with culturally conventional work-family ideologies aspire to lower career aspirations regardless of their own abilities (Davis & Pearce, 2007). In addition, girls are often raised in environments (e.g., families, schools and communities) where educational and career expectations differ from those for boys, leading girls to be unaware of how these expectations influence their choices (Kerr, 1994). Further, gender differences in parent support for mathematics and science learning can be seen at a very young age (Wang & Degol, 2017). While previous studies have shown that parents tend to spend more time teaching girls verbal activities, such as reading and storytelling (Baker & Milligan, 2013), they discuss and explain science content more frequently to 1 to 8 years old young boys than girls, even though both genders initiated science-related questions equally often (Crowley et al., 2001). Although socialisers may not intentionally convey stereotypes, the experiences that girls receive often indicate that mathematics and science are male-dominant (Wang & Degol, 2017). Similarly, secondary school students in China hold beliefs that boys perform better at mathematics than girls (Liu, 2018). In addition, Asian societies often adhere to traditional gender stereotypes regarding work and family responsibilities, with several Asian countries scoring lower on gender equality than the United States and Western Europe (Nollenberger et al., 2016). Starr et al.'s (2022) study of four longitudinal datasets directly examined parents' mathematics gender stereotypes among four ethnic/racial groups and found that Caucasian and Asian-American parents of boys reinforced stereotypes about mathematics that benefit the boys in their ethnic groups, and Caucasian and Asian-American parents of girls held traditional mathematics gender stereotypes which did not favour their daughters. They explained this is because Caucasian and Asian students are overrepresented in mathematics (and other STEM fields) and tend to be exposed to more mathematics-related stereotypes. Black and Latinx-American parents, on the other hand, held more gender egalitarian mathematics beliefs, perhaps being aware of social injustice as they are marginalised in STEM field (Rowley et al., 2007; Starr et al., 2022). Nevertheless, more than 90% of participants in the four datasets were Caucasian, impeding their ability to test for similarities or differences for other ethnic groups, especially Asian American participants who were only 3% of the participants and only in one dataset (Starr et al., 2022).

Therefore, whether or not these patterns generalise to Asian immigrant parents is unclear, and there is a need for studies exploring the role of gender stereotypes in mathematics and mathematical beliefs, motivations and aspirations among Asian students in other contexts. Positive stereotypes in regard to mathematics are often associated with Caucasian and Asian boys from middle to upper-middle socioeconomic backgrounds (Stephens et al., 2012). The present study aimed to diversify the evidence by including gender and cultural stereotypes among girls from Asian-Australian backgrounds, who have socioeconomic affordances and the potential added affordance of attending a single-sex selective girls' school.

2.4 The Present Study

While a large number of previous studies have investigated students' mathematical educational and career aspirations using the lens of SEVT, there are several aspects needing to be further explored. Previous studies have not yet sufficiently studied how SEVT costs influence students' mathematical aspirations and underemphasised cultural influence towards mathematical learning. This present study is centred around a specific context in which the majority of the participants are Asian Australian girls from a single-sex selective school in NSW, aligning with the "situative and culturally bound" nature of SEVT. The study aims to investigate how grades 7 to 10 Asian Australian girls' mathematical educational and career aspirations can be influenced by the interplay of perceived parental influences, students' mathematics self-concept and subjective task values, and perceived cultural influence using the lens of SEVT.

Figure 1. Conceptual diagram of the present study.



**Note. Added dimension - 'cultural stereotype' to subjective task values in this study.*

A conceptual model (Figure 1) was developed based on Eccles and colleagues' situated expectancy-value theory (SEVT) of achievement choice and their model of parental socialisation (Eccles et al., 1983; Eccles & Wigfield, 2020). Students are strongly influenced by sociocultural factors within their physical setting, and parents are the primary socialisers to influence students' beliefs and their mathematical educational and career aspirations (Eccles & Wigfield, 2023). The conceptual diagram starts with demographic information and student-perceived parental expectations and support (e.g., motivational and behavioural support), which affect girls' perceived talent in mathematics and subjective task values. The STVs display Eccles' original subjective task values, instrumental value and the underemphasised costs along with an added factor - 'cultural stereotypes'. This is because gender and racial/ethnic stereotypes strongly link to students' cultural background and stereotypes and is conveyed in girls' daily life (Wang et al., 2013). The outcome are mathematics-related educational and career aspirations influenced by individuals' cultural, parental and STV aspects.

Participants in this present study are grades 7 to 10 Asian Australian girls from an academically selective school in NSW. Previous studies have highlighted the significance of understanding the intersection between gender and culture when investigating gendered educational and career aspirations in mathematics and emphasised how gender and being high ability learners can negatively influence academically selective girls' learning within competitive school settings.

This study aims to understand grades 7 to 10 Asian Australian girls' mathematics-related educational and career aspirations using the lens of situated expectancy-value theory.

There are three research questions in this study:

RQ1. Which mathematics subjective task value or cost (STVs: intrinsic, utility, instrumental; Costs: psychological, social) has the strongest influence on Asian Australian adolescent girls' mathematical education, career aspirations and aspired career prestige; and is there a difference between younger and older girls in terms of their Stage level (Stage 4: grades 7 – 8; Stage 5: grades 9 – 10)?

RQ2. To what extent do Asian Australian girls' perceived parental influences (expectations and support), parents' mathematical education level and mathematics-related jobs shape their perceived talent, STVs, costs and aspired level of HSC mathematics enrolment and mathematics-related careers?

RQ3. How does culture (with a focus on home languages: Asian versus English) influence Asian Australian girls' mathematics-related STVs and education and career aspirations?

Three hypotheses are proposed to address each of the questions:

H1: It is hypothesised that utility value will have the strongest correlation with girls' mathematics-related education and career aspirations.

H2: It is expected that girls' aimed HSC mathematics enrolment, mathematics-related career aspirations and mathematics-related STVs are strongly correlated with their perceived parental influences (e.g. perceived support and expectation), parents' highest level of education and level of mathematics in parents' jobs.

H3: It is anticipated that these girls' mathematics-related education and career aspirations will not be strongly influenced by gender/cultural stereotypes possibly due to their affordance of attending a single-sex selective school. It will be explored whether their aspirations might differ according to their Asian subgroups (e.g. East Asian, South Asian, Southeast Asian).

CHAPTER 3

METHOD

3.1 Context

The present study is located within the larger ‘umbrella’ study: “Promoting Adolescents’ Mathematics Engagement and Participation in NSW” (PERFORM). The PERFORM project is a collaborative project between Western Sydney University and The University of Sydney funded by the NSW Department of Education. The Chief Investigators are Holmes, Watt, Anderson, Berger, Mackenzie, and Reid O’Connor. The present study applied a mixed-methods approach focusing on one government single-sex selective girls’ school from the 22 schools involved in the PERFORM project. The mixed-methods approach was constituted by survey and focus group data for a more holistic view (Spratt et al., 2004). Quantitative survey data described relationships between measured variables, the qualitative focus group data probed further in-depth meanings and interpretations of the central phenomena. Cross-sectional data sources were from an online questionnaire and two student focus groups. Data were collected between mid-August and September 2023 by researchers from the PERFORM project, and the use of data for this study was approved by Western Sydney University Human Research Ethics Committee in July 2024.

3.2 Participants

In the participating girls’ school, the present study initially invited 240 participants (98.3% Asian backgrounds) from 8 Stages[1] 4 and 5 mathematics classes (30 girls per class), with an even distribution of 4 classes for each Stage and 2 for each grade level. 177 participants ranging from 11 to 15 years old completed the online student questionnaire with a 73.9% response rate Stage 4 = 103, [grade 7 = 51, grade 8 = 52]; Stage 5 = 74, [grade 9 = 37, grade 10 = 37].

The school’s location is classified as ‘metropolitan or provincial’ on the public source ‘MySchool’ website (ACARA, 2023), with 95% of the girls from a language background other than English and over 80% of them from an upper-middle socioeconomic background. As an indicator of cultural background, the survey asked one question about the language that the girls mainly spoke at home. All participants who responded

[1] In NSW secondary school settings, ‘Stage’ refers to a grouping of school grades within the NSW Curriculum. There are three Stages at NSW secondary schools: Stage 4 = grades 7 – 8; Stage 5 = grades 9 – 10; Stage 6 = grades 11 – 12.

to the online questionnaire were included. Approximately 64.4% of the girls in this study reported speaking an Asian home language, with the largest Asian subgroup being East Asian (n = 75, 42.4%), followed by South Asian (n = 29, 16.4%) and Southeast Asian (n = 10, 5.6%). 35.6% of participants reported that they only spoke English at home (n = 63).

Age was not included in the surveys because secondary school students in each grade usually went to school at a similar age. For Stage 4 (grades 7 – 8) girls' mean age should be around 13 years old and Stage 5 (grades 9 – 10) their mean age should be around 15 years old.

3.3 Procedure

The principal at the school decided to minimise disruption to instructional time by inviting only four out of ten classes from each Stage to participate. At this school, Stage 4 girls attended their regular classes for all subjects with a consistent group of classmates. At Stage 5, mathematics classes were differentiated based on mathematics ability, with the class composition being restructured every year. Therefore, four Stage 4 classes were chosen randomly, and two top and two bottom Stage 5 classes were invited, to encompass the range of students.

An online notification to parents with a parental consent form was created through 'SchoolBytes'. Parents were invited for their daughters to participate in an online questionnaire, and an optional audio-recorded focus group interview. They could only participate in the study with parental/guardian and their own consent. To protect participants' privacy, the girls and their parents were assured that no personal information would be utilised, and individuals' responses would be confidential. Students' names were not requested, to protect students' privacy.

Ethics approval and Working with Children Checks were obtained by all PERFORM team members before data collection. As I was both the research candidate of this study and a former classroom teacher at this school, I was not involved in inviting or administering online surveys or focus group interviews. This was important to avoid role conflict and potential actual or perceived coercion, which can occur when the researcher's and educator's responsibilities overlap (Ferguson, Yonge, & Myrick, 2004).

3.3.1 Survey Procedure

For the classes involved in this study, their mathematics teachers were given a list of girls who had informed consent to participate in the survey. The survey was administered online during a school mathematics timetabled period to optimise ecological validity. The survey took 20 – 25 minutes to complete.

3.3.2 Focus Group Interview Procedure

Approximately 6 – 8 participants were anticipated in each of the Stages 4 and 5 focus groups. Girls were reminded the focus group interview would be audio-recorded before it commenced. As many girls liked to participate in the focus groups, participants were then randomly chosen, with 4 girls for each grade. In Stage 5, 7 out of 8 girls were from the top mathematics classes. Two researchers from the PERFORM project came to the school on the day to conduct the focus group interviews. The two focus groups were scheduled in parallel in two separate meeting rooms at the school library. The researchers first introduced themselves and the purpose of the focus group. They then asked participants a set of prepared questions regarding their perceptions of mathematics. Each question was presented to all group members to ensure each of them had an opportunity to participate. Each focus group took about 20 minutes to complete, and recordings were then transcribed by a commercial company. On the day of the focus group interviews, 6 Stage 4 and 8 Stage 5 girls were in attendance.

3.4 Measures

3.4.1 Quantitative Measures

The quantitative measures were in three major categories: student mathematics-related educational and career aspirations; SEVT values and costs; and student-perceived parental support and expectations and cultural stereotypes.

Demographic Information
Participants provided their date of birth, country of birth, home language, whether they were Aboriginal or Torres Islanders, their parents' highest level of education and occupation, and the highest level of mathematics they intended to complete.

3.4.1.1 Mathematics-related Educational and Career Aspirations

Intended Subject Selections in Stage 6

A question regarding students' intended level of HSC mathematics was designed by researchers from the PERFORM project. In NSW, mathematics is not mandatory for the HSC (High School Certificate), students can either not choose mathematics or enrol in one of the three different levels: standard, advanced, extensions (1 or 2). One item "What level of senior maths (Year 11 and 12) do you plan to study?" was rated on a 4-point scale from None (no maths subjects) to Highest (Extension 1 or 2 maths).

Perceived Capability of Doing the Highest Level of HSC Stage 6 Mathematics

One question regarding the highest level of HSC Stage 6 mathematics (grades 11 and 12) students felt capable of doing, ranging from None (no maths subjects) to Highest (Extension maths).

Students' Mathematics-relatedness, Aspired Careers and Job Prestige

In an open-ended question, participants indicated the job they would like to have at age 25.

*O*NET Career Coding*

Each career was objectively coded for its extent of mathematics knowledge, mathematics importance, and prestige using the database from the United States Department of Labor O*NET 2016 (National Center for O*NET Development, 2016). This quantified how much mathematics was involved (from 0 to 100), and the prestige (from 1 to 5) for each career. Constructs "Mathematics in student's/parent(s)' job" (Table 2) were averages of the level of mathematics and the importance of mathematics in a certain job. For example, for accountants: mathematics knowledge = 70, importance = 73, prestige = 4. Mathematics knowledge and importance were then averaged for a 'mathematics-relatedness' score = 71.5. If a participant listed more than one career, only the first indicated career was coded. If the participant provided a vague response, for example, "engineers", it was coded with an estimated closest career based on online research (e.g., mechanical engineers, because it is the most common form of engineering).

3.4.1.2 SEVT Values and Costs

SEVT Perceived Talent, Intrinsic and Utility Values

SEVT positive motivational constructs regarding mathematics were assessed using SEVT measures (Eccles & Wigfield, 1995). Questions for this study were from Watt et al. (2019) for the Australian sample. Students' perceived talent, intrinsic and utility values were assessed on a 7-point Likert scale, from 1 (not at all) to 7 (extremely).

Perceived talent was measured by 4 items (α = .92), e.g., “Compared with other students in your class, how talented do you consider yourself to be at maths?”. Intrinsic value was measured by three items (α = .95), e.g., “How enjoyable do you find maths?”. Utility value was tapped by three items (α = .90), e.g. “How useful do you think maths is in the everyday world?”.

Instrumental Value

Participants were asked how important learning mathematics was for their future aspired career to measure their instrumental value by 5 items (α = .92), e.g., “Studying maths is worthwhile for me because what I learn will improve my career prospects.
”. Rated on a 7-point Likert scale (OECD, 2024), ranging from 1 (strongly disagree) to 7 (strongly agree).

SEVT Costs

Questions regarding participants’ perceived SEVT costs were from Watt et al. (2019) for adolescents in the Australian context. There were three cost factors, effort cost (4 items, e.g., “Considering what I want to do with my life, studying maths is just not worth the effort.”), psychological cost (2 items, e.g. “It frightens me that maths courses are harder than other courses.”) and social cost (2 items, α = .71, e.g., “I’m concerned that working hard in maths classes might mean I lose some of my close friends.”), rated on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). The factors “Effort Cost” and “Psychological Cost” were excluded from further analyses and the Results chapter as their reliability results were too low (α = .33 and .47 respectively).

Mathematics Anxiety

Questions in relation to student-perceived mathematics anxiety, akin to psychological cost, were tapped by 8 items (α = .94) from Bai's (2011) Mathematics Anxiety Scale. All items were on a 6-point Likert Scale, e.g., “Maths makes me feel uneasy.”, rated from 1 (strongly disagree) to 6 (strongly agree).

3.4.1.3 Student-perceived Parental Support, Expectations and Cultural Stereotypes

Students' perceived parental influences (motivational support and expectation) and perceived cultural stereotypes on their aspired level of HSC mathematics were measured by one item each. The item stem was: “Why do you plan to enrol in this level of maths for the HSC?”; The following text was - “Because of how much my parent/s motivate me.”; “Because of how much my parent/s expect me to do that level.”; “Because it fits with cultural stereotypes (e.g., racial or gender groups).” from Watt et al. (2024). The 7-point Likert response scale, ranged from 1 (not at all) to 7 (extremely).

3.4.2 Qualitative Measures

Table 3 shows the focus group questions tapping the same major constructs. Transcripts were coded based on three major categories: educational and career aspirations (e.g., “What do you want to do when you leave school ?”; “Will you need maths to study/partake in this profession?”), perceived mathematics-related SEVT values and costs (e.g. “Do you enjoy maths, and why/why not?”), and perceived expectation from socialisers (e.g. “What do your parents/caregivers think about the maths you are studying this year?”).

3.5 Data Analyses

This mixed-methods study implemented two statistical techniques to answer the three research questions (see 2.4 The Present Study): Pearson correlation to explore factor interrelationships, and multivariate analysis of variance (MANOVA) to compare the girls from Stages 4 and 5, and cultural subgroups. Qualitative data from student focus group interviews were coded thematically to further elaborate patterns from the student questionnaire responses.

3.5.2 Bivariate Correlations

Pearson correlation analysis was applied to explore and understand how and to what extent the girls’ choice of their future HSC mathematics and mathematics-related career, STVs and costs, and perceived parental and cultural influences were interrelated.

3.5.3 Multivariate Analyses of Variance (MANOVAs)

To understand the potential differences and similarities between girls in Stages 4 versus 5, and those who spoke an Asian home language versus only English, both were between-subject factors in 3 MANOVAs. The 3 MANOVAs explored potential differences on: 1) mathematics-related education and career aspirations; 2) the combined set of SEVT latent constructs and mathematics anxiety; and 3) perceived parental influences (support and expectation) and cultural stereotypes.

Participants were divided into 2 cultural groups (English and Asian home language) and 4 cultural subgroups (South, Southeast or East Asian home language, and English) based on their home language, to further investigate mean-level differences among subgroups, using MANOVA.

3.5.4 Focus Group Interviews

Thematic analysis was used to identify, analyse and interpret findings from the 2 focus group interviews (Braun & Clarke, 2012), based on the three research questions, initially into three broad categories: 1) mathematics-related education and career aspirations; 2) SEVT values and costs; 3) perceived parental influences. They were then further refined into smaller codes (e.g., “mathematics anxiety” and “perceived talent”).

Table 1
Descriptive Statistics, Cronbach's Alpha, and Sample Construct Items from the Student Questionnaire

Construct	*M*	*SD*	Cronbach's Alpha	No. of items	Sample item	Anchor
Intended HSC mathematics in Stage 6	4.55	0.67	N/A	1	What level of senior maths (Year 11 and 12) do you plan to study?	1 (No maths subjects - None) – 4 (Extension maths - Highest)
Perceived Stage 6 mathematics capability	4.31	0.75	N/A	1	What is the highest level of senior maths (Year 11 and 12) you feel capable of doing?	1 (No maths subjects - None) – 4 (Extension maths - Highest)
Perceived talent	4.18	1.54	.92	4	Compared with other students in your Year, how talented do you consider yourself to be at maths?	1 (Not at all) – 7 (Extremely)
Intrinsic value	4.05	1.79	.95	3	How enjoyable do you find maths?	1 (Not at all) – 7 (Extremely)
Utility value	5.01	1.37	.90	3	How useful do you believe maths is?	1 (Not at all) – 7 (Extremely)
Instrumental value	5.45	1.25	.92	5	What I learn in maths is important for me because I need this for what I want to study later on.	1 (Strongly disagree) – 7 (Strongly agree)
Social cost	3.02	2.24	.71	2	I'm concerned that working hard in maths classes might mean I lose some of my close friends.	1 (Strongly disagree) – 7 (Strongly agree)
Mathematics anxiety	3.28	1.22	.94	8	Maths makes me feel nervous.	1 (Strongly disagree) – 6 (Strongly agree)
Student-perceived parental support	4.93	1.80	N/A	1	Why do you plan to enrol in this level of maths for the HSC? ...because of how much my parent/s motivate me.	1 (Not at all) – 7 (Extremely)
Student-perceived parental expectation	4.85	1.88	N/A	1	...because my parent/s expect me to do that level	1 (Not at all) – 7 (Extremely)
Student-perceived cultural stereotypes	3.53	2.14	N/A	1	...because it fits with cultural stereotypes (e.g., racial or gender groups)	1 (Not at all) – 7 (Extremely)

Table 2

*Descriptive Statistics for O*NET Jobs*

Construct	*M*	*SD*	n
Mathematics in student's aspired job	55.78	17.14	139
Mathematics in mother's job	53.44	15.78	144
Mathematics in father's job	59.78	15.02	150
Student's aspired job prestige	4.61	0.65	139
Mother job prestige	3.46	1.07	144
Father job prestige	3.67	0.90	150

Note. Mathematics scale range 0 – 100; Job prestige scale range 1 – 5.

Table 3

Student Focus Group Sample Questions

Construct	Sample Question
Mathematical education and career aspirations	What do you want to do when you leave school? Will you need maths to study/partake in this profession?
SEVT values	Do you enjoy maths? Why/Why not?
SEVT costs	Do you find maths stressful? Why/Why not?
Student-perceived parental influences	What do your parents/caregivers think about the maths you are studying this year?

CHAPTER 4

RESULTS

In this chapter, the quantitative and qualitative results are sequentially presented. Quantitative results start with a brief introduction of descriptive statistics (4.1), followed by three main sections based on the three research questions (4.2 – 4.4): The first presents the findings regarding correlations between the girls' perceived parental influences and their subjective task values (STVs), costs, and mathematics-related educational and career aspirations. The second examines differences between Stage 4 and Stage 5 girls regarding their STVs, career aspirations, and aspired career prestige. The third presents how different cultural subgroups differ in their STVs and mathematics-related education and career aspirations. Qualitative results (4.5) are divided into four main sections. The first three sections align with each of three broad themes identified from the thematic analysis. The fourth section compares the qualitative results across Stages.

4.1 Descriptive Statistics

Latent constructs were formed by averaging component items. Descriptive statistics for this study are shown in Table 1 and Table 2. In Table 1, 11 student questionnaire constructs are tabulated. Most participants reported finding mathematics important for their future educational and occupational pursuits (*M* = 5.45, *SD* = 1.25). Utility value was the highest rated among the SEVT value constructs (*M* = 5.01, *SD* = 1.37), and student-perceived parental support was the highest among the perceived influences.

In Table 2, mathematics in father's job (n = 150, *M* = 59.78, *SD* = 15.02) was relatively higher than mathematics in student-aspired and mother's jobs. Student-aspired job prestige (n = 139, *M* = 4.61, *SD* = 0.65) was higher than their parents'. The total number (n) varied in Table 2 as not all girls responded to each open-ended question.

4.2 Intercorrelations among Girls' Mathematical Education and Career Aspirations, Parents' Occupations, Girls' SEVT Values and Costs, and Perceived Parental and Cultural Influences

Pearson correlations between all constructs are shown in Table 4. Pairwise correlations were estimated to accommodate missing data.

4.2.1 Student-aspired Careers and Their Parents' Jobs

Girls' mathematics-related aspired jobs did not correlate statistically-significantly with aspired job prestige, or job prestige or mathematics in their parents' jobs. There was a moderately strong, positive correlation between mathematics in the mother/father's job and participants' aspired job prestige (n = 144, *r* = .624; n = 150, *r* = .589). Weak, positive correlations were also found between mathematics in mother' jobs and father's job prestige, and vice versa. Mathematics in parents' job and parents' job prestige were also not correlated to other constructs (e.g., students' mathematical aspirations, SEVT values and costs, and student-perceived parental and cultural influences).

4.2.2 Girls' Aspired Careers and Aspired HSC Mathematics Enrolment

Mathematics in student aspired careers and student aspired job prestige were both weakly but positively correlated with their intended HSC mathematics and perceived Stage 6 mathematics capability. A moderate, positive correlation occurred between intended HSC mathematics in Stage 6 and perceived HSC Stage 6 mathematics capability (n = 177, *r* = .644).

4.2.3 Girls' Mathematical Aspirations, SEVT values and costs

A moderate, positive correlation was found between mathematics in student aspired jobs and instrumental value (n = 139, *r* = .332), and a weak, positive correlation with intrinsic value. The same association also occurred between student aspired job prestige and perceived mathematics talent (n = 139, *r* = .182). Social cost was weakly and negatively correlated with student aspired job prestige (n = 139, *r* = -.228).

Both HSC mathematics-related constructs (i.e., Intended HSC mathematics in Stage 6 and Perceived HSC Stage 6 mathematics capability) displayed moderately positive correlations with perceived talent (n = 177; *r* = .444, *r* = .552) and intrinsic value (n = 177; *r* = .529, *r* = .490). A positive moderate correlation was also found between Intended HSC mathematics in Stage 6 and instrumental value (n = 177, *r* = .376). In addition, both HSC mathematics-related constructs had weak, positive correlations with utility value (n = 177; *r* = .226, *r* = .173), and negatively correlated with mathematics anxiety (n = 177; *r* = -.382, *r* = -.452). Perceived Stage 6 mathematics capability had a weak, negative correlation with social cost (n = 177, *r* = .-154), indicating students who perceived greater social cost were those who perceived themselves capable of advanced HSC mathematics course levels.

Within SEVT-related constructs, intrinsic value moderately correlated with each of perceived talent and utility value (n = 177; *r* = .659, *r* = .517 respectively), and perceived talent weakly correlated with utility value. (n = 177, *r* = .299) Similarly, instrumental value showed moderate, positive correlations with perceived talent and intrinsic value (n = 177; *r* = .326, *r* = .509). The positive correlation between instrumental value and utility value was significant and strong (n = 177, *r* = .779).

No statistically significant correlation was found between social cost and other SEVT-related constructs. Mathematics anxiety had moderate negative correlations with perceived talent and intrinsic value (n = 177; *r* = -.672, *r* = -.563), and weak, negative correlations with utility value and instrumental value (n = 177; *r* = -.283, *r* = -.236). Intrinsic value showed weak, positive correlations with all student-perceived parental and cultural influences. Both perceived talent and utility value were weakly positively correlated with student-perceived parental motivational support. Instrumental value showed a moderate, positive correlation with student-perceived parental support (n = 177, *r* = .332), and positive but weak correlations with student-perceived parental expectations and cultural stereotypes (n = 177; *r* = .257, *r* = .243). No significant correlations were found between SEVT costs (i.e., social cost and mathematics anxiety) and student-perceived parental and cultural influences.

4.2.4 Girls' Mathematical Aspirations, Perceived Parental and Cultural Influences

No significant correlations were found among mathematics-relatedness of student aspired or parent jobs, student aspired or parent job prestige, or student-perceived parental support, expectations and cultural influences. Both HSC-mathematics related constructs weakly, positively correlated with student-perceived parental and cultural influences. Correlations of all student-perceived parental and cultural influences with SEVT values were rather weak. Student-perceived parental support, expectations and cultural influences demonstrated moderate, positive intercorrelations (n = 177; *r* = .579, *r* = .392, *r* = .367).

4.3 Differences between Stages and Cultural Subgroups

Three sets of MANOVAs compared girls': 1) mathematics-related education aspirations; 2) SEVT values and costs, and 3) perceived parental and cultural influences (as dependent variables) by 2 independent variables: Stages (4 or 5), cultural subgroups (Asian home language versus English home language), and their potential interactions. Pillai's trace tested multivariate significance. Univariate tests with Bonferroni protected *p*-values compared between-subjects effects for each factor (Table 7). Box's test (Table 6) assessed the equality of covariance matrices and homogeneity of variance. Descriptive statistics by Stage and cultural groups (Table 5) summarised participants' responses and categorised them into Stage level and cultural groups based on their home languages. A Welch ANOVA was conducted whenever the homogeneity of variance assumption was violated, to estimate reliable between-subject effects on the dependent variables.

While Box's test for the equality of covariance matrices on SEVT values and costs and perceived parental and cultural influences was satisfied (Box's M = 75.885, $p = .248$; Box's M = 21.583, $p = .291$), it was significant for student educational and career aspirations (Box's M = 40.311, $p = <.001$). Levene's test, for homogeneity of variance was not significant for most of the dependent variables ($p > .05$), whereas violations were found for intended HSC mathematics in Stage 6 ($p < .001$) and student-perceived parental expectations ($p = .017$).

4.3.1 Differences Between Stages 4 and 5

Girls' mathematics-related education aspirations by Stage

A significant multivariate effect was found for Stage on girls' mathematics-related education aspirations (Pillai's Trace = .077, F (2, 172) = 7.131, η_p^2 = 0. 077, $p = .001$). The follow-up univariate tests (Bonferroni corrected $\alpha = .025$) revealed that Stage level had a significant and moderately strong influence on girls' intended level of HSC mathematics (F (1, 173) = 6.825, $p = .010$, $\eta_p^2 = .038$). A Welch's ANOVA further confirmed this significant, small-moderate effect ($p = .002$), indicating Stage 5 girls (M = 2.73, SD = 0.51) intended to choose higher level HSC mathematics more so than Stage 4 girls (M = 2.43, SD = 0.71). This was similar to the univariate effect of Stage on perceived Stage 6 mathematics capability (F (1, 173) = 14.209, $p < .001$, $\eta_p^2 = .076$). Stage 5 girls (M = 2.58, SD = 0.60) perceived higher HSC mathematics capability than Stage 4 girls (M = 2.13, SD = 0.72).

SEVT values and costs by Stage

Despite no overall multivariate effect on SEVT values and costs (Pillai's trace = .038, F (6, 168) = 1.102, $\eta_p^2 = .038$, $p = .363$), a significant, small-moderate univariate effect was found on girls' utility value (F (1, 173) = 5.590, $p = .019$, $\eta_p^2 = .031$), where Stage 4 girls (M = 5.23, SD = 1.36) held higher utility value than Stage 5 girls (M = 4.70, SD = 1.33). However, this effect did not remain statistically significant after the Bonferroni correction ($\alpha = .00083$). No significant effect was found on other values or costs, meaning that girls' subjective task values and costs did not vary for younger and older girls.

Student-perceived parental motivational support, expectation and cultural stereotypes by Stage

The multivariate effect of Stage was not statistically significant on student perceived parental support, expectation and cultural stereotypes (Pillai's trace = .005, F (3, 171) = 0.306, $\eta_p^2 = .005$, $p = .821$). Neither were any univariate effects statistically significant (student-perceived parental support F (1, 173) = .019, $p = .890$, $\eta_p^2 = .000$, student-perceived parental expectation *F* (1, 173) = .018, *p* = .892, η_p^2 = .000 and student-perceived cultural stereotypes *F* (1, 173) = .685, *p* = .409, η_p^2 = .004).

Table 4

Pearson Correlations Among All Constructs (pairwise)[a]

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Mathematics in student aspired job	1																
2. Student aspired job prestige	.026	1															
3. Mathematics in mother's job	.024	-.083	1														
4. Mother job prestige	-.103	-.108	**.624****	1													
5. Mathematics in father's job	.043	-.042	**.237****	**.208***	1												
6. Father job prestige	-.111	.073	**.237****	**.293****	**.589****	1											
7. Intended HSC mathematics in Stage 6	**.229****	**.269****	.022	-.065	.115	-.003	1										
8. Perceived Stage 6 mathematics capability	**.249****	**.199***	.086	.154	.098	.029	**.644****	1									
9. Perceived talent	.089	**.182***	-.044	-.006	-.089	-.092	**.467****	**.574****	1								
10. Intrinsic value	**.171***	.113	.037	-.009	.036	-.049	**.542****	**.505****	**.659****	1							
11. Utility value	.150	-.009	.044	-.102	.036	-.021	**.229****	**.158***	**.299****	**.517****	1						
12. Instrumental value	**.332****	.093	.061	-.084	.010	-.049	**.376****	**.268****	**.326****	**.509****	**.779****	1					
13. Social cost	-.050	**-.228****	.074	.093	.077	.070	-.132	-.142	-.079	-.024	-.012	-.062	1				
14. Mathematics anxiety	-.042	-.135	.126	.119	.116	.150	**-.382****	**-.452****	**-.672****	**-.563****	**-.283****	**-.236****	.119	1			
15. Student-perceived parental support	.040	-.006	-.018	.061	.078	.045	**.284****	**.228****	**.178***	**.279****	**.171***	**.332****	.045	-.054	1		
16. Student-perceived parental expectation	.036	.094	-.058	-.044	.063	.056	**.286****	**.171***	.136	**.164***	.099	**.257****	-.054	.026	**.579****	1	
17. Student-perceived cultural stereotypes	.086	-.014	-.036	-.041	.084	.028	**.223****	**.182***	.117	**.163***	.141	**.243****	.131	.037	**.392****	**.367****	1

**. p < .01; *. P < .05 (2-tailed).

Note: Bold indicates significant correlations.

[a] For career-related constructs 1 – 6, participants' numbers varied. Referred to Table 2.

Table 5

Descriptive Statistics by Stage and Cultural Group

	Stage 4 (*n* = 103)	Stage 5 (*n* = 74)	Asian Home Language (*n* = 108)	English Home Language (*n* = 69)
	***M*(*SD*)**	***M*(*SD*)**	***M*(*SD*)**	***M*(*SD*)**
Intended HSC mathematics in Stage 6	2.43(0.71)	2.73(0.51)	2.68(0.53)	2.36(0.77)
Perceived HSC Stage 6 mathematics capability	2.13(0.72)	2.58(0.60)	2.40(0.68)	2.19(0.73)
Perceived talent	4.18(1.48)	4.17(1.64)	4.25(1.56)	4.06(1.52)
Intrinsic value	4.06(1.75)	4.04(1.85)	4.29(1.76)	3.67(1.78)
Utility value	5.23(1.36)	4.70(1.33)	4.98(1.41)	5.04(1.31)
Instrumental value	5.57(1.21)	5.29(1.30)	5.58(1.21)	5.25(1.30)
Social cost	2.98(2.21)	3.08(2.30)	3.08(2.26)	2.93(2.22)
Mathematics anxiety	3.23(1.17)	3.36(1.28)	3.22(1.24)	3.39(1.17)
Student-perceived parental support	4.86(1.86)	5.01(1.72)	5.14(1.71)	4.59(1.90)
Student-perceived parental expectation	4.73(1.96)	5.03(1.78)	5.20(1.71)	4.30(2.02)
Student-perceived cultural stereotypes	3.35(2.13)	3.77(2.16)	3.84(2.10)	3.03(2.14)

Note: HSC Stage 6 mathematics ranging from 0 (no mathematics) to 3 (mathematics extension); Mathematics anxiety rated 1 – 6; all other constructs rated 1 – 7.

Table 5

Descriptive Statistics by Stage and Cultural Groups (Continued)

	Stage 4 (*n* = 77)	**Stage 5 (*n* = 62)**	**Asian Home Language (*n* = 87)**	**English Home Language (*n* = 52)**
	***M*(*SD*)**	***M*(*SD*)**	***M*(*SD*)**	***M*(*SD*)**
Level of mathematics in girls aspired job	54.01(16.71)	57.91(17.57)	56.82(17.24)	54.04(17.00)
Student aspired job prestige	4.58(0.71)	4.64(0.58)	4.60(0.69)	4.63(0.60)

Note: The number for each Stage and cultural group is different from the previous table.

Table 6

Box's Tests for the 3 MANOVA Sets of Dependent Variables by Stage and Cultural Subgroups

	Mathematics-related education aspirations	**SEVT values and costs**	**Perceived social influences**
Box's M	32.037	75.885	21.583
F	3.472	1.115	1.155
df1	9	63	18
df2	66715.581	26238.115	35645.69
p	< .001	.248	.291

Table 7

Univariate Test Statistics from the 3 MANOVA

	Stage			Cultural Group			Stage * Cultural Group		
Dependent Variable	***F* (1, 173)**	***p***	**η_p^2**	***F* (1, 173)**	***p***	**η_p^2**	***F* (1, 173)**	***p***	**η_p^2**
Intended HSC mathematics in Stage 6	6.825	.010	.038	7.260	.008	.040	.005	.941	.000
Perceived HSC Stage 6 mathematics capability	14.209	<.001	.076	2.184	.141	.012	.609	.436	.004
Perceived talent	.632	.428	.004	1.803	.181	.010	4.768	.030	.027
Intrinsic value	.419	.518	.002	5.875	.016	.033	.493	.484	.003
Utility value	5.590	.019	.031	.002	.962	.000	.113	.737	.001
Instrumental value	2.871	.092	.016	3.654	.058	.021	.017	.896	.000
Social cost	.001	.980	.000	.278	.599	.002	.462	.498	.003
Mathematics anxiety	.869	.352	.005	1.174	.280	.007	.110	.741	.001
Student-perceived parental support	.019	.890	.000	4.702	.032	.026	1.611	.206	.009
Student-perceived parental expectation	.018	.892	.000	10.921	.001	.059	2.021	.157	.012
Student-perceived cultural stereotypes	.685	.409	.004	5.213	.024	.029	.029	.865	.000

4.3.2 Differences between Cultural Subgroups

To understand whether cultural background (in terms of home language) had effects on girls' mathematics-related aspirations, SEVT values and costs, or perceived parental and cultural influences, the girls were initially grouped into 4 cultural subgroups based on the specific home language they spoke: Southeast Asian (n = 10), South Asian (n = 29), East Asian (n = 75), or English (n = 63). The same analytical procedures were followed as in Section 4.3, and Bonferroni post hoc tests compared paired differences among the 4 groups.

In the Asian home language subgroup analysis, Box's tests for both SEVT values and costs and perceived parental and cultural influences were satisfied, yet the equality of covariance matrices for student educational and career aspirations was violated (Box's M = 39.86, p = .005). Multivariate effects were found on mathematics-related educational and career aspirations (Pillai's trace = .108, F (9, 519) = 2.156, η_p^2 = .036, p = .024) and student-perceived parental and cultural influences (Pillai's trace = .144, F (9, 519) = 2.898, η_p^2 = .048, p = .002). For Levene's test, the homogeneity of variance on intended HSC mathematics and student-perceived parental expectation was violated (p < .001; p = .002). Univariate effects were found for girls' intended HSC mathematics (F (3, 173) = 5.652, p = .001, η_p^2 = .089), intrinsic value (F (3, 173) = 4.356, p = .006, η_p^2 = .070), student-perceived parental motivational support (F (3, 173) = 4.45, p = .005, η_p^2 = .072), and student-perceived parental expectation (F (3, 173) = 5.93, p < .001, η_p^2 = .093). Post hoc Bonferroni tests revealed that only girls who spoke English at home significantly differed from the other three Asian cultural subgroups. Consequently, the girls were regrouped into 2 cultural groups: English (n = 69) and Asian home language (n = 108) for further analysis.

<u>Girls' mathematics-related education aspirations by cultural group</u>
A significant multivariate effect was detected for cultural group on girls' HSC mathematics-related education aspirations (Pillai's trace = .041, F (2, 172) = 3.633, η_p^2 = .041, p = .028). A significant univariate effect of cultural group was discovered on girls' intended HSC mathematics (F (1, 173) = 7.260, p = .008, η_p^2 = .040); a one-way Welch ANOVA further confirmed its reliability (p = .001). Girls who spoke an Asian language at home intended to pursue a higher level of HSC mathematics than English home language speakers (M = 2.68, SD = 0.53; M = 2.36, SD = 0.77, respectively). However, there was no significant difference between cultural groups and their perceived HSC Stage 6 mathematics capability.

<u>SEVT values and costs by cultural group</u>
A significant multivariate effect was discovered for cultural group on girls' STVs (Pillai's trace = .085, F (6, 168) = 2.588, η_p^2 = .085, p = .02). Univariate tests demonstrated that girls' intrinsic value significantly differed by their cultural group (F (1, 173) = 5.875, p = .016, η_p^2 = .033), where girls who spoke an Asian home language had higher

intrinsic value than girls who spoke English at home (*M* = 4.29, *SD* = 1.76; *M* = 3.67, *SD* = 1.78). Nevertheless, this univariate effect did not remain following Bonferroni correction (α = .0083). No significant differences were found on girls' perceived talent (*p* = .181), utility value (*p* = .962), instrumental value (*p* = .058), social cost (*p* = .599) or mathematics anxiety (*p* = .280).

Student-perceived parental motivational support, expectation and cultural influences by cultural group

A multivariate effect was found for cultural group on student-perceived social influences (Pillai's trace = .067, F (3, 171) = 4.108, η_p^2 = .067, *p* = .008). Interestingly, cultural group showed significant effects on all three dependent variables. Girls who spoke an Asian home language perceived higher parental motivational support (F (1, 173) = 4.702, *p* = .032, η_p^2 = .026), parental expectation (F (1, 173) = 10.921, *p* = .001, η_p^2 = .059) and cultural stereotypes (F (1, 173) = 5.213, *p* = .024, η_p^2 = .029) than girls who spoke English at home. However, only student-perceived parental expectation remained significant following the Bonferroni correction (α = .0167) (Asian home language: *M* = 5.20, *SD* = 1.71; English at home: *M* = 4.30, *SD* = 2.20). A Welch ANOVA confirmed the reliability of the univariate effect on student-perceived parental expectation (*p* = .002).

4.3.3 Interaction Effects of Stage and Cultural group

No statistically significant multivariate interaction effects were found between Stage and cultural group. However, there was a statistically significant univariate interaction effect of Stage and cultural group on perceived talent (F (1, 173) = 4.768, *p* = .030, η_p^2 = .027). In Stage 4, English home language speakers reported higher perceived talent than Asian home language speakers (*M* = 4.29, *SD* = 1.43; *M* = 4.08, *SD* = 1.52), whereas in Stage 5, girls who spoke an Asian home language reported higher perceived talent than girls who spoke English at home (*M* = 4.43, *SD* = 1.60; *M* = 3.56, *SD* = 1.61). However, this univariate interaction effect did not remain significant after applying Bonferroni correction (α = .0083).

4.4 Summary of Quantitative Analyses

4.4.1 Construct Interrelations

Mathematics in students' aspired job positively correlated with the two HSC mathematics-related aspiration constructs (i.e., Intended HSC mathematics, Perceived Stage 6 mathematics capability), intrinsic and utility value. Students' aspired job prestige positively correlated with intended HSC mathematics, perceived HSC Stage 6 mathematics capability, and perceived talent.

Both HSC mathematics-related aspiration constructs and SEVT values were positively correlated with each other. The strongest positive correlation was between utility and instrumental value, followed by perceived Stage 6 mathematics capability and intended HSC mathematics in Stage 6, and intrinsic value and perceived talent. Mathematics anxiety negatively correlated with both aspiration constructs and positive values. The strongest negative correlation was mathematics anxiety with perceived talent, followed by mathematics anxiety and intrinsic value. Social cost was found to only have a weak and negative correlations with students' aspired job.

Both student-perceived parental motivational support and expectation showed moderate positive correlations with student-perceived cultural stereotype. All three student-perceived parental and cultural influence constructs weakly, positively correlated with both HSC mathematical aspiration constructs. Student-perceived parental support also weakly positively correlated with all positive student values.

4.4.2 Differences by Stage and Cultural Group

A multivariate effect of Stage was found on HSC mathematics-related aspirations, due to two univariate effects on intended HSC mathematics and perceived HSC Stage 6 mathematics capability. Stage 5 girls intended to enrol in higher level of HSC mathematics, and perceived higher HSC Stage 6 mathematics capability than Stage 4 girls.

When comparing Asian home language versus English, multivariate effects were found on all three sets of constructs: mathematics-related education aspirations; SEVT values and costs; student-perceived parental and cultural influences. Specifically, the two cultural groups significantly differed on intended HSC mathematics, and student-perceived parental expectation. Girls who spoke an Asian home language intended to enrol in higher level HSC mathematics, and perceived higher parental expectation than English home language speakers.

4.5 Understanding Girls' Mathematical Aspirations, SEVT Values and Costs and Perceived Parental Influences from a Focus Group Perspective

Transcripts of the focus group interviews conducted with participants from each of Stage 4 (n = 6), and Stage 5 (n = 8) were reviewed multiple times to ensure that themes were properly coded in alignment with the core constructs from the student survey. Three major themes emerged in this process which were also consistent with the quantitative analyses: Student mathematics-related education and career aspirations, SEVT costs and values, and Student-perceived socialisers' influences. Findings for focus groups supported and helped to explain MANOVA Stage differences.

Because instrumental value links to an end (in terms of aspired future education and careers), it was coded as part of the mathematics-related education and career aspirations. Questions regarding girls' perceived HSC Stage 6 mathematics capability and perceived cultural stereotypes were not specifically asked in the focus group interviews. Girls' responses for some questions involved other socialisers, such as teacher and siblings. Thus, 9 of core survey constructs were relevant coding frames in the qualitative analysis. Table 8 below illustrates these constructs, the frequency of mentions and sample responses. In Table 8, a slash sign "/" indicates an opposite response "e.g. "I asked parents for maths homework help." / "They don't really know."). Specific keywords or phrases associated with the constructs were counted when measuring frequency. For example, if a girl mentioned she enjoyed learning mathematics, then it was coded for intrinsic value and the frequency was recorded as one count. In addition, if a girl mentioned she was confident in mathematics, but felt stressed at the same time, then "confident" was coded as perceived talent and recorded as one count, and "stressed" was coded under mathematics anxiety and recorded as one occurrence. However, if a girl mentioned the similar keyword/phrases multiple times in the same response, it was only coded and recorded once.

4.5.1 Girls' Mathematics-related Education and Career Aspirations

<u>*Stage 4 (grades 7 – 8)*</u>

The girls in the Stage 4 focus group interview demonstrated a clear understanding of their future mathematics-related HSC and future career aspirations. Most of them knew what future career they would like to have. Even those who were unsure of a specific career path still had a general plan such as being a psychiatrist or an optometrist ("*I want to become a psychiatrist, so I first have to get an undergraduate in medicine, which means a lot of math.*"). While Stage 4 students may not have had a consolidated strategy of how to achieve their goals, they recognised the importance of learning mathematics, such as "*I will probably do the highest level because I think it would help a lot*". They mentioned that learning mathematics would be helpful not only for their future education (instrumental value), but also important in everyday life (utility value). All these students mentioned they would choose advanced, or the higher Extension mathematics level for the HSC in Stage 6 (upper secondary grades 11 – 12).

Stage 5 (grades 9 – 10)

Girls in the Stage 5 focus group also referred to the importance of doing mathematics. There was a clear link between their aspired HSC mathematics and future career goals, for example, *"I'd either go in the medical direction or the engineering field and for that I'm probably going to need Extension 1 or 2*". Additionally, they understood that some careers require more mathematics than others, "*Obviously HSC, but it depends on what job you have because there's some jobs which you need maths and some jobs which you don't*". Stage 5 girls' aspired HSC mathematics level and career goals tended to be more well-defined, where they understood there would be a prerequisite mathematics level for certain professions ("*Well, I'm planning going to the med [medical] field. Specifically, hospital doctor…I'm pretty sure math Extension 1 is prerequisite…*"). Six of them planned to study Extension 1 or 2 mathematics.

4.5.2 Subjective task values and costs

Stage 4

Girls in Stage 4 displayed genuine interest in mathematics. They described mathematics as "*Just fun*" and "*I really enjoy solving them [mathematical problems]*". Some of them also recognised enjoyment would play a key role in doing well in mathematics, "*I think engagement and enjoyment actually helps a lot in doing well*". Utility value was very high in this focus group. All six of the participants described mathematics as "*Essential in everyday life*", "*It's useful*" and "*It's everywhere*". Two of them expressed high perceived talent in mathematics, however, they also acknowledged they made "*silly mistakes*" when doing mathematics, resulting in them feeling stressed. Psychological cost was implicit when girls reported making "*silly mistakes*", not understanding a problem, and overlooking key aspects when solving problems or preparing for exams. Social comparison also played a significant role, with some girls expressing that they felt stressed when seeing that others performed better than themselves.

Stage 5

Most girls in Stage 5 showed very high perceived talent and high psychological cost at the same time. When asked whether they felt confident or stressed in mathematics - five out of eight participants answered, all revealing feeling confident but simultaneously feel stressed because of exams (e.g. "*I think I'm pretty confident, but in certain situations, it's stressful. Mainly exams"*; "*I think I'm pretty confident in math too, stress-wise before exams it's like……*"). In addition, six participants reported receiving after-school tutoring. Some of them mentioned that learning ahead of their grade contributed to their confidence and they did not like the feeling of falling behind in school. Comparatively, one student mentioned that she liked mathematics because it was easier than other subjects, while another student mentioned she preferred English more than mathematics. Six girls reported mathematics as their favourite or equal favourite subject.

Table 8
Focus Group Interview Constructs, Frequency and Sample Response

	Stage 4 (n = 6)		Stage 5 (n = 8)	
	N	Sample Response	N	Sample Response
Mathematical education and career aspirations	10/3	“I want to become a psychiatrist, so I first have to get an undergraduate in medicine, which means a lot of math.” / “I am not really sure because I'm still trying to find out what all the different jobs are.”	10/1	“I'd either go in the medical direction or the engineering field and for that I'm probably going to need Extension 1 or 2.” / “I don't really know what I want to do in the future, but I'd probably go to maybe Extension 1.”
Intended HSC mathematics in Stage 6	6/1	“I probably do the highest level because I think it would help a lot.” / “I'm not really sure. I think probably either the highest level, the second-highest level.”	7	“I'm pretty sure math Extension 1 is prerequisite, but I'm planning on taking up to Extension 2 because for me, math is easy...”
Perceived talent	4	“...but I only enjoy the areas of maths that I'm stronger and better at.”	14	“I'm pretty confident in math.”
Intrinsic value	9	“It's just fun doing it...”	4	“Well, personally I enjoy math. I've been enjoying it since I was a child.”
Utility value	13	“They use it in our everyday life and for living, we have to deal with money and that includes lots of maths.”	4	“Geometry isn't very useful.”
Mathematics anxiety	11	“I feel stressed when I continuously get a certain type of question wrong and I don't know.”	13	“I get stressed before an exam and sometimes again when I'm learning a new topic I also get stressed.”
Socialisers for support	6	“I turned to my parents because they're really good at maths.”	2/5	“I ask my parents or my siblings.” / “They (parents) don't really know.”
Student-perceived socialisers’ expectation	17	“My parents think it should be at a harder level.”; "My parents want me to either be a doctor or an accountant like them."	2	“Well, mine doesn't really know about the Australian curriculum, so they (parents) just expect me to do well.”

Note: N = frequency; ‘/’ indicates an opposite response.

4.5.3 Roles of Socialisers

<u>Stage 4</u>

The perceived parental behavioural support of Stage 4 girls was quite high, as half of the students mentioned they tended to seek their parents' help when doing mathematics. Girls' perceived parental expectation was even more pronounced. All of the girls mentioned that their parents thought they should learn more advanced mathematics and put more effort into learning mathematics. One student also revealed "*My parents also think I should be doing a bit harder math, but they aren't also that involved in my math*". The majority reported going to tutoring outside of school to learn higher-level mathematics (e.g., study ahead of the syllabus). Moreover, when discussing HSC mathematics levels and future career aspirations, girls mentioned their parents expected them to do the highest Extension 2 or 1 for HSC mathematics and expected them to pursue certain careers in the future. Their expected HSC mathematics and careers were closely aligned with what their parents pursued, for example, "*My parents want me to either be a doctor or an accountant like them."; "My parents want me to do the hardest level of math because they also did it…".* When the interviewer asked the girls what helps people succeed in mathematics, they highlighted the importance of having supportive socialisers around (e.g., parents, teachers and friends) and being surrounded by individuals who are passionate about mathematics. These girls also suggested collaborating with peers when solving mathematics activities, as it would be easier to communicate and solve problems together.

<u>Stage 5</u>

Although the majority of the Stage 5 girls attended tutoring, only 2 girls mentioned they asked their parents for help with mathematics. While perceived parental behavioural support was not often mentioned, these girls still experienced very high parental expectations, even though they revealed their parents *"don't really know"* but *"they just expect me to do well"*. Only one girl said she did not know what level of HSC mathematics to do, but would do Extension 1 because of her parents. In general, the Stage 5 girls did not mention their parents much throughout the focus group interview.

4.6 Focus Group Comparison by Stage

Both Stages 4 and 5 girls demonstrated clear mathematics-related educational and career aspirations. Stage 5 girls gave more specific plans and linked their intended HSC mathematics to aspired university degrees or careers. While Stage 4 girls' educational and career aspirations were comparatively more general, they still preferred to do higher-level mathematics for the HSC and pursue careers with a high level of mathematics involved. Both focus group participants expressed high intrinsic value in mathematics and expressed the importance of feeling motivated in learning mathematics. Girls in both Stages suggested that more practical activities and investigations would make their mathematics class more interesting.

Stage 4 girls more frequently mentioned higher utility value than Stage 5 girls, yet their responses regarding the usefulness of mathematics were vague (e.g., *"It's essential")*, compared with Stage 5 girls who found a more personalised usefulness of mathematics depended on what future career they aspired to pursue. Stage 5 girls reported high perceived talent, not surprisingly given their classes were differentiated based on their mathematical ability and 7 of them were from top mathematics classes. Nevertheless, when asked *"Are you confident in maths, or do you find it stressful, or both?"*, all responses followed a consistent structure: *"I am pretty confident but get stressed before exams."* Stage 4 girls also revealed feeling stressed when making *"silly mistakes"* or trying but still *"can't solve this question"*. Although social and dimensional comparisons were not frequent, they were still revealed in Stage 4 (*"It's very stressful for me when the people around me are better*") and Stage 5 (*"some people are just good at maths, and some people just aren't. I prefer to do English."*).

Parents of girls in both Stages were perceived to held high expectations for their daughters' mathematics-related educational and career aspirations. The majority of them expected their daughters to enrol in Extension 2 or 1. Many of the girls in Stage 4 received high parental behavioural support, and asked their parents for help in mathematics, while Stage 5 girls reported that parents did not know what their daughters were doing (lower parental behavioural support) but still expected them to pursue high levels of mathematics in the HSC and future careers. Many students in both Stages attended after-school tutoring to learn more advanced mathematics.

CHAPTER 5

DISCUSSION

The present study examined how grades 7 – 10 Asian Australian girls' mathematical education and career aspirations were shaped by addressing three aims under three major categories: 1. Asian Australian girls' mathematical education and career aspirations; 2. Mathematical values and costs; 3. Perceived parental and cultural influences. The first aim was to investigate what girls' mathematical education and career aspirations were; and how their aspirations were shaped by understanding their intended level of Stage 6 HSC mathematics, aspired job prestige and level of mathematics involved in their aspired jobs. The second aim was to understand which subjective task values (STVs) (i.e., values and costs) had the strongest influence on these aspirations and their intercorrelations. between STVs. The final aim was to discover how these Asian Australian girls' mathematical education and career aspirations and mathematics-related STVs were influenced by their perceived parental influences and cultural stereotypes. Participants were compared by Stage (Stage 4: grades 7 – 8; Stage 5: grades 9 -10) and home language (Asian versus English) when addressing each research question.

There are 4 sections in this Chapter. Section 5.1 discusses girls' aspired level of HSC mathematics and future career as well as how their aspirations were influenced by STVs, Stage level and home language groups. Section 5.2 focuses on the interrelations among SEVT values and costs to help better understand how Asian Australian girls' mathematical education and career choices were developed. Section 5.3 explains how these participants' mathematical aspirations are influenced by parents and how did girls in different Stage levels and cultural groups perceive parental and cultural influences differently. A further section of the discussion focuses on these combined effects to provide a holistic view of how girls' mathematical education and career aspirations are influenced.

5.1 Understanding Asian Australian girls' mathematics-related education and career aspirations and the role of mathematical expectancies, values and costs

5.1.1 What Were Asian Australian Girls' Education and Career Aspirations?

The mathematics-relatedness of Asian Australian girls' aspired jobs was only moderate on average, yet their aspired job prestige was high. There was no correlation between the level of mathematics in girls' aspired jobs and their job prestige, indicating that many girls aimed to pursue prestigious careers that involved a low level of mathematics. The results aligned with a previous study (Farmer, 1997), which suggested students may aspire to prestigious but low mathematics-involved careers, such as lawyers. Similarly, Watt et al. (2012) found mathematically aspiring girls aimed to pursue equally as prestigious jobs as boys. They also investigated whether mathematics-related expectancies and values would predict non-mathematical education and career aspirations, but did not discover any direct relationship to job prestige. This present study further confirmed that girls' aspired careers can be highly prestigious but not mathematically intense. In addition, the level of mathematics in girls' aspired jobs and job prestige were positively, weakly correlated with their intended HSC mathematics and capability, illustrating that individuals' professional aspirations can be predicted by their education pathways (Farmer et al., 1999). Girls' perceived Stage 6 HSC mathematics capability strongly correlated with their intended Stage 6 HSC mathematics. The survey results showed that most of the girls were intending to enrol in at least advanced mathematics in Year 11, possibly because they attended an academically selective school.

5.1.2 Which STV Had the Strongest Influence on Asian Australian Girls' Mathematical Education and Career Aspirations?

When taking a closer look at the correlations between education and career aspirations with SEVT values and costs, the mathematical demands in girls' aspired jobs weakly correlated with mathematics intrinsic value, and moderately correlated with mathematics instrumental value, and their job prestige weakly correlated with perceived talent in mathematics.

Previous research found that social cost was usually low endorsed (Watt et al., 2019), and girls tend to perceive less social cost than boys in mathematics (Watt et al., 2025). This study found that only aspired job prestige was negatively correlated with social cost. Although most participants chose "somewhat disagree" when answering 'social cost' questions in the survey, the large standard deviation indicated there were some girls who experienced substantial social costs. This is concerning as this implies girls who perceived grater social costs were those whose aspired jobs were less prestigious.

Both Stage 6 HSC mathematics-related constructs (i.e., intended HSC mathematics and perceived HSC mathematics capability) moderately, positively correlated with perceived talent and intrinsic value, and negatively correlated with mathematics anxiety. These results were consistent with research literature finding that mathematics-related SEVT values could lead to greater effort into mathematics, and eventually lead to higher mathematical achievement (Wigfield & Eccles, 2002; Wang, 2012). This helps to explain why higher intrinsic value and perceived talent related to higher levels of planned Stage 6 HSC mathematics enrolment. Although studies also found that girls generally hold higher mathematics anxiety, which would be detrimental to mathematical learning (e.g., Hyde, 2005), it is important to examine how values and costs work together in influencing individuals' mathematics-related choices (Watt et al., 2012; Wigfield & Eccles, 1992). Unexpectedly, both Stage 6 HSC mathematics constructs only weakly, positively correlated with utility value. Although instrumental value moderately and positively correlated with intended Stage 6 HSC mathematics, there was only a weak positive correlation between it and perceived Stage 6 HSC capability. The results were rather interesting as they did not align with either Hypothesis 1 - “It is hypothesised that utility value will have the strongest correlation with girls’ mathematics-related education and career aspirations.” or with previous studies. For example, the study of Watt et al. (2012) found utility value was especially important for girls (e.g. Watt et al., 2012), yet perceived talent and intrinsic value played an even more important role in this present study.

5.1.3 Were There Any Differences between Stage 4 and 5 Girls’ Mathematical Aspirations by Age?

Differences regarding girls’ mathematical education aspirations were discovered, where Stage 5 girls generally intended to enrol in higher HSC mathematics and perceived higher HSC mathematics capability than Stage 4 girls. This might be because the older girls had more opportunities to acquire HSC-related information (e.g., subject selection events and workshops), thus, they tended to have a clearer goal towards their HSC mathematics subject selection. The focus group interviews reflected that Stage 5 girls clearly linked their HSC mathematics to their future aspired careers, while Stage 4 girls were unclear about which level of HSC mathematics to enrol in.

Furthermore, (as described in Chapter 3) Stage 5 girls’ mathematics classes were streamed based on their mathematical ability whereas classes for Stage 4 girls were mixed. Although no direct questions regarding their level of Stage 5 mathematics class were asked in the survey, girls who were in a bottom mathematics class may not have been willing to participate in this mathematics-related study due to not seeing themselves as a “mathematics” person in the first place. The focus group interviews further backed up this suggestion, since 7 out of 8 girls who voluntarily participated in the Stage 5 focus group were from the top mathematics classes. It made sense why Stage 5 girls had higher perceived HSC mathematics capability if most of the Stage 5 survey participants were from the top mathematics classes. Because of mathematics class setting, the Internal/External model was also evident in the Stage 5 focus group (Marsh et al., 2014). While the older girls compared their mathematics and English abilities and showed higher mathematics anxiety in their responses, no across subject comparison was found in the Stage 4 focus group given the younger girls were in mixed-ability classes. While the selective school setting and age might be a reason for the older girls to differentiate the subjects more (internal comparison), the structure of the streamed mathematics might reinforce external comparison leading Stage 5 girls to have higher mathematics anxiety (von Keyserlingk et al., 2021; Seaton et al.,2009).

5.1.4 Were There Any Differences between Asian and English Home Language Speakers' Mathematical Aspirations?

Differences regarding girls' mathematical education aspirations were evident when comparing their home languages. Despite no difference in potential mathematical career aspirations, Asian Australian girls who spoke English at home planned to enrol in relatively lower level of HSC mathematics than Asian Australian girls who spoke an Asian home language. This indicates that girls who spoke English at home might harm their range of aspirations by choosing lower levels of mathematics.

5.2 What Were the Intercorrelations among SEVT Values and Costs?

5.2.1 What Were the Interrelations among Mathematics Subjective Task Values and Costs?

Aligning with the research literature, it was expected and found that girls' instrumental value was highly correlated with their utility value, since both values are goal-oriented and relate to extrinsic motivation (Ryan & Deci, 2009). In addition, the positive correlation between Asian Australian girls' utility and intrinsic value was moderate, but the correlation between utility value and perceived talent was rather weak. Eccles (2005) pointed out that utility and intrinsic value can have a strong correlation. In addition, previous studies found individuals' goals usually connect to how they perceive themselves and what they like without considering to be useful, explaining the weak correlation between perceived talent and utility value.

Interestingly, while girls in both focus group interviews expressed genuine interest and especially high perceived talent in the Stage 5 focus group, their responses from larger sample in the survey were rather moderate. According to the survey, questions regarding perceived talent asked students to compare themselves with others and compare between subjects. One possible explanation is the big-fish-little-pond effect, where students in a high-achieving school often perceive lower academic self-concept (Marsh et al., 2008). Furthermore, Trautwein et al., (2006)'s extended research showed that STVs can be negatively influenced by the average ability levels of classmates and school-average achievement. Girls in this study were asked to complete the survey during a timetabled mathematics class; they may have been more likely to compare themselves with peers when answering the questions, therefore, reporting lower interest and talent towards mathematics. It was not surprising that mathematics anxiety negatively correlated with all three positive STVs. Girls who had higher mathematics anxiety perceived lower talent and interest in mathematics. On the other hand, mathematics anxiety only weakly negatively correlated with girls' utility and instrumental value indicating they recognised the usefulness of mathematics regardless of any negative feelings.

5.2.2 Did Subjective Task Values Relate to Stage?

In this study, girls' STVs and costs did not differ by their Stage level. However, when taking a closer look at the focus group interviews, Stage 4 girls mentioned the usefulness of mathematics more frequently than Stage 5 girls. Nevertheless, their responses remained unclear as most of them viewed mathematics as being "useful" or "essential". This indicates Stage 4 girls might be echoing STVs from socialisers around them (e.g., parents might tell them mathematics is important), but still be at an early stage of value consolidation. Stage 5 girls on the other hand, provided more realistic views towards mathematics and were able to link their aspired jobs to the level of HSC mathematics they intended to enrol in. It is worth noting that most participants in the Stage 5 focus group perceived high perceived talent and high mathematics anxiety at the same time. This may relate to a student profile identified by Watt et al. (2019)'s of "struggling ambitious" students.

5.3 How did Asian Australian Girls' Mathematical Education and Career Aspirations, SEVT Values and Costs Relate to Perceived Parental Influence and Cultural Stereotypes?

5.3.1 What Were the Mean Level Differences of Parental Influence and Cultural Stereotypes?

It was hypothesised that Asian Australian girls' mathematical education and career aspirations would be strongly correlated with their parental influences. However, the findings did not align with this hypothesis as the mathematics in girls' aspired jobs and their aspired job prestige did not correlate with their parents' jobs, even though the mathematics in girls' aspired job was close to that in their parents' jobs at the mean level. This indicates that girls' career plans were probably influenced by other socialisers such as teachers and friends. Interestingly, the extent of mathematics in parents' jobs was moderately correlated with parents' job prestige, yet there was no correlation between the mathematics in girls' aspired job and its job prestige. Given that the girls were still in the junior levels of secondary school, they might not have enough knowledge or information to understand the connection between their aspired jobs and the level of mathematics required to pursue them.

Girls' intended HSC mathematics and perceived HSC mathematics capability were weakly positively correlated with their perceived parental support, expectation and cultural stereotypes. However, no correlations were found between mathematics in girls' aspired job and job prestige with their perceived parental support, expectation and cultural influences. This may be because the parents in this study tended to set expectations and provide behavioural support directly towards their daughters' overall academic achievement rather than discussing future careers their daughters might pursue. Second, parents themselves may be unsure about, for example, what level of HSC mathematics is required for becoming a mechanical engineer because of not having access to HSC-related information. This was evident in the focus group interviews, given that Stage 4 girls in the focus group mentioned they usually seek parental help with mathematics homework, while Stage 5 girls mentioned their parents were not sure about what they were learning, but still expect their daughters to work harder.

There is no doubt that parental involvements play a crucial role in students' cognitive, emotional and social development. The extent to which girls' choice of mathematics enrolment was influenced by perceived parental support and cultural stereotypes, could be limited to the positive "Asian = Maths" stereotype when supporting and setting expectations in their daughters' learning in mathematics. Moreover, the reported correlation showed girls' perceived parental support, expectation and cultural stereotypes all weakly and positively correlated with their intended HSC mathematics, perceived HSC mathematics capability, intrinsic value, and instrumental value. Nevertheless, only student-perceived parental support showed a weak positive correlation with girls' perceived talent and utility value. The 'parental support' question in the survey was more motivation focused as it directly asked the students whether they chose a certain level of HSC mathematics because of parental support, while in the focus group participants mentioned more behavioural support, like how parents helped them with homework. Perhaps the parents encouraged their daughters to do mathematics and showed them how to solve mathematics problems to provide the girls with structure which increased the girls' sense of feeling competent (Reeve, 2002). It was expected that Asian Australian girls' education and career aspirations would be strongly influenced by their parents, however, the results were not strong. Given the 'situative' setting in this present study, where girls were from an academically selective girls' school, and as such were all enrolled in the High Potential and Gifted program, it is not surprising they tended to be more independent learners with higher autonomy and were more intrinsically motivated (Gottfried et al., 2005). Their parents might also encourage their daughters to explore what they want to do and make their own decisions, as well as discuss the usefulness of mathematics through everyday conversations (Peters, 2012).

5.3.2 How Did Stage 4 and 5 Girls Perceive Parental and Cultural Influences?

How students perceived their level of parental support and expectations did not differ by Stage level, meaning that they were slightly influenced by their parents regardless of their age. However, the focus group interview revealed that the younger girls (Stage 4) tended to perceive higher parental support and expectations than the older girls (Stage 5). They were also more likely to ask parents for mathematics-related homework help “I turned to my parents because they're really good at maths” and were more likely to internalise their parents’ expectations “I want to do this, because my parents want me to do it” (quoted from the Stage 4 focus group). On the other hand, Stage 5 girls perceived very low parental support yet still experienced high parental expectations (e.g., “They don’t know but they expect me to do well”). In addition, Stage 5 girls mentioned their parents less frequently compared to Stage 4 girls, and their intended HSC mathematics and aspired jobs were not related to their parents' expectations.

Drawing on another theory, self-determination theory (SDT) (e.g., Deci and Ryan, 1985; Reeve, 2002), individuals’ motivations can be satisfied by meeting three psychological needs for autonomy (feel volitional), competence (experience a sense of mastery in an activity) and relatedness (feel connected to others). In an education context, learning and aspiration-related values and expectations can be internalised through autonomy support, where parents and other socialisers play an important role to encourage and support girls’ learning (Lerner et al., 2022; Ryan & Deci, 2017). As mentioned before, girls in the Stage 4 focus group interview experienced more parents’ behavioural support as most of their parents would help them with homework and solve problems with them, indicating they might internalise their parents’ expectations of learning mathematics through this. As the expectations have been internalised, this may explain why Stage 4 girls tended to pursue jobs their parents expected them to do. In addition, studies found that student-perceived parental influence and involvement decline over time from childhood to adolescence (Szwedo et al., 2017), which can also explain why the younger girls were more influenced by parents. Younger girls may still be gathering information and exploring their own academic goals and pathways, and be more likely to be influenced by more experienced socialisers. Older girls may draw on a broader range of influence from other socialisers (e.g., teachers and peers) given that Stage 5 focus group girls reported that most of their parents were not very familiar with what they were learning in Stage 5 and not able to provide support in terms of homework or subject selection.

5.3.3 Were There Any Differences between Asian and English Home Language Speakers?

Girls who spoke an Asian home language tended to perceive stronger parental and cultural influences specifically in relation to student-perceived parental expectations.

Many studies have emphasised that immigrant parents face a language barrier to their involvement in their children's education (Antony-Newman, 2019). Because of the potential language barriers, immigrant parents tend to provide additional instruction at home and maintain the native home language (Guo, 2011; Johnson et al., 2016). This might explain why girls who spoke an Asian home language perceived higher parental expectations, as there could be more communication and academic socialisation between parents and Asian home language speakers. However, this study did not specifically ask about participant parents' country of birth meaning parents of English home language speakers might also speak English at home if they were first-generation immigrant parents. Although results have found that girls who spoke an Asian home language tended to perceive higher parental expectations, it remained unclear whether English home language speakers perceived fewer parental expectations because of the potential language barrier between girls and parents or whether their parents just generally held lower expectations.

5.4 Integrating All Factors Together to Understand Asian Australian Girls' Mathematical Education and Career Aspirations and How These Aspirations were Developed?

5.4.1 Were There Any Differences between Girls' Stage and Cultural Group

This study examined interaction effects between both Stage level and cultural groups, but no mean level differences were found. This means girls' Stage level did not depend on their cultural groups and vice versa, emphasising all the cultural influences were true and robust regardless the Stage.

Although older girls intended to enrol in higher level of HSC mathematics, this was the only difference by Stage. The cultural groups differed in both intended level of HSC mathematics and perceived parental expectations. Specifically, Asian Australian girls who spoke an Asian language were more likely to enrol in higher level of Stage 6 HSC mathematics and perceived higher parental expectations than Asian Australian girls who only spoke English. Possible explanations have been mentioned in the previous sections separately. However, it also worth to consider these factors together and analyse their intersecting influences. As mentioned in the Literature Review chapter, Confucian ideologies strongly influence Asian immigrant parents, where they emphasise the importance of learning and academic achievement as well as value diligence and persistence in education (Mok, 2020). In addition, Eastern cultures tend to emphasise the importance of being interdependent with others (Markus & Kitayama, 1991). Asian immigrant parents, therefore, tend to hold a collectivist view towards their children's learning in which they expect their children to achieve better results for the family. This might explain why girls who spoke an Asian home language perceived higher parental expectation and resulted in them planning to enrol in higher levels of mathematics for the HSC exam. The Asian Australian girls who only spoke English, on the other hand, might be gradually assimilated to a more individualistic, self-directed value where family obligation values were less frequently emphasised and personal interests were more endorsed (Brewer & Chen, 2007).

Linking back to SDT, perhaps the Asian Australian girls who spoke an Asian home language were able to communicate more with parents, resulting them in experiencing relatively higher relatedness towards their parents' expectations. They might then gradually internalise their parents 'expectations through familial socialisation (Grolnick et al., 1997), leading their motivations in learning mathematics to increase. Given that relatedness is the critical component for learners to begin internalising the reasons (parental expectations) for engaging in assigned learning tasks (Vansteenkiste et al., 2017), this may explain why Asian home language speakers experienced both stronger parental expectations and were planning to pursue higher HSC mathematics. Although girls who only spoke English intended to enrol in relatively lower Stage 6 HSC mathematics, the majority of them still planned to enrol in at least advanced mathematics. Consistent with the cultural stereotype, the positive cultural stereotype of Asian students being mathematically capable might be encouraging the girls in this study to enrol in a higher level of mathematics.

5.4.2 For Girls Who Aspired to Low Level of Mathematics Careers, What Did They Really Want to Do?

It was mentioned earlier that girls who were aspired to prestigious careers in this study may not be aspiring to a mathematically intensive career. When taking a closer look at their aspired jobs, most girls who aspired to a low mathematics involved career (the level of mathematics in their aspired job was below average) aspired to become a lawyer, followed by psychologist, dentist and anaesthesiologist. Girls who aspired to a moderate level of mathematics job aspired to be doctors, surgeons or architects. Finally, girls whose aspired careers were mathematically intensive aspired to careers either finance-related, or science and engineering related. These low mathematics-involved careers are prestigious and require very high Australian Tertiary Admission Rank (ATAR) to get enrolled into university. This clearly explains why most of the girls who aspired to low level of mathematics careers might enrol in at least advanced mathematics.

5.4.3 How Did the Selective School Setting Influence the Girls' Perceptions of Themselves?

Furthermore, as mentioned in the previous section, girls tended to hold a rather moderate view in terms of their perceived talent and intrinsic value in mathematics.

Given that the survey questions related to perceived talent were all about comparing with peers or other subjects, the influence of BFLPE cannot be overlooked. BFLPE can be concerning as comparing with peers is inevitable especially in a highly competitive selective school setting. In this type of setting there may be increasing psychological costs and lowered girls' academic self-concept (Marsh et al., 2014). Surprisingly, mathematics anxiety and social cost did not correlate with the mathematics required in girls' aspired jobs nor their aspired job prestige. According to the reflected glory effect, individuals who are in a high-achieving setting tend to obtain a higher self-concept through the sense of belonging towards the setting (Wolff et al., 2021). Although Marsh et al. (2000)'s study discovered an opposite finding, where the academic self-concept of students in Hong Kong were negatively affected by their high school's prestigious status, it seemed that girls in this study may have been negatively influenced by the BFLPE due to their moderate ratings for perceived talent and intrinsic value. On the other hand, their aspired job prestige were still very high, indicating the affordances of attending a selective school and coming from upper-middle SES families might have increased the strength of the reflected glory effect resulting in counterbalancing the negative BFLPE.

5.4.4 Why Did Intrinsic Value Have the Strongest Influence on Girls' Educational Aspiration in Mathematics?

It was interesting that girls in this study viewed utility and instrumental values (extrinsic motivation) as more important and reported relatively higher perceived parental support and expectations compared with intrinsic value. Nevertheless, intrinsic value played the most important role when deciding the level of HSC mathematics they wanted to pursue. It is clear that girls demonstrated both extrinsic and intrinsic motivation towards mathematics, but why was intrinsic value more important even it scored lower on average? According to Eccles and Wigfield (2020), while the extent of values is often measured, the situated, contextual influence on the developmental process of values is largely neglected. Perhaps, it was an integration of their own characteristics, socialisers and the school setting. Scholars have examined and compared cognitive and motivational characteristics of academically gifted and high potential learners with their comprehensive counterparts, and found that gifted and high potential learners are cognitively more competent and are more intrinsically motivated (Fehrenbach, 1991; Zimmerman & Martinez-Pins, 1990), although this study did not deliberately measure other socialisers' support and perceived support in detail. Given girls were more interest-driven when making mathematics-related education decisions, it implies their three psychological needs were satisfied in both home and classroom settings (Ryan & Deci, 2000).

It was mentioned in the Literature Review chapter that Asian immigrant parents tend to show an authoritarian parenting style (high expectation, low responsiveness) (Ng & Wang, 2019), rather than authoritative parenting (high expectation and high affection).

Therefore, some individuals might be motivated with a partially internalised contingency (Vansteenkiste et al., 2010). However, both girls' perceived support and expectations did not correlate with mathematics anxiety nor was it negatively correlated with positive values, suggesting the internalisation of perceived parental expectation was healthy and adaptive.

5.5 Limitations

There are a number of limitations which need to be mentioned for this study that should be taken into consideration. As this study was located within the larger 'umbrella' 'PERFORM' study, all questions were drawn from the larger study's questionnaire, which was not designed to directly answer the aims of this current study. Therefore, existing questions in the survey could not be changed nor new items added. Only the data collected could be analysed. Questions regarding parents' country of birth and home language were not included which caused difficulties when classifying home language subcultural groups.

Secondly, there was only one question regarding cultural stereotypes, which combined assessment of both racial and gender stereotypes "Why do you plan to enrol in this level of mathematics for the HSC? Because it fits with cultural stereotypes (e.g., racial or gender groups)". The wording of the question might be too ambiguous for both participants and researchers to interpret. Another limitation is, no cultural stereotypes or gender-related questions were asked in the focus groups which limited the opportunity for these to arise.

Third, as this present study had a focus on parental influences, items regarding student-perceived influences from other socialisers, for example peers and teachers, were not chosen from the original survey. Fourth, data from this present study were cross-sectional, not longitudinal, meaning the given data can only be used to compare the current Stages 4 and 5 girls but cannot be used to predict whether the current Stage 4 girls would also be the same as the current Stage 5 girls. For example, it remains unknown whether the current Stage 4 girls would become more realistic regarding their capability for HSC mathematics or have a clearer goal for their future career aspirations when they are older. Lastly, due to the 'situative and culturally bound' nature of SEVT, the results found in this study may not be able to generalise to students in different schools. For example, the 'cultural stereotype' was found to be a positive construct in this given context, however, girls at this school were from an academically selective school with an upper-middle SES background. Results might be completely different if this study was to be replicated in different school settings (e.g., co-educational selective school, or comprehensive girl school).

5.6 Implications and Future Directions

5.6.1 Future Research directions

The theoretical framework Situated Expectancy-Value Theory was initially developed to understand how gender differences influence individuals' motivational choices regarding STEM-related field yet neglected the importance of considering how cultural influences would shape individuals' motivations. In 2024, Matthews and Wigfield specifically focused on the SEVT's 'cultural milieu box', linking SEVT to critical racial theory to reconceptualise subjective task values for Black people. Their study not only suggested adding racialised opportunity costs to emphasise discriminations minority groups (Black people in their study) may experience but also related Black joy to intrinsic and attainment value, helping SEVT to better situate Black people's motivation.

This present study implemented a mixed-methods approach to discern how Asian Australian girls' mathematical aspirations are influenced by a set of constructs. According to Eccles and Wigfield (2020), gender stereotypes are culturally formed which influence oneself's motivation and behaviours. While stereotypes can be either positive or negative, some stereotypes, for example 'Mathematics = Boys' and 'Asian = Mathematics' particularly favoured Caucasian and Asian boys (Cvencek et al. 2015; Starr et al., 2022;), yet it remains unclear how Asian girls would be influenced by the 'Asian = Mathematics' stereotype (Hsieh et al., 2021; Lee-Poon & Simpkins, 2024).

One of the innovative elements in this study was to add 'cultural stereotype' as an additional item under subjective task value to investigate whether it was positive or negative for Asian Australian girls under a given context. In order to do this, the study divided participants into different cultural groups to compare them according to home language background (spoke an Asian language versus only spoke English). As mentioned in the Limitation section, no questions were asked regarding parents' country of birth. Future studies should consider adding these demographic questions to achieve a more comprehensive understanding of cultural and racial aspects. In addition, having cultural (racial) stereotypes and gender stereotypes to be asked separately in the survey would provide future studies a better perspective to understand how and why participants' mathematical education and career aspirations are influenced by each. Designing secondary school age-appropriate questions regarding cultural and gender stereotypes for focus groups would also be beneficial. Previous studies have shown that parental influences gradually decrease when adolescents grow older (Szwedo et al., 2017). Therefore, it is also important to measure other socialiser influences to examine whether teachers or peers would have stronger influences on students' mathematical education and career aspirations. Cross-sectional data in this existing study were collected during school Term 3. Future studies could collect longitudinal data to investigate whether student mathematical aspirations would change or not when they are older, such as at the beginning of the school Term 1 and at the end of school Term 4, to compare whether mathematical aspirations would change across the year. Future studies would need to encompass a range of different school settings.

5.6.2 Practical Directions for families and schools

Possible suggestions are offered for parents and schools. According to Hill and Tyson (2009)'s meta-analysis, parental involvement shows positive associations with students' academic achievement. Specifically, academic socialisation, which involves parents communicating their academic expectations, cultivate students' educational and career aspirations through discussing learning strategies as well as the level of mathematics required for different careers, had the strongest positive relationship with adolescents' learning. In the focus groups, while parents in this present study were found to set high academic expectations in both Stages, parents of Stage 5 girls demonstrated less behavioural support in terms of helping their daughters with mathematics homework and understanding what their daughters were learning.
Because parents are central socialisers of their daughters' mathematics learning, possible practices which can facilitate parent-school communication were also discussed. Firstly, it is important to consider potential challenges parents may encounter due to the specific context in the present study. Antony-Newman (2019)'s meta-synthesis study of immigrant parent' parental involvement pointed out that many immigrant parents face obstacles such as language barriers and are unfamiliar with the education system, which impeded communication with school as frequently as their English-speaking counterparts (Ji & Koblinsky, 2009). To better facilitate, parents can navigate their daughters' school systems and collaborate with teachers through electronic communications (e.g., Bouffard, 2009). It would be beneficial if school and mathematics classroom teachers can initiate communications and provide more information to parents as well as language support, including sending translated emails home and providing modified homework to help parents familiarise with schools (Ladky & Peterson, 2008).

As mentioned in the previous chapters, participants in this study were from an academically selective girls' school, indicating they were academically gifted and high potential learners. Previous studies have found that gifted individuals are more intrinsically motivated in learning and require a higher level of autonomy (Clinkenbeard, 2012; Olszewski-Kubilius et al., 1988). The reciprocal relationship between autonomy support and intrinsic motivation has been established by previous SDT-related studies (Liu & Wen, 2025). Therefore, it is important for academically gifted and high potential learners to be able to make their own choices and decisions. In addition, previous studies have found providing gifted learner with evaluative feedback, for example praise for independence and their effort-based success is likely to make them more self-determined (Neihart et al., 2002). Furthermore, due to the genuine interest the girls at this school had in mathematics, teachers (e.g., mathematics and career advisors) can discuss how mathematics is linked to careers and could encourage students to attend more mathematics and mathematically intensive STEM activities from Stage 4. Girls who participated in the focus group interviews specifically mentioned that they preferred to work in groups and would like to have more practical activities in their mathematics classes. Therefore, teachers should not only discuss mathematical topics but also provide students with opportunities to apply mathematics in everyday life situations (Graumann, 2011).

CHAPTER 6

CONCLUSION

6.1 Purpose of This Study

It is undoubtable that individuals think about what they like and what they are good at throughout their life (Wan et al., 2021). These thoughts are important as they can influence what and why an individual will or will not choose to pursue a certain education or career pathway (Cai et al., 2018; Wan et al., 2021). The importance of mathematics and mathematics-related STEM disciplines has been emphasised for economic growth and social development (Office of the Chief Scientist, 2016). The gender gap in medical and life sciences enrolment has narrowed (Eccles & Wang, 2016); nevertheless, girls and young women are still underrepresented in advanced mathematics and mathematically intensive STEM disciplines in many countries, including in Australia (Australian Industry Group, 2015; National Science Foundation, 2017; OECD, 2010).

Why does this happen? Although scholars have examined how gender shapes girls/women and boys/men in choosing mathematics-related STEM disciplines (e.g., Lloyd et al., 2018; Watt et al., 2012), many of the researched samples have been homogenous in terms of Caucasian ethnicity limiting the generalisability to individuals from other cultural backgrounds. Other factors such as cultural and social influences should also be taken into account to understand individuals' choices in a more holistic perspective (Matthews & Wigfield, 2024), for example, gender and cultural stereotypes in mathematics and science. Although the "male = mathematics" stereotype shows positive association with boys' learning, it negatively relates to girls' attitudes towards mathematics (Nosek et al., 2002). The "Asian = mathematics" stereotype has been documented among American students since grade 5 (Cvencek et al., 2015), yet it has been unclear whether Asian girls also experience the "Asian Advantage" (Hsieh et al., 2021; Lee-Poon & Simpkins, 2024). Parents are also important socialisers who play a key role in influencing adolescents' mathematics education and career aspirations. While Black and Latinx-American parents hold a more gender egalitarian belief in their children's mathematical performance (Rowley et al., 2007), Caucasian and Asian American parents of girls, on the other hand, have been found to hold traditional mathematics gender stereotypes which do not even favour their daughters (Starr et al., 2022). Nevertheless, whether or not these results can generalise to the Australian context and Asian immigrant parents was not known.

The purpose of this study was to understand what grades 7 – 10 Asian Australian girls' mathematics education and career aspirations were; and how these aspirations were shaped by their mathematical values and costs, and perceived parental influences (i.e.

expectation and support), and cultural stereotypes. This mixed-methods study investigated the intersection of gender and race in a single-sex, academically selective school setting where 95% of girls were from an Asian cultural background, and over 80% of them from an upper-middle socioeconomic background. Correlations between Asian Australian girls' mathematics-related education and career aspirations, subjective task values (STVs) and costs, and perceived parental and cultural influences were explored. These constructs were also compared by girls' Stage level (Stage 4: grades 7 – 8; Stage 5: grades 9 – 10) and home language (Asian versus English).

6.2 Key Findings and Contributions

One of the main contributions of this study was to examine whether the two cultural stereotypes - "males = mathematics" and "Asian = mathematics" may relate to the girls' mathematics education and career aspirations. While the "cultural stereotype" related question did not specifically ask the exact stereotype - *"Why do you plan to enrol in this level of maths for the HSC? because it fits with cultural stereotypes (e.g., racial or gender groups)."*, positively and weakly correlated with their future mathematical education aspirations as well as their intrinsic and instrumental value for mathematics. Given that the school was an academically selective all-girls school, and most of them were from an upper-middle SES background, it might be because these social affordances counteracted the negative "male = mathematics" stereotype. Or perhaps, the "Asian = mathematics" stereotype might dominate.

Aligning with Farmer's study (1997) where she suggested girls who opt out of mathematics may pursue prestigious jobs with low level of mathematics, girls in this study aspired to careers which were prestigious with low level of mathematics involved such as lawyer, psychologist and surgeon. In addition, this study further confirmed Watt et al. (2012)'s study that girls aspired to equally prestigious jobs as boys even though those jobs were not mathematically intense. In the Introduction chapter, parental involvement was defined as a social capital that provides support and resources for their children's learning. Interestingly, girls' perceived cultural stereotypes positively and moderately correlated with their perceived parental support and expectations, indicating Asian Australian parents in the study tended to support their daughters' mathematics learning that aligned with positive stereotypes.

Another contribution of the study is that previous studies often emphasise the importance of utility value as the crucial indicator to determine individuals' mathematics education and career aspirations (Simpkins et al., 2006), yet it might not be a lever for all students. Watt et al. (2012) found that utility value positively predicted

Australian girls' aspired level of mathematics and mathematical career aspirations but not boys. Other scholars pointed out that Asian immigrants often hold a functional view of learning mathematics and mathematics-intensive STEM disciplines for upward mobility (Ng & Wei, 2020). Therefore, the first hypothesis of this study assumed that utility value would have the strongest influence on girls' mathematics education and career aspirations. Although in this study, both girls' HSC mathematics and perceived HSC mathematics capability correlated with utility value, those correlations were surprisingly not strong. Instead, girls' perceived talent and intrinsic value for mathematics had much stronger correlations with their future mathematical education aspirations, indicating girls in this study had genuine interest in learning mathematics. This finding is important as it emphasises Situated Expectancy-Value Theory's nature of being situative and culturally bound (Eccles & Wigfield, 2020). In addition, Eccles and Wigfield (2020) discussed the research gap about the little emphasis on the developmental process of how STVs are formed and intrinsic values are developed. They proposed that intrinsic value could be from a good balance between individuals' consistent characteristics and specific aspects of their experiences and environments.

Given the specific academically selective, single-sex school setting, many girls might be academically high potential or gifted learners so that the characteristics of these learners and the specific school setting might explain why intrinsic value had a higher correlation with mathematical education aspirations. It would be interesting to see whether intrinsic value would be a more important influence than utility value in a co-educational selective school setting, and whether girls and boys would be similarly influenced.

Fourthly, this study provides a new perspective of how female adolescents experience Asian immigrant parents' parenting. Previous studies often emphasise a collectivist cultural orientation where Asian immigrant parents tend to hold high academic expectations and exhibit a more authoritarian parenting style (Ng & Wang, 2019). As a result, Asian students usually work to satisfy their parents' expectations and are strongly influence by them (Kodama & Huymh, 2017). As reviewed in the Introduction chapter, Starr and her colleagues (2022) found American Caucasian and Asian parents held mathematics gender stereotypes towards their daughters. One of the limitations of their study was, there were only 3% of Asian American participants in that study (Starr et al., 2022). In this study, while girls' perceived parental support and expectations weakly correlated with their intended HSC mathematics enrolment and perceived HSC mathematics capability, neither their perceived parental influence nor the level of mathematics in their parents jobs or job prestige correlated with the level of mathematics in girls' aspired jobs or job prestige. Neither did girls' parental influences in terms of perceived parental support and expectations negatively correlate with other constructs (weak positive relations were observed) meaning the parenting style might not be the traditional authoritarian style but rather healthy. This also suggests that even within cultural groups influences are not homogenous and can differ across contexts. Future studies could fruitfully consider contextual, school, and other demographic factors (e.g. SES background) when examining parents' influences on individuals' mathematics learning.

Additional to exploring how Asian Australian girls' mathematics education and career aspirations are shaped, the study compared girls by their Stage level and home language to highlight the situative setting. In line with existing literature, the older girls showed a more realistic view towards their future mathematics related education and career aspirations than younger girls, where the older girls were able to link the level of intended HSC mathematics to their future mathematical career goals, but the younger girls generally just found mathematics "important" and "useful".

More interestingly, all three major categories (aspirations, SEVT values and costs, perceived parental and cultural influences) showed mean level differences when comparing the two home language groups. Asian Australian girls who spoke an Asian home language perceived higher parental expectation and aspired to enrol in higher levels of HSC mathematics and perceived higher HSC mathematics capability than their English-speaking counterparts. It is worth noting that although the mean level differences in parental influences were found, parental influences towards mathematics learning were not as strong as hypothesised.

In this study, how girls' mathematical aspirations, values and costs were studied within an academically competitive context. Martin and Hau (2014) pointed out that cross-cultural studies often generalise an ethnic group without considering variations across contexts. In their study, when comparing Asian students in Western and Asian contexts, they discerned no differences in what categories of factors students were motivated by, but differences in the extent of how students were influenced. However, no significant mean-level differences were found on STVs when comparing girls' home language groups.

Previous BFLPE-focused studies revealed that while the reflected glory effect could counteract the BFLPE (in a German study by Wolff et al., 2021), attending a prestigious school negatively influenced secondary school students' academic self-concept in Hong Kong (Marsh et al., 2000). Very interestingly, girls in this study rated intrinsic value at average, indicating the presence of BFLPE. Yet, their HSC mathematics aspirations still correlated more strongly with their intrinsic value for mathematics. The level of mathematics in girls' aspired jobs and job prestige could suggest the reflected glory effect counteracted the BFLPE, due to positive self beliefs.

6.3 Key implications and future directions

While the situative context of this study offered meaningful findings and made contributions to the existing literature and theories, the generalisability of these findings is also limited due to the specific school and cultural context. Limitations were elaborated in the preceding Discussion chapter. These findings might be generalisable to other academically selective girls' schools with a similar cultural setting, but it is unclear whether girls from a single-sex comprehensive school or girls from an academically selective co-educational school would have similar aspirations; whether their HSC mathematics-related decisions would also be "interest-driven", and if they would report similar levels and associations with their perceived parental and cultural influences. It would be worthwhile for future studies to explore how girls' mathematics-related aspirations are influenced in different schools, cultural and sociodemographic settings. A substantial body of research in different settings highlights the importance of positive parental involvement in individuals' mathematics-related learning (i.e., Chhin et a., 2008; Lloyd et al., 2018; Watt et al., 2018), to which present findings contribute. It is therefore important that parents provide their children with positive support and healthy expectations towards mathematics. Schools may need to help immigrant parents who might experience certain language barriers to increase their involvement.

6.4 Close

The starting premise for this study was the two opposing gender and cultural stereotypes that "male = mathematics" and "Asian = mathematics", to explore how Asian Australian girls' mathematical education and career aspirations are shaped by their mathematical SEVT values and costs, and perceived parental influences and cultural stereotype. Counter to hypothesis, girls' mathematical aspirations were not strongly influenced by their parents, and utility value did not have the strongest correlation with girls' mathematics education and career aspirations. While girls who spoke an Asian home language perceived higher parental expectation which was associated with their higher level of aspired HSC mathematics. Overall, HSC-related aspirations were most correlated with intrinsic value, suggesting the academically selective girls in this study may be autonomous learners. As hypothesised, girls' perceived gender/cultural stereotypes did not strongly relate to their mathematical aspirations, potentially due to their affordance of attending an academically selective school and coming from upper-middle SES backgrounds. Parents in this study may draw on the positive "Asian = mathematics" stereotype to encourage their daughters' learning mathematics, and it was good to see girls' perceived parental and cultural influences seemed a resource to support their mathematical aspirations and STVs. While stereotypes can be positive or negative, in this study "cultural stereotype" seemed to play a positive role to motivate girls' mathematics learning. However, might using positive stereotypes to encourage individuals' learning be sustainable in the long run, or lead to something more detrimental such as a fixed mindset to fit into certain stereotypes? It is the author's hope that these findings could offer readers new perspectives on how particular contexts are part of individuals' mathematics-related trajectories and decision-making, in the sense of exploring individuals' mathematical aspirations within diverse cross-cultural contexts.

REFERENCES

Ang R. P., Goh D. H. (2006). Authoritarian parenting style in Asian societies: a cluster analytic investigation. *Contemp. Fam. Ther.* 28, 131–151. doi: 10.1007/s10591-006-9699-y

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2012). Science aspirations, capital, and family habitus: How families shape children's engagement and identification with science. *American Educational Research Journal*, *49*(5), 881–908. doi: 10.3102/0002831211433290

Archer, L., Dewitt, J., & Willis, B. (2014). Adolescent boys' science aspirations: Masculinity, capital and power. *Journal of Research in Science Teaching*, *51*(1), 1–30. doi: 10.1002/tea.21122

Ashby, J. S., & Schoon, I. (2010). Career success: The role of teenage career aspirations, ambition value and gender in predicting adult social status and earnings. *Journal of Vocational Behavior*, *77*(3), 350-360.

Australian Government Department of Education and Training. (2014). *UCube higher education data*. Retrieved from http://highereducationstatistics.education.gov.au/

Australian Industry Group. (2015). *Progressing STEM skills in Australia.* http://cdn.aigroup.com.au/Reports/2015/14571_STEM_Skills_Report_Final_-.pdf

AWPA (2012). *Future focus: Australia's skills and workforce development needs*. Canberra: Australian Workforce and Productivity Agency.

Baker, M., & Milligan, K. (2013). Boy-girl differences in parental time investments: evidence from three countries. National Bureau of Economic Research (NBER) Working Paper 18893. doi: 10.3386/w18893

Baudson, T. G. (2016). The mad genius stereotype: Still alive and well. Frontiers in Psychology, 7, 368.

Baudson, T. G., & Preckel, F. (2016). Teachers' conceptions of gifted and average-ability students on achievement-relevant dimensions. *Gifted Child Quarterly*, 60, 212–225.

Becker, G. (1978). The mad genius debate. Beverly Hills, CA: Sage.

Bench, S. W., Lench, H. C., Liew, J., Miner, K., & Flores, S. A. (2015). Gender gaps in overestimation of math performance. Sex roles, 72, 536-546.

Ben-Zeev, T., Duncan, S., & Forbes, C. (2005). Stereotypes and math performance. In *The Handbook of Mathematical Cognition*. Psychology Press, 235-249.

Bleeker, M. M., & Jacobs, J. E. (2004). Achievement in math and science: do mothers' beliefs matter 12 years later? *Journal of Educational Psychology, 96*, 97–109. doi:10.1037/0022-0663.96.1.97.

Brody, J. L., Cluck, J. P., & Aragon, A. S. (1997). Participants' understanding of the process of psychological research: Informed consent. *Ethics & Behavior*, *7*(4), 285-298.

Bronfenbrenner, U. (1977). Toward an experimental ecology of human de- velopment. American Psychologist, 32(7), 513–531. https://doi.org/10 .1037/0003-066X.32.7.513

Busse, T. V., Dahme, G., Wagner, H., & Wieczerkowski, W. (1986). Teacher perceptions of highly gifted students in the United States and West Germany. *Gifted Child Quarterly*, 30, 55–60.

Byun, Soo-yong, and Hyunjoon Park. 2012. "The Academic Success of East Asian American Youth the Role of Shadow Education." *Sociology of Education* 85(1):40–60. doi: 10.1177/0038040711417009.

Campbell, J. R. 1991. "The Roots of Gender Inequity in Technical Areas." *Journal of Research in Science Teaching* 2(8):251–64. doi: 10.1002/tea.3660280306.

Cai, D., Viljaranta, J., & Georgiou, G. K. (2018). Direct and indirect effects of self-concept of ability on math skills. *Learning and Individual Differences*, *61*, 51-58.

Chao, R. K. (1994). Beyond parental control and authoritarian parenting style: Understanding Chinese parenting through the cultural notion of training. *Child development*, *65*(4), 1111-1119.

Chao, R. K. (1996). Chinese and European American mothers' beliefs about the role of parenting in children's school success. Journal of Cross-Cultural Psychology, 27, 403–423. https://doi.org/10.1177/ 0022022196274002

Chen, J. J. L. (2008). Grade-level differences: Relations of parental, teacher and peer support to academic engagement and achievement among Hong Kong students. School Psychology International, 29, 183-198. http://dx.doi.org/10.1177/0143034308090059

Chen, Y., Chiu, S. W. K., Zhu, J., & So, W. W. M. (2022). Maintaining secondary school students' STEM career aspirations: The role of perceived parental expectations, self-efficacy, and cultural capital. *International Journal of Science Education*, *44*(3), 434-462.

Cherney, I. D., & Campbell, K. L. (2011). A league of their own: Do single-sex schools increase girls' participation in the physical sciences?. *Sex roles*, *65*, 712-724.

Chhin, C. S., Bleeker, M. M., & Jacobs, J. E. (2008). Gender-typed occupational choices: The long-term impact of parents' beliefs and expectations.

Coll, C. G., Crnic, K., Lamberty, G., Wasik, B. H., Jenkins, R., Garcia, H. V., & McAdoo, H. P. (1996). An integrative model for the study of developmental competencies in minority children. *Child Development*, *67*(5), 1891-1914.

Chow G. W. (2011). The model minority myth. *Independent School*, 70, 40-46.

Crowley, K., Callanan, M. A., Tenenbaum, H. R., & Allen, E. (2001). Parents explain more often to boys than to girls during shared scientific thinking. *Psychological Science, 12*, 258–261. doi:10.1111/1467-9280.00347

Cvencek, D., Nasir, N. I. S., O'Connor, K., Wischnia, S., & Meltzoff, A. N. (2015). The development of math–race stereotypes:"They say Chinese people are the best at math". *Journal of Research on Adolescence*, *25*(4), 630-637.

Davis S. N., Pearce L. D. (2007). Adolescents' work-family gender ideologies and educational expectations. *Sociological Perspectives*, 50(2), 249–271. https://doi.org/10.1525/sop.2007.50.2.249

Dhingra, P. (2018). What Asian Americans Really Care about When They Care about Education. *The Sociological Quarterly*, *59*(2), 301–319. https://doi.org/10.1080/00380253.2018.1436944

Dicke, A. L., Safavian, N., & Eccles, J. S. (2019). Traditional gender role beliefs and career attainment in STEM: A gendered story?. *Frontiers in Psychology*, 1053.

Dobson, I. R. (2012). *Unhealthy Science? University Natural and Physical Sciences 2002 to 2009/10.* Available at: http://www.chiefscientist.gov.au/wp-content/uploads/Unhealthy-Science-Report-Ian-R-Dobson.pdf

Eccles, J. (1984). Sex differences in achievement patterns. Nebraska Symposium on Motivation, 32, 97–132.

Eccles, J. S. (2013). Gender and STEM: Opting in versus dropping out. International Journal of Gender, Science and Technology, 5(3), 184-186.

Eccles (Parsons), J. S., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., et al. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.). Achievement and Achievement Motivation, 75–146.

Eccles, J. S., Freedman-Doan, C., Frome, P., Jacobs, J., & Yoon, K. S. (2000). Gender-role socialization in the family: A longitudinal approach. The Developmental Social Psychology of Gender, Lawrence Erlbaum Associates Publishers, 333-360.

Eccles, J. S., & Jacobs, J. E. (1986). Social forces shape math attitudes and performance. Signs: Journal of women in culture and society, 11(2), 367-380.

Eccles, J. S., & Wigfield, A. (2020). From expectancy-value theory to situated expectancy value theory: A developmental, social cognitive, and sociocultural perspective on motivation. Contemporary Educational Psychology, 61, Article 101859. https://doi.org/10.1016/j.cedpsych.2020.101859

Eccles, J. S., & Wigfield, A. (2023). Expectancy-value theory to situated expectancy-value theory: Reflections on the legacy of 40+ years of working together. *Motivation Science*, *9*(1), 1.

Eccles-Parsons, J., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., & Midgley, C. (1983). Expectancies, values, and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motivation* (pp. 75–146). W. H. Freeman.

European Commission. (2009). *She figures 2009: Statistics and indicators on gender equality in science*. Publications Office of the European Union.

Fang, J., Huang, X., Zhang, M., Huang, F., Li, Z., & Yuan, Q. (2018). The big-fish-little-pond effect on academic self-concept: A meta-analysis. *Frontiers in psychology*, *9*, 1569.

Farmer, H. S. (1997). Women's motivation related to mastery, career salience, and career aspiration: A multivariate model focusing on the effects of sex role socialization. *Journal of Career Assessment*, *5*(4), 355-381.

Farmer, H. S., Wardrop, J. L., & Rotella, S. C. (1999). Antecedent factors differentiating women and men in science/nonscience careers. *Psychology of Women Quarterly*, *23*(4), 763-780.

Ferguson, L. M., Yonge, O., & Myrick, F. (2004). Students' involvement in faculty research: Ethical and methodological issues. *International Journal of Qualitative Methods*, *3*(4), 56-68.

Festinger L. (1954). A theory of social comparison processes. *Human Relations*, 7(2), 117–140. https://doi.org/10.1177/001872675400700202

Gaspard, H., Dicke, A. L., Flunger, B., Schreier, B., Häfner, I., Trautwein, U., & Nagengast, B. (2015). More value through greater differentiation: Gender differences in value beliefs about math. *Journal of Educational Psychology*, *107*(3), 663.

Gaspard, H., Lauermann, F., Rose, N., Wigfield, A., & Eccles, J. S. (2020). Profiling the cross-domain development of students' motivations: Joint trajectories of students' ability self-concepts and values in math and language arts. *Child Development, 91*, 1800–1818.

Georgiou, S. N., Stavrinides, P., & Kalavana, T. (2007). Is victor better than victoria at maths? Educational Psychology in Practice, 23(4), 329–342. https://doi.org/10.1080/02667360701660951.

Gilligan C. (1982). In a Different Voice. Harvard University Press.

Gil-Flores, J., Padilla-Carmona, M. T., & Suárez-Ortega, M. (2011). Influence of gender, educational attainment and family environment on the educational aspirations of secondary school students. *Educational Review*, *63*(3), 345-363.

Godec, S. (2020). Home, school and the museum: Shifting gender performances and engagement with science. *British Journal of Sociology of Education*, *41*(2), 147-159.

Gottfried, A. W., Gottfried, A. E., Cook, C. R., & Morris, P. E. (2005). Educational characteristics of adolescents with gifted academic intrinsic motivation: A longitudinal investigation from school entry through ea

Guo, J., Marsh, H. W., Parker, P. D., Morin, A. J., & Dicke, T. (2017). Extending expectancy-value theory predictions of achievement and aspirations in science: Dimensional comparison processes and expectancy-by-value interactions. *Learning and Instruction*, *49*, 81-91.

Guo, J., Marsh, H. W., Morin, A. J., Parker, P. D., & Kaur, G. (2015). Directionality of the associations of high school expectancy-value, aspirations, and attainment: A longitudinal study. *American educational research journal*, *52*(2), 371-402.

Gutman, L. & Schoon, I. (2012). Correlates and consequences of uncertainty in career aspirations: Gender differences among adolescents in England. *Journal of Vocational Behavior, 80*(3), 608–618.

Harackiewicz, J. M., Rozek, C. S., Hulleman, C. S., & Hyde, J. S. (2012). Helping parents to motivate adolescents in mathematics and science: An experimental test of a utility-value intervention. *Psychological Science*, 23(8), 899–906. doi: 10.1177/0956797611435530

Harackiewicz, J. M., Tibbetts, Y., Canning, E., & Hyde, J. S. (2014). Harnessing values to promote motivation in education. In *Motivational interventions* (pp. 71-105). Emerald Group Publishing Limited.

Helm, F., Mueller-Kalthoff, H., Nagy, N., & Möller, J. (2016). Dimensional comparison theory: Perceived subject similarity impacts on students' self-concepts. *AERA Open*, *2*(2), 2332858416650624.

Henfield M. S., Woo H., Lin Y., Rausch M. A. (2014). Too smart to fail: Perceptions of Asian American students' experiences in a collegiate honors program. *Gifted Child Quarterly*, 58, 137-148.

Hilton, J. L., & von Hippel, W. (1996). Stereotypes. Annual Reviews of Psychology, 47, 237–271. doi:10.1146/annurev.psych.47.1.237.

Ho, C. (2017). Angry Anglos and aspirational Asians: Everyday multiculturalism in the selective school system in Sydney. Discourse: Studies in the Cultural Politics of Education, 40(4), 1–16. https://doi.org/10.1080/01596306.2017.1396961.

Holmes, K., Gore, J., Smith, M., & Lloyd, A. (2018). An integrated analysis of school students' aspirations for STEM careers: Which student and school factors are most predictive?. *International Journal of Science and Mathematics Education*, *16*, 655-675.

Homel, J., & Ryan, C. (2014). *Educational outcomes: the impact of aspirations and the role of student background characteristics*. Adelaide: National Centre for Vocational Education Research. https://www.ncver.edu.au/__data/assets/file/0022/16780/education-outcomes-2669.pdf

Hong, S., & Ho, H. Z. (2005). Direct and indirect longitudinal effects of parental involvement on student achievement: Second-order latent growth modeling across ethnic groups. *Journal of Educational Psychology*, *97*(1), 32.

Hsieh, T. Y., Simpkins, S. D., & Eccles, J. S. (2021). Gender by racial/ethnic intersectionality in the patterns of adolescents' math motivation and their math achievement and engagement. *Contemporary Educational Psychology*, *66*, 101974.

Huang G., Gove M. (2015). Asian parenting styles and academic achievement: views from eastern and Western perspectives. *Education (Chula Vista)* 135, 389–397.

Hulleman, C. S., & Harackiewicz, J. M. (2009). Promoting interest and performance in high school science classes. *science*, *326*(5958), 1410-1412.

Jacobs, J. E., & Eccles, J. S. (1992). The impact of mothers' gender-role stereotypic beliefs on mothers' and children's ability perceptions. *Journal of Personality and Social Psychology, 63*(6), 932–944.

Jirwe, M., & Rudman, A. (2012). Why choose a career in nursing? *Journal of Advanced Nursing*, *68*(7), 1615–1623. doi:10.1111/j.1365-2648.2012.05991.x

Kao, G., & Tienda, M. (2022). Optimism and achievement: The educational performance of immigrant youth. In *The new immigrants and American schools* (pp. 83-101). Routledge.

Kennedy, J., Lyons, T., & Quinn, F. (2014). The continuing decline of science and mathematics enrolments in Australian high schools. *Teaching science*, *60*(2), 34-46.

Kerr B. (1994). *Smart girls: A new psychology of girls, women, & giftedness* (2nd ed.). Great Potential Press.

Kerr B., Gahm J. (2018). Developing talents in girls and young women. In Pfeiffer S. I. (Ed.), *APA handbook of giftedness and talent* (pp. 399–415). American Psychological Association. https://doi.org/10.1037/0000038-000

Kerr B., Sodano S. (2003). Career assessment with intellectually gifted students. *Journal of Career Assessment*, 11(2), 168–186. https://doi.org/10.1177/1069072703011002004

Kitayama, S., Markus, H. R., Matsumoto, H., & Norasakkunkit, V. (1997). Individual and collective processes in the construction of the self: self-enhancement in the United States and self-criticism in Japan. *Journal of Personality and Social Psychology*, *72*(6), 1245.

Kronborg L. (2010). What contributes to talent development in eminent women? *Gifted and Talented International*, 25(2), 11–27. https://doi.org/10.1080/15332276.2010.11673567

Lareau, A., & Horvat, E. M. (1999). Moments of social inclusion and exclusion: Race, class, and cultural capital in family-school relationships. Sociology of Education, 72(1), 37–53.

Lau, E. Y., Li, H., & Rao, N. (2011). Parental involvement and children's readiness for school in China. Educational Research, 53, 95–113. https://doi.org/10.1080/00131881.2011.552243

Lawson K. M., Lee B., Crouter A. C., McHale S. M. (2018). Correlates of gendered vocational development from middle childhood to young adulthood. *Journal of Vocational Behavior*, 107, 209–221. https://doi.org/10.1016/j.jvb.2018.05.002

Lazarides, R., & Watt, H. M. G (2017). Student-perceived mothers' and fathers' beliefs, mathematics and english motivations, and career choices. Journal of Research on Adolescence, 27(4), 826-841.

Lee-Poon, G., & Simpkins, S. D. (2024). Trajectories of math expectancies for success and values in Latinx and Asian students. *Developmental Psychology*. Advance online publication. https://dx.doi.org/10.1037/dev0001687

Lee, S. J. (1994). Behind the model-minority stereotype: Voices of high- and low-achieving Asian American students. Anthropology and Education Quarterly, 25, 413– 429. doi:10.1525/aeq.1994.25.4.04x0530j

Lloyd, A., Gore, J., Holmes, K., Smith, M., & Fray, L. (2018). Parental influences on those seeking a career in STEM: The primacy of gender. *International Journal of Gender, Science and Technology*, *10*(2), 308-328.

Liu, R. (2018). Gender-math stereotype, biased self-assessment, and aspiration in STEM careers: The gender gap among early adolescents in China. *Comparative Education Review, 62*(4), 522–541. https://doi.org/10.1086/699565

Liu, S. N. C., Brown, S. E., & Sabat, I. E. (2019). *Patching the "leaky pipeline": Interventions for women of color faculty in STEM academia. Archives of Scientific Psychology*, 7(1), 32.

Louie, V. S. (2004). *Compelled to excel: Immigration, education, and opportunity among Chinese Americans*. Stanford University Press.

Lubinski, D., Benbow, C. P., & Kell, H. J. (2014). Life paths and accomplishments of mathematically precocious males and females four decades later. *Psychological Science*, 25, 2217–2232.

Marchant, T., & Kennedy, S. (2024). The state of the mathematical sciences 2024. Australian Mathematical Sciences Institute. https://amsi.org.au/?publications=the-state-of-mathematical-sciences-2024-8th-discipline-profile-of-mathematics-and-statistics-in-australia

Marchant, T., & Kennedy, S. (2025). Year 12 mathematics participation report card. Australian Mathematical Sciences Institute. https://amsi.org.au/wp-content/uploads/2025/07/year-12-participation-2025-july.pdf

Maltese, A. V., & Tai, R. H. (2011). Pipeline persistence: Examining the association of educational experiences with earned degrees in STEM among US students. *Science education*, *95*(5), 877-907.

Marsh H. W., Kuyper H., Seaton M., Parker P. D., Morin A. J. S., Möller J., Abduljabbar A. S. (2014). Dimensional comparison theory: An extension of the internal/external frame of reference effect on academic self-concept formation. *Contemporary Educational Psychology*, 39(4), 326–341. https://doi.org/10.1016/j.cedpsych.2014.08.003

Martin, L., Burns, R., & Schonlau, M. (2010). Mental disorders among gifted and nongifted youth: A selected review of the epidemiologic literature. *Gifted Child Quarterly*, 54, 31–41.

Matheis, S., Keller, L. K., Kronborg, L., Schmitt, M., & Preckel, F. (2020). Do stereotypes strike twice? Giftedness and gender stereotypes in pre-service teachers' beliefs about student characteristics in Australia. *Asia-Pacific Journal of Teacher Education*, *48*(2), 213-232.

Matthews, J. S., & Wigfield, A. (2024). Past due! Racializing aspects of situated expectancy-value theory through the lens of critical race theory. Motivation Science. Advance online publication. https://dx.doi.org/ 10.1037/mot0000337

Mau, W. C. J., & Li, J. (2018). Factors influencing STEM career aspirations of underrepresented high school students. *The Career Development Quarterly*, *66*(3), 246-258.

Meisels, G. G. (2010). *Science literacy: Hand in glove with numeracy*. *Numeracy: Advancing Education in Quantitative Literacy*, *3*(2), 1-3.

Mok, A. (2020). "It's a skill that can be trained": How Chinese parents view mathematics and what this means. *New Zealand Journal of Educational Studies*, *55*(1), 73-89.

Möller J., Marsh H. W. (2013). Dimensional comparison theory. *Psychological Review*, 120(3), 544–560. https://doi.org/10.1037/a0032459

Muller, C. (1993). Parent involvement and academic achievement: An analysis of family resources available to the child. In B. Schneider & J. S. Coleman (Eds.), Parents, their children, and schools. pp. 77–114. Boulder, CO: Westview Press.

Mun, R. U., & Hertzog, N. B. (2019). The influence of parental and self-expectations on Asian American women who entered college early. *Gifted Child Quarterly*, *63*(2), 120-140.

Musu-Gillette, L. E., Wigfield, A., Harring, J., & Eccles, J. S. (2014). Trajectories of change in student's self-concepts of ability and values in math and college major choice. *Educational Research and Evaluation, 21*(4), 343.

Napier, R. D., Jarvis, J. M., Clark, J., & Halsey, R. J. (2024). Influences on Career Development for Gifted Adolescent Girls in Selective Academic Programs in Australia. *Gifted Child Quarterly*, *68*(1), 49-64.

National Science Board (2014). *Science & engineering indicators*. https://wayback.archive-it.org/5902/20231214031351/https://www.nsf.gov/statistics/seind14/

National Science Foundation (2017). *Women, minorities, and persons with disabilities in science and engineering: 2017.* NSF, 17-310. Arlington, VA. http://www.nsf.gov/statistics/wmpd/.

Neihart, M., Pfeiffer, S., & Cross, T. L. (2015). *The social and emotional development of gifted children: What do we know?* (2nd ed., pp. 159–172). Waco, TX: Prufrock Press.

Ng, F. F. Y., Sze, I. N. L., Tamis-LeMonda, C. S., & Ruble, D. N. (2017). Immigrant Chinese mothers' socialization of achievement in children: A strategic adaptation to the host society. *Child Development*, *88*(3), 979-995.

Ng F. F., Wang Q. (2019). "Asian and Asian American parenting," in *Handbook of Parenting*. ed. Bornstein M. H. 3rd Edn. Vol. 4: Social conditions and applied parenting (Mahwah, NJ: Routledge;), 108–169.

Nishen, A. K., Streck, H., Kessels, U., & Steinmayr, R. (2024). Feeling joy× feeling competent: Predicting math-related occupational aspirations from math grades, gender, and parents' occupational background via motivational beliefs. *Journal of Educational Psychology*, *116*(5), 785.

Nollenberger, N., Rodríguez-Planas, N., & Sevilla, A. (2016). The math gender gap: The role of culture. *American Economic Review, 106*(5), 257–261. https://doi.org/10.1257/aer.p20161121

Nosek, B. A., Banaji, M., & Greenwald, A. G. (2002). Harvesting implicit group attitudes and beliefs from a demonstration web site. *Group Dynamics: Theory, Research, and Practice, 6*, 101–115. doi:10.1037/1089-2699.6.1.101

NSW Department of Education. (2018b). What are selective high schools. Retrieved September 21, 2018 from https://education.nsw.gov.au/public-schools/selective-high-schools-and-opportunity-classes/ year-7/what-are-selective-high-schools.

Office of the Chief Scientist (2014). Benchmarking Australian Science, Technology, Engineering and Mathematics. Canberra: Australian Government.

Office of the Chief Scientist. (2016). *Australia's STEM workforce.* https://www.chiefscientist.gov.au/sites/default/files/Australias-STEM-workforce_full-report.pdf.

Olla M. G., Daulima N. H. C., Putri Y. S. P. (2018). The experience of parents implementing authoritarian parenting for their school-age children. *Enferm. Clin.* 28, 122–125. doi: 10.1016/S1130-8621(18)30050-0

Organisation for Economic Co-operation and Development (OECD). (2010). *Education at a glance 2010: OECD indicators*. Paris: Oecd.

Pahlke, E., Hyde, J. S., & Allison, C. M. (2014). The effects of single-sex compared with coeducational schooling on students' performance and attitudes: A meta-analysis. *Psychological bulletin*, *140*(4), 1042.

Parker, P. D., Schoon, I., Tsai, Y. M., Nagy, G., Trautwein, U., & Eccles, J. S. (2012). Achievement, agency, gender, and socioeconomic background as predictors of postschool choices: a multicontext study. *Developmental psychology*, *48*(6), 1629.

Perez, T., Cromley, J. G., and Kaplan, A. (2014). The role of identity development, values, and costs in college STEM retention. *J. Educ. Psychol.* 106, 315–309. doi: 10.1037/a0034027

Peters, S. J. (2012). Underachievers: From whose perspective? A commentary on "Differentiating low performance of the gifted learner: Achieving, underachieving, and selective consuming students." Journal of Advanced Academics, 23, 176-179. doi:10.1177/1932202X12438718

PricewaterhouseCoopers (PwC). (2015). *Future-proofing Australia's workforce by growing skills in science, technology, engineering and maths (STEM): A smart move*. Retrieved from https://www.pwc.com.au/pdf/a-smart-move-pwc-stem-report-april-2015.pdf.

Ravenscroft, S. P. (1997). In support of cooperative learning. Issues in Accounting Education, 12(1), 187–190.

Reeve, J. (2002). Self-determination theory applied to educational settings. In E. L. Deci & R. M. Ryan (Eds.), Handbook of self-determination research: Theoretical and applied (pp. 183-203). Rochester, NY: Rochester Press.

Riegle-Crumb, C., & King, B. (2010). Questioning a white male advantage in STEM: Examining disparities in college major by gender and race/ethnicity. *Educational Researcher*, *39*(9), 656-664.

Rosenzweig, E. Q., & Wigfield, A. (2016). STEM motivation interventions for adolescents: A promising start, but further to go. *Educational Psychologist*, *51*(2), 146-163.

Rozek, C. S., Svoboda, R. C., Harackiewicz, J. M., Hulleman, C. S., & Hyde, J. S. (2017). Utility-value intervention with parents increases students' STEM preparation and career pursuit. *Proceedings of the National Academy of Sciences*, *114*(5), 909-914.

Rudy D., Grusec J. E. (2006). Authoritarian parenting in individualist and collectivist groups: associations with maternal emotion and cognition and children's self-esteem. *J. Fam. Psychol.* 20, 68–78. doi: 10.1037/0893-3200.20.1.68

Ryan, R. M., Deci, E. L., Grolnick, W. S., & La Guardia, J. G. (2015). The significance of autonomy and autonomy support in psychological development and psychopathology. *Developmental psychopathology: Volume one: Theory and method*, 795-849.

Schneider, B., & Coleman, J. S. (Eds.). (1993). Parents, their children, and schools. San Francisco: Westview Press.

Schneider, B., & Lee, Y. (1990). A model for academic success: The school and home environment of East Asian students. *Anthropology & Education Quarterly*, *21*(4), 358-377.

Schoon, L. & Parsons, S. (2002). Teenage aspirations for future careers and occupational outcomes. *Journal of Vocational Behavior, 60*(2), 262–288.

Seaton, M., Marsh, H. W., Yeung, A. S., & Craven, R. (2011). The big fish down under: Examining moderators of the 'big-fish-little-pond'effect for Australia's high achievers. *Australian journal of education*, *55*(2), 93-114.

Seginer, R. (2006). Parents educational involvement: A developmental ecology perspective. Parenting: Science and Practice, 6, 1-48. http://dx.doi.org/10.1207/s15327922par0601_1

Sells, L. W. (1980). Mathematics: The invisible filter. *Engineering Education*, *70*(4), 340-41.

Senko, C., Liem, G. A. D., Lerdpornkulrat, T., & Poondej, C. (2023). Why do students strive to outperform classmates? Unpacking their reasons for pursuing performance goals. Contemporary Educational Psychology, 73(4), Article 102178. https://doi.org/10.1016/j.cedpsych.2023.102178

Siddall, J., Huebner, E. S., & Jiang, X. (2013). A prospective study of differential sources of school-related social support and adolescent global life satisfaction. American Journal of Orthopsychiatry, 83, 107-114. http://dx.doi.org/10.1111/ajop.12006

Simpkins SD, Davis-Kean PE, Eccles JS (2006) Math and science motivation: A longitudinal examination of the links between choices and beliefs. *Dev Psychol* 42(1): 70–83.

Simpkins, S. D., Fredricks, J. A., Eccles, J. S., & Huston, A. C. (2015). The Role of Parents in the Ontogeny of Achievement-related Motivation and Behavioral Choices. *Monographs of the Society for Research in Child Development*, 2(2), 1-169.

Šimunović, M., Reić Ercegovac, I., & Burušić, J. (2018). How important is it to my parents? Transmission of STEM academic values: the role of parents' values and practices and children's perceptions of parental influences. *International Journal of Science Education*, *40*(9), 977–995. https://doi.org/10.1080/09500693.2018.1460696

Spratt, C., Walker, R., & Robinson, B. (2004). PREST in Open and Distance Learning: Mixed Research Methods (A5 Module).

Starr, C. R., Gao, Y., Lee, G., Safavian, N., Rubach, C., Dicke, A. L., & Simpkins, S. D. (2022). Parents' math gender stereotypes and their correlates: An examination of the similarities and differences over the past 25 years. *Sex Roles*, *87*(11), 603-619.

Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist*, 52, 613–629. doi:10.1037/0003-066X.52.6.613

Stephens, N. M., Fryberg, S. A., Markus, H. R., Johnson, C. S., & Covarrubias, R. (2012). Unseen disadvantage: how American universities' focus on independence undermines the academic performance of first-generation college students. *Journal of Personality and Social Psychology*, *102*(6), 1178.

Stevenson, H. W., Chen, C., & Lee, S. Y. (1993). Mathematics achievement of Chinese, Japanese, and American children: Ten years later. Science, 259, 53–58.

Su, R., Rounds, J., & Armstrong, P. I. (2009). Men and things, women and people: a meta-analysis of sex differences in interests. *Psychological bulletin*, *135*(6), 859.

Subotnik, R. F., Olszewski-Kubilius, P., & Worrell, F. C. (2011). Rethinking giftedness and gifted education: A proposed direction forward based on psychological science. *Psychological Science in the Public Interest*, 12, 3–54.

Tenenbaum, H. R. (2009). 'You'd be good at that': gender patterns in parent-child talk about courses. *Social Development, 18*, 447–463. doi:10.1111/j.1467-9507.2008.00487.x.

Tiedemann, J. (2000a). Gender-related beliefs of teachers in elementary school mathematics. *Educational Studies in Mathematics, 41*, 191–207. doi:10.1023/A:1003953801526.

Toh, L., & Watt, H. M. (2022). How do adolescent mathematical self-concept and values explain attainment of different kinds of STEM degrees in adulthood?. *Contemporary educational psychology*, *69*, 102057.

Valla, J., & Ceci, S. J. (2011). Can sex differences in science be tied to the long reach of prenatal hormones? Brain organization theory, digit ratio (2D/4D), and sex differences in preference and cognition. *Perspectives on Psychological Science, 6*, 134–136. doi:10.1177/174569161140023.

von Keyserlingk, L., Dicke, A.-L., Becker, M., & Eccles, J. S. (2021). What Matters When? Social and Dimensional Comparisons in the Context of University Major Choice. *AERA Open*, *7*. https://doi.org/10.1177/23328584211020711

Vida, M., & Eccles, J. S. (2003). Predicting mathematics-related career aspirations and choices. In *Symposium "Antecedents of Mathematics-Related Career Paths and Aspirations: Perspectives from Australia, Canada and the USA". Society for Research in Child Development (SRCD) Biennial Conference, Tampa, FL*, 24-27.

Wan, S., Lauermann, F., Bailey, D. H., & Eccles, J. S. (2021). When do students begin to think that one has to be either a "math person" or a "language person"? A meta-analytic review. *Psychological Bulletin*, *147*(9), 867.

Wang, M. T., & Degol, J. L. (2017). Gender gap in science, technology, engineering, and mathematics (STEM): Current knowledge, implications for practice, policy, and future directions. *Educational psychology review*, *29*, 119-140.

Wang, M. T., Degol, J. L., & Ye, F. (2015). Math achievement is important, but task values are critical too: Examining the intellectual and motivational factors leading to gender disparities in STEM careers. *Frontiers in Psychology, 6*, 1–9. doi:10.3389/fpsyg.2015.00036.

Wang, M. T., Eccles, J. S., & Kenny, S. (2013). Not lack of ability but more choice: individual and gender differences in STEM career choice. *Psychological Science, 24*, 770–775. doi:10.1177/0956797612458937.

Watt, H. M. G. (2016). Promoting girls' and boys' engagement and participation in senior secondary STEM fields and occupational aspirations. ACER 2016 Research Conference Proceedings. ACER: Camberwell. ISBN 978-1-74286-407-5. 34-44.

Watt, H. M. G, Bucich, M., & Dacosta, L. (2019). Adolescents' motivational profiles in mathematics and science: Associations with achievement striving, career aspirations and psychological wellbeing. *Frontiers in Psychology*, *10*, 990.

Watt, H. M. G., Hyde, J. S., Petersen, J., Morris, Z. A., Rozek, C. S., & Harackiewicz, J. M. (2017). Mathematics—A Critical Filter for STEM-related Career Choices? A longitudinal examination among Australian and US adolescents. *Sex Roles*, *77*, 254-271.

Watt, H. M. G., Shapka, J. D., Morris, Z. A., Durik, A. M., Keating, D. P., & Eccles, J. S. (2012). Gendered Motivational Processes Affecting High School Mathematics Participation, Educational Aspirations, and Career Plans: a Comparison of Samples from Australia, Canada, and the United States. *Developmental Psychology*, *48*(6), 1594-1611.

Wigfield, A., & Eccles, J. S. (2020). 35 years of research on students' subjective task values and motivation: A look back and a look forward. In *Advances in motivation science* (Vol. 7, pp. 161-198). Elsevier.

Wigfield, A., & Eccles, J. S. (2024). The Relevance of Situated Expectancy-Value Theory to Understanding Motivation and Emotion in Different Contexts. In G. Hagenauer, R. Lazarides & H. Järvenoja (Eds.), *Motivation and Emotion in Learning and Teaching across Educational Contexts* (1st ed, 21, pp. 3-18). Routledge.

Wigfield, A., Tonks, S., & Eccles, J. S. (2004). Expectancy Value Theory in Cross-cultural Perspective. In D. M. McInerney, S. V. Etten (Eds.), *Big Theories Revisited*, *Research on Sociocultural Influences on Motivation and Learning (4, pp. 165-198)*, Information Age Publishing.

Wilder, S. (2023). Effects of parental involvement on academic achievement: a meta-synthesis. In *Mapping the field* (pp. 137-157). Routledge.

Xu, Y., Farver, J. A., Zhang, Z., Zeng, Q., Yu, L., & Cai, B. (2005). Mainland Chinese parenting styles and parent-child interaction. *International Journal of Behavioral Development*, *29*(6), 524-531.

Yan, W., & Lin, Q. (2005). Parent involvement and mathematics achievement: Contrast across racial and ethnic groups. *Journal of Educational Research*, *99*(2), 116-127.

Yang, W. (2007). Gifted or not, parental perceptions are the same: A study of Chinese American parental perceptions of their children's academic achievement and home environment. *Diaspora, Indigenous, and Minority Education,* 1, 217–234. https://doi.org/10.1080/ 15595690701394824

Yim, E. P. Y. (2022). Effects of Asian cultural values on parenting style and young children's perceived competence: A cross-sectional study. *Frontiers in Psychology*, *13*, 905093.

YouthInsight. (2021). 2021 Youth in STEM Report, Canberra: Department of Industry, Innovation and Sciences. https://www.industry.gov.au/sites/default/files/2022-08/youth-in-stem-report-2021.pdf

Zeidner, M., & Shani-Zinovich, I. (2011). Do academically gifted and nongifted students differ on the Big-Five and adaptive status? Some recent data and conclusions. *Personality and Individual Differences,* 51, 566–570.

APPENDICES

Appendix A Human Research Ethics Approval

WESTERN SYDNEY
UNIVERSITY

Ethics Reference: H15084
Expiry Date: 15 September 2024

HUMAN RESEARCH ETHICS COMMITTEE

29 July 2024

Distinguished Professor Kathryn Holmes
School of Education

Dear Kathryn,

RE: Amendment Request to H15084

I wish to formally advise you that the Human Research Ethics Committee has approved your request to amend your approved research protocol H15084 "Promoting adolescents' mathematics engagement and participation in NSW".

The approved amendments are:

Add an external student to the research team:
Dorothy (Dengyue) Chen.

Project specific approval conditions:

Please quote the registration number and title as indicated above in the subject line on all future correspondence related to this project. All correspondence should be sent to humanethics@westernsydney.edu.au as this email address is closely monitored.

Regards

[redacted]

Dr Kristy Coxon
Presiding Member,
Western Sydney University Human Research Ethics Committee

Appendix B Student / Parent Information and Consent Form

Research Activity	Additional Information/Action Required
Student Consent We will provide you with a database of those students who have provided consent.	Please provide the following link to all students in Years 7 – 10. This link is a link to the Participant Information Sheet and Consent Form for students to take part in the student survey and focus groups: https://surveyswesternsydney.au1.qualtrics.com[redacted]
	Here is a blurb that you might like to use when sharing this with your school community: *Dear Parents/Carers,* *Our school is taking part in a research project titled 'Promoting adolescents' mathematics engagement and participation in NSW'. This research is being conducted by researchers at Western Sydney University and The University of Sydney. This study aims to explore what might influence students' (Years 7 -10) decision making to study mathematics in Years 11 and 12.* *If you would like your child to participate in this research, please view the participant information sheet and complete the consent form by clicking on the following link:* https://surveyswesternsydney.au1.qualtrics.com/[redacted]
Teacher Consent (Head Teacher Mathematics, Career Advisor, Member of the school's leadership team)	Please provide the following link to the Mathematics Head Teacher, the Career Advisor, and to a member of your schools Leadership team. This link is a link to the Participant Information Sheet and Consent Form for this group: https://surveyswesternsydney.au1.qualtrics.com/[redacted]
Student Survey	Here is the link to the student survey that students who have provided consent, will complete during Term 3. https:/[redacted] Please note on the timeline above, that students will be required to enter their SRN number into the survey.
School Visit • Focus Groups • Teacher Interviews	Pease let me of ***some dates during Term 3*** that would work for 2 x research team members to attend your school for the day to conduct the following: • Stage 4 Focus Group of 6 – 8 students from a range of ability levels (these students will be selected by the school, from those that have provided consent) • Stage 5 Focus Group of 6 – 8 students from a range of ability levels (these students will be selected by the school, from those that have provided consent) • Interview the Mathematics Head Teacher • Interview the Career Advisor • Interview a member of the school's leadership team

Note: As this study is conducted under the PERFORM project, it used the same consent form approved for the PERFORM project.

Appendix C Focus Group Interview Consent Form

Email sent successfully:[redacted]- Maths Research Focus Group Interview

Email Type:	Event Management
Email Subject:	[redacted]- Maths Research Focus Group Interview
Email URL:	https://online.schoolbytes.education/excursions/[redacted]email_type=6
Sent By:	[redacted]
Attachments:	None
Email Body:	Dear {recipient_name}, Please use the link below to give or deny consent for {student_names} for the following: {activity_name}. {activity_consent_links} Thank you. -- [redacted]