International Journal of Gender, Science and Technology
http://genderandset.open.ac.uk

Selected papers presented at the 5th Network Gender & STEM Conference, 29–30 July 2021, in Sydney, Australia

In association with
NETWORK GENDER & STEM educational and occupational pathways and participation

How Does Starting a Family Affect Pathways for Women and Men Who Aspired to Mathematics-related Careers in Secondary School?

Lili Toh & Helen M. G. Watt
The University of Sydney, Australia

ABSTRACT
The underrepresentation of women in mathematics-related careers remains a pressing concern. While a vast literature studied the impact of starting a family on women's employment in general, few studies examined how parenthood affects mathematical career choices from a long-term perspective, taking into account traditional gender role beliefs and prior mathematical achievement. We examined mathematics-related career choices from adolescents' aspired careers, until their actual careers at average age 33 (N = 300; 168 women). Repeated-measures ANOVA explored whether career choice changed differentially for gender, parenthood and gender × parenthood groups. Despite a significant three-way interaction, only gender significantly affected mathematical career trajectory; males scored higher overall. However, an increase in mathematics-related career choices did approach significance, for women who had no children. Prior mathematics achievement and traditional gender role beliefs were tested as potential explanations in career trajectories. There were no group differences on prior mathematics achievement, but men who had children held more traditional gender role beliefs than women who did not. Yet, only prior mathematics achievement emerged as a significant covariate, indicating that traditional gender role beliefs did not explain the trend for increasing mathematical career choices for women without children over time. Mathematical career choices also did not decrease for women with children, counter to our prediction. Practical implications and future research recommendations are discussed.

KEYWORDS
gender; mathematical career choices; parenthood; traditional gender role beliefs; longitudinal

How Does Starting a Family Affect Pathways for Women and Men Who Aspired to Mathematics-related Careers in Secondary School?

INTRODUCTION

The underrepresentation of women in mathematically intensive fields of 'STEM' (science, technology, engineering and mathematics) has been a recurring theme of concern in the fight for gender equity for the past four decades (Sax et al., 2016). While women have made progress in some STEM domains such as the life and medical sciences, they continue to be underrepresented in mathematics-intensive STEM domains in Australia (Department of Education and Training, 2018), the United States (Chen & Ho, 2012; National Science Foundation, 2017) and elsewhere. One of the widely discussed arguments for this phenomenon is that mathematically intensive occupations are incompatible with motherhood (e.g., Eagly et al., 2000; Singh et al., 2018; Weisgram & Diekman, 2017; Williams & Ceci 2012). The pervasiveness of stereotypic gender roles in work and parenthood can impact women's identities and life decisions, interrupting their careers or career intentions in STEM (Jean & Payne, 2015), and mathematics-intensive STEM (Singh et al., 2018). Although women's balance of work and family has been studied extensively (e.g., Grandey & Cropanzano, 1999; Hoffnung & Williams, 2013; Singh et al., 2018; Weisgram & Diekman, 2017), few have examined the impact of having a family on women's and men's mathematical career trajectories from a long-term longitudinal perspective. Our study utilised a contemporary longitudinal dataset following students from secondary school to adulthood to investigate how starting a family may influence trajectories of mathematical career choices for women and men.

Theoretical background

Several interrelated theories shine a spotlight on how and why starting a family would detrimentally impact women's career advancement. According to Conservation of Resources theory, individuals seek to acquire, invest in, and maintain valued resources such as time and energy (Grandey & Cropanzano, 1999; Hobfoll et al., 1990). Yet, the experience of work-family conflict leads to resources being threatened, lost or depleted (Grandey & Cropanzano, 1999), leading to outcomes such as occupation withdrawal (Hammer et al., 2003), burnout and turnover intent (Greenhaus et al., 1997; Greenhaus et al., 2001; Thanacoody et al., 2009), career change (Singh et al., 2018) or lowered aspirations (Versey, 2015).

Gender stereotypical roles can affect women and men's balance of work and family differently. Traditional gender roles refer to women's charge of household and caretaking duties, in contrast to men providing financial support for the family (Eagly, 1987), which upholds men's career responsibilities but adds strain on women's careers. Women report a higher 'spillover' effect of stress from family to work and vice versa in U.S. studies (in general, Voydanof, 2005; among teachers, Erdamar & Demirel, 2014). Gender stereotypical roles disproportionately negatively affect women's ability to balance work and family.

Person-environment fit theory suggests that individuals will flourish when there is a match between their personal characteristics and workplace environment (Holland, 1985). Mathematics-intensive occupations (e.g., physicist, engineer,

computer scientist) are reported to have a "chilly organisational climate" for women (Hall & Sandler, 1982), characterised by inflexible hours, intense job demands incongruent with the role of a mother (Hewlett et al., 2008), and negative stigmatisation of maternity leave (Villablanca et al., 2011). These factors add another layer of difficulty for women in such careers who wish to balance the roles of career and family, and have been regarded as a barrier for women to enter and pursue mathematical occupations (Eccles, 1987; Frome et al., 2006; Singh et al., 2018). Women aiming to fulfil work and family roles simultaneously can find it difficult when expected behaviours in these two domains compete for finite resources of time and energy, and are therefore perceived as incompatible (Greenhaus & Beutell, 1985). The pressure to perform behaviours appropriate to one role (e.g., parent) can interfere with performance of another role (e.g., mathematically intensive career) – leading to work-family conflict.

Among dual-career couples, women have consistently been found to shoulder the majority of household and caretaking work (Berardo et al., 1987; Bianchi et al., 2000; Clarkberg & Moen, 2001 in the U. S.; Irving, 2008 in England; Tao, 2011 in Taiwan). This pattern of women returning home from work to start on domestic household work was named women's "second shift" (Hochschild & Machung, 1989). Balancing responsibilities changes when a marriage/defacto relationship evolves into a family over time. The birth of the first child has been found to be a pivotal point that intensifies gendered divisions of labour among dual-career couples and slows down women's careers (Weisgram & Diekman, 2017). Panel data from the Household Income and Labour Dynamics in Australia survey (2001 to 2018) examined changes in women's average share of couples' total time spent on employment, housework and caretaking (Wilkins & Lass, 2018). Proportions were between each couple for each activity such that percentages summed to 100% per activity. Five years prior to having a first child, partners' share of paid and unpaid work was relatively equal. Women's share in gainful employment started to decrease 3 years prior to the first child (down from 47% to 37% at 1 year prior, then to 14% less than 1 year after birth). A year after birth, women's relative time spent on caregiving compared to their spouse was 72% (i.e., spouse contributed 28%), share of housework was 64% and time spent on employment was 23%. Even 10 years after the first child, this gendered division of labour persisted with women's average share of time spent on employment increasing slowly to only 30% (70% for spouse).

Starting a family can obstruct achievement of women's career goals which can subsequently impact their wellbeing. These consequences are consistent with the sex-role hypothesis; that men benefit more from a marriage/defacto relationship than women (Bernard, 1972), through women's greater advocacy for health and prevention behaviours (Thoits, 1992), and more time freed up by women taking on the majority of household responsibilities (Greenstein, 1996). A 40-year longitudinal study among mathematically talented adolescents (Lubinski et al., 2014) revealed that women's income did not differ significantly based on marital status, whereas married men earned significantly more than unmarried men. Our study focuses on starting a family and traditional gender role beliefs as a potential explanation for why girls who aspired to mathematics-intensive careers during high school, may opt out of their earlier career aspirations in adulthood, and how this may differ for boys and men.

Traditional gender role beliefs, parenthood and career

Endorsement of traditional gender role beliefs interestingly increased, for both men and women, following transition to parenthood in a longitudinal Australian study, with effects more pronounced for men than women (Perales et al., 2018). The internalisation of traditional gender roles can shape men's and women's perspectives on what it means to care for one's family and could help explain different ways they approach both career and family. For example, women are more likely to perceive caring for their family as taking time from their career to be the primary caregiver at home, while men are more likely to perceive caring for their family as providing financial support for necessities and other expenses (Brown & Diekman, 2010; Curry et al., 1994; Weisgram & Diekman, 2017). Traditional perspectives of family and career therefore impact women and men differently by favouring gainful career advancement for men but not for women (Blakemore et al., 2005; Friedman & Weissbrod 2005). More importantly, the responsibilities of parenthood coupled with traditional gender role beliefs can magnify career disadvantages for women.

A vast literature has examined the impact of family obligations on women's employment. Yet, the number of studies examining women's long-term outcomes in mathematics-related fields remains relatively small. In qualitative studies, women have cited family obligations for leaving mathematics-intensive STEM careers (e.g., engineering, geophysicist) (Fouad et al., 2011; Herman et al., 2013; Stage & Maple, 1996). However, those studies were conducted with small sample sizes of 7 to 25 participants. In cross-sectional studies, scholars found that most women from high school through to their late college years perceived scientific careers as incompatible with family goals, in which they would have a hard time integrating family and work (Ware & Lee, 1988; Weisgram & Diekman, 2017). Others found that family-oriented women college students tended to prefer female-typed over male-typed professions, both for career preferences (Barth et al., 2015) and educational attainment (Burge, 2013). Barth et al. (2015) found that women preferred stereotypically feminine jobs for reasons of family-friendly conditions, whereas men preferred masculine jobs regardless of the goal affordance. Jobs were presented in pairs, selected from gendered workforce data and gender stereotypes identified by the authors in a pilot study. Burge (2013) found that women more frequently attained non-STEM than STEM fields including life sciences, because they perceived these to better accommodate future family demands.

Longitudinal studies have looked at the effects of starting a family on women's participation in paid work in general (e.g., Abele & Spurk, 2011; Hoffnung & Williams, 2013; Johnstone et al., 2011), but rarely specifically for mathematics-intensive career choices. The few longitudinal studies suggest that women in mathematical fields find it challenging to balance their family and career, often compromising one or the other. A longitudinal study conducted in England and Wales (1971 – 1991) showed that women (followed from age 25 to 44) who persisted in physical science, engineering and technology careers were less likely to be mothers, and mothers in mathematical fields were more likely to leave mathematical occupations or the workforce entirely (Blackwell & Glover, 2008). In a short-term longitudinal U.S. study, mothers in engineering rated their work-family conflict and occupational turnover intent over a timeframe of 18 months, revealing that work-family conflict at Time 1 increased their turnover intent by Time 2 (Singh et al., 2018). This pattern of women compromising their career

choices for family could reflect a shift in priorities due to increasing family demands. A long-term longitudinal study that followed mathematically precocious participants from ages 25 to 35 (in 1992 and 2003), found that mothers placed increased importance on a flexible work schedule, limited work hours, and available weekends compared to fathers, or women and men without children (Ferriman et al., 2009).

The desire for a family-flexible job could lead women to opt out from mathematical occupational aspirations even early on. Women tended to switch their initial male-typed occupational aspirations (e.g., pilots, engineers, lawyers, computer scientists) to female-dominated or gender-neutral aspirations due to the desire for a family-flexible job. These findings were from the U.S. Michigan Study of Adolescent and Adult Life Transitions (MSALT) study of grade 12 high school girls until 7 years later (1990 to 1997). Occupations were coded as male-dominated, neutral or female-dominated based on the gender proportion per occupation according to the 1990 U.S. Census (≤ 30% women coded as male-dominated; 31-69% women coded as neutral; ≥ 70% coded as female-dominated; Frome et al., 2006). Although the study provides insight to the long-term impact of starting a family on women's male-typed career choices, male-typed occupational aspirations analysed were not specific to mathematics, and perceptions of male-typed occupations at the time may no longer apply in the same way today. Some of the male-typed occupations included were dentist, doctor, lawyer, veterinarian and writer, which may be viewed as gender-neutral or even female-dominated today. In addition, only women were examined so no gender comparisons were made.

Although studies have documented the negative impact of family obligations on women pursuing mathematical careers, not many longitudinal studies have captured women's and men's mathematical career choices before and after the age of parenthood to answer the research question: how does starting a family impact whether individuals follow their adolescent mathematics-related career aspirations to career entry, and is this effect different for women compared to men? In addressing this question, it is important to control for level of mathematical achievement, on which meta-analyses show girls and boys generally perform similarly (e.g., Else-Quest et al., 2010 cross-nationally; Hyde et al., 1990 among Australian, Canadian and U.S. studies; Lindberg et al., 2010 among U.S. studies).

Since then, changes in contemporary society including increased government and employer support for working mothers have prompted the need for research utilising contemporary data. Although in Australia, government and employer support for working mothers has increased through the 2011 paid parental leave scheme (Australian Government Department of Human Services, 2019), others have recently highlighted that greater maternity leave entitlement for women than men may reinforce traditional divisions of labour (Perales et al., 2018), and organisational family-friendly policies may result in lower lifetime earnings and missed opportunities for career advancement especially for women (Schlenker, 2015; Villablanca et al., 2011; Williams et al., 2013). As such, the current study aims to provide contemporary long-term evidence on whether women's mathematical career trajectories were impacted by parenthood, and how this might be different for men.

The current study

To examine how parenthood could affect mathematics-related career choices for women and men, and the potential role of traditional gender role beliefs in mediating that relationship, our study drew on contemporary longitudinal Australian data from the Study of Transitions and Education Pathways Study (STEPS; see www.stepsstudy.org) that followed participants through secondary school until mid-30s years of age. The dataset captured participants' mathematics achievement and mathematics-related career aspirations in secondary school; and parenthood status, traditional gender role beliefs, and actual career in adulthood. Based on the literature reviewed, we proposed and tested four hypotheses, in each case controlling for prior mathematics achievement:

H1) women would aspire to and subsequently pursue less mathematically-intensive careers than men;
H2) women who had children would pursue less mathematically related careers than those they had aspired to in secondary school, but this effect would not be present for men;
H3) women without children may least endorse traditional gender role beliefs among the gender × parenthood groups and conversely, men with children endorse the most;
H4) traditional gender role beliefs may mediate relations between gender × parenthood, and mathematical career trajectory.

METHOD

Participants and Procedure

Participants (N = 300; n = 168 / 56% women) were from the Study of Transitions and Education Pathways Study (STEPS; see www.stepsstudy.org) who were retained from adolescence until adulthood and responded to the questions regarding aspired (T1) and actual mathematical careers (T2), and parenthood status (T2) (i.e., 300 of the retained 376 study participants). The T2 adulthood survey occurred 2015-2019, approximately 20 years after participants' latest timepoint during secondary school in 1998, at grade 9, 10, or 11 for sequential cohorts. At Time 2, participants' ages ranged from 31 to 37 years (M = 33.35, SD = 1.03). The overall retention rate (27.5% of the initial 1,367 adolescent participants) was similar to other long-term longitudinal studies (e.g., 25.7% retention rate after 30 years in the Michigan Study of Adolescent and Adult Life Transitions [MSALT]; see Eccles et al., 1989; Dicke et al., 2019). Compared with the initial attrited sample (n = 991) and other retained participants (n = 76) (see Appendix A), participants in the present study contained a higher proportion of women and participants who had higher mathematical achievement scores in secondary school, but did not differ on the mathematics-relatedness of their aspired careers during adolescence.

Participants were initially from three government upper-middle class coeducational secondary schools in metropolitan Sydney, Australia, matched on socioeconomic status based on the Index of Education and Occupation from census data (Australian Bureau of Statistics, 1991). Informed parent/guardian consent was obtained during participants' secondary schooling, and informed participant consent at the adulthood follow-up. Self-report surveys at T1 were administered in regular classtime by the second author and two trained assistants. The T2 adulthood survey was conducted online using the Qualtrics platform.

Table 1
Participants' Demographic Background Information

	n (%)
Home Language	
English	241 (80.3%)
Asian	25 (8.3%)
European	7 (2.3%)
Middle Eastern	6 (2.0%)
Missing data	21 (7.0%)
Birth Country	
Australia/New Zealand/United States/United Kingdom	227 (75.7%)
Asia	35 (11.7%)
Europe	8 (2.7%)
Middle East	5 (1.7%)
Africa	5 (1.7%)
South America	1 (0.3%)
Missing data	19 (6.3%)
Mother/Female Guardian's Birth Country	
Australia/New Zealand/United Stated/United Kingdom	191 (63.7%)
Asia	48 (16%)
Europe	19 (6.3%)
Middle East	12 (4.0%)
Africa	7 (2.3%)
South America	2 (0.7%)
Missing data	21 (7.0%)
Father/Male Guardian's Birth Country	
Australia/New Zealand/United Stated/United Kingdom	190 (63.3%)
Asia	43 (14.3%)
Europe	19 (6.3%)
Middle East	11 (3.7%)
Africa	7 (2.3%)
South America	3 (1.0%)
Missing data	27 (9.0%)
Mother's Education Level	
University	142 (47.3%)
High School	68 (22.7%)
Part High School	42 (14.0%)
Vocational School/College	12 (4.0%)
No High School	0 (0.0%)
Missing data	36 (12.0%)
Father's Education Level	
University	165 (55.0%)
High School	57 (19.0%)
Part High School	27 (9.0%)
No High School	2 (0.7%)
Vocational School/College	1 (0.3)
Missing data	48 (16.0%)

Demographic background information included language spoken at home, country of birth, parents' countries of birth and highest education level. Table 1 presents demographic characteristics for participants of the present study. More than 75% were born in Australia or culturally similar countries (i.e., New Zealand, United States, United Kingdom); Asian countries was the second largest group at 11.7%. The same pattern was reflected by mothers' and fathers' birth countries. Language spoken at home was predominantly English (80.3%); Asian languages formed the second largest group (8.3%). Approximately half of mothers and fathers held a university degree as their highest level of education; high school was the next largest category (22.7% of mothers, 19.0% of fathers).

Measures

Demographic information. Participants provided their date of birth and gender at both timepoints. During secondary school (T1) participants reported their home language and birth country, and parents' birth countries and highest levels of education.

Prior mathematical achievement background ('prior achievement'). Mathematical achievement was assessed in grade 9 by an age-appropriate timed multiple-choice standardised Progressive Achievement Test (PAT; Form 2B) developed by the Australian Council for Educational Research (ACER, 1984). The test involved 57 questions across the topics of computation, fractions, logics and sets, measurement and money, numbers, statistics and graphs, and spatial relations. Alternate items were selected to fit within 20 minutes and administered during regular classtime under test conditions, resulting in a reliable 28-item assessment (α = .81 among participants in the present study).

Aspired mathematical careers. At participants' latest secondary school timepoint (grade 9, 10 or 11 for sequential cohorts in 1998), participants responded to an open-ended question "What career are you mainly considering for your future?". The mathematics-relatedness of their career intentions was quantified using the U.S. occupational coding system O*NET™ 98: The Occupational Information Network (U.S. Department of Labor Employment and Training Administration, 1998). Participants' open-ended responses were matched to job titles in the database by the second author, which quantified their mathematics-relatedness from 0 (none), 1 (low), 2 (average) up to 3 (high). Examples of jobs in the category for '0' included childcare, handyman and law; '1' included carpenter, police and salesperson; '2' included management, medical doctor and teacher; and '3' included astronomy, engineering and accountancy.

Gender × parenthood groups. Participants reported parenthood status at T2 by selecting "yes", "no" or "expecting first child", in response to the question "Do you have any children?". The answers "yes" and "expecting first child" were coded as '1' to indicate parenthood, "no" was coded as '0'. Gender × parenthood groups were formed by crossing this with gender to create four groups: women with children, men with children, women without children, men without children.

Traditional gender role beliefs. Endorsement of traditional gender role beliefs was measured at T2 using 3 items from the 'Beliefs about Family Life' scale used in the Childhood and Beyond study (CAB; see Dicke et al., 2019), measured by

7-point scales from 1: strongly disagree, 4: neutral, 7: strongly agree (the original CAB items used 5-point scales). Participants were asked "What is your opinion on each of the following statements?": "Children are better off if their mothers don't have demanding jobs", "Preschool children are likely to suffer if their mothers work outside of the home" and "It is usually better for everyone involved if the man is the achiever outside the home and the woman takes care of the home and family" (α = .81).

Actual mathematical careers. Participants' current occupation (or most recent, for 18 participants not currently working) was ascertained through an open-ended question at T2. Mathematics-relatedness of current or most recent occupation was coded by 4 trained research assistants; 2 coded all occupations while the other 2 coded portions each. In this way, there were 3 coders for each occupation, one of whom was the first author. As at T1, coders matched participants' responses with occupational titles in O*NET™ (2019) on a 101-point scale from 0-100. Of all coded occupations, 79% were coded the same by the 3 coders. The remaining 21% of occupation codes were negotiated among the relevant coders and consensus was reached for all. Examples of nominated careers included actor, lawyer, orderly, graphic designer (with low mathematical scores of 8–46); human resource manager, medical doctor, sociologist (47–71); and actuary, astronomer, physicist, engineer (72–97).

Analytical Approach

Missing data. Low proportions of data were missing for traditional gender role beliefs (6.67%) and grade 9 mathematics achievement score (9.67%). Because Little's missing completely at random (MCAR) test delivered a significant *p*-value (χ^2 = 11.50, df = 2, p = .003), missing data were handled using hot deck imputation (Myers, 2011). Relative to other methods, this was the most statistically appropriate and robust approach (e.g., Hawthorne & Elliot, 2005; Roth, 1994); multiple imputation is not suitable for mixed ANCOVA (see van Ginkel & Kroonenberg, 2014).

Gender × parenthood effects. Gender × parenthood groups were compared on the covariates – traditional gender role beliefs and prior achievement – using multivariate analysis of variance (MANOVA). Repeated-measures ANOVA compared mathematics-related career trajectories (*z*-scores of T1 aspired and T2 actual mathematics-related careers) for gender × parenthood groups. Repeated-measures ANCOVA subsequently included prior achievement as a covariate. The potential mediating role of traditional gender role beliefs in the relationship between gender × parenthood and mathematics-related career trajectory was next tested by adding traditional gender role beliefs as a second covariate, comparing potential differences in results due to its inclusion. All analyses were conducted using SPSS Statistics 28 software.

RESULTS

Presentation of results commences with the MANOVA comparing gender × parenthood groups on traditional gender role beliefs and prior achievement, followed by the initial repeated measures ANOVA and subsequent ANCOVAs.

Gender × parenthood differences in traditional gender role beliefs and prior achievement

MANOVA revealed a significant difference among the gender × parenthood groups on the combined dependent variables of traditional gender role beliefs and prior achievement ($F(6,590) = 2.21$, $p = .041$, Wilk's $\Lambda = 0.957$, $\eta_p^2 = .022$), accounted for by a significant univariate effect on traditional gender role beliefs ($F(3,296) = 4.25$, $p = .006$, $\eta_p^2 = .041$) but not prior achievement ($F(3,296) = .23$, $p = .875$, $\eta_p^2 = .002$). Tukey's post hoc tests indicated that, on average, men with children ($M = 3.71$ $SD = 1.45$) were more likely to endorse traditional gender role beliefs than women without children ($M = 2.81$ $SD = 1.60$) ($p = .003$). Other groups scored in between and did not significantly differ (see Table 2 for descriptive statistics on all variables; Table 3 for associations between main study constructs for men/women).

Gender × parenthood effects on mathematical career trajectory

An initial repeated-measures ANOVA, with gender and parenthood as between-subjects and mathematical career choice as within-subjects factors, revealed a significant three-way interaction between mathematical career trajectory, gender, and parenthood ($F(1,296) = 4.38$, $p = .037$, Wilk's $\Lambda = 0.985$, $\eta_p^2 = .015$) (see Figure 1a). There were no significant two-way interactions between gender and parenthood for aspired ($F(1,296) = 2.56$, $p = .111$, $\eta_p^2 = .009$) or actual mathematical careers ($F(1,296) = 1.54$, $p = .215$, $\eta_p^2 = .005$), nor between mathematics career trajectory and gender ($F(1,296) = .20$, $p = .659$, $\eta_p^2 = .001$) or parenthood ($F(1,296) = .36$, $p = .551$, $\eta_p^2 = .001$). There was a significant main effect of gender ($F(1,296) = 32.24$, $p < .001$, $\eta_p^2 = .098$) indicating that boys'/men's mathematical career choices ($EM = .26$, $SE = .06$) were higher than girls'/women's ($EM = -.21$, $SE = .06$). Separate repeated-measures ANOVAs were conducted for each gender × parenthood group to further probe the relationships of interest; none showed a significant change in mathematics-relatedness of career choice although the increase for women without children approached significance with a moderate effect size ($F(1,82) = 2.96$, $p = .089$, $\eta_p^2 = .035$; secondary school $M = -.34$, $SD = .88$; adulthood $M = -.10$, $SD = 1.01$).

Gender × parenthood effects on mathematical career trajectory controlling for prior achievement

A repeated measures ANCOVA added prior achievement as a covariate, which explained significant ($F(1,295) = 8.03$, $p = .005$, $\eta_p^2 = .027$) variance in mathematical career trajectory (correlations are reported in Table 3). Other results were similar to those of the preceding repeated measures ANOVA: a) a significant three-way interaction between mathematical career trajectory, gender, and parenthood ($F(1,295) = 4.43$, $p = .036$, Wilk's $\Lambda = 0.985$, $\eta_p^2 = .015$) (see Figure 1b); b) no significant two-way interactions between gender and parenthood for aspired ($F(1,295) = 2.79$, $p = .096$, $\eta_p^2 = .009$) or actual mathematical careers ($F(1,295) = 1.47$, $p = .227$, $\eta_p^2 = .005$), or between mathematics career trajectory and gender ($F(1,295) = .22$, $p = .640$, $\eta_p^2 = .001$) or parenthood ($F(1,295) = .34$, $p = .559$, $\eta_p^2 = .001$); c) a significant main effect of gender ($F(1,295) = 34.27$, $p < .001$, $\eta_p^2 = .104$) where boys/men ($EM = .27$, $SE = .06$) had more mathematical career choices than girls/women ($EM = -.21$, $SE = .06$). Separate repeated-measures ANCOVAs again showed the increase in mathematical career choice for women without children was not significant but approached significance with a moderate effect size ($F(1,81) =$

Table 2
Descriptive Statistics for all Variables

		T1 aspired mathematical careers (raw scores)[a]	T2 actual mathematical careers (raw scores)[b]	T1 aspired mathematical careers (*z*-scores)	T2 actual mathematical careers (*z*-scores)	T1 prior achievement[c]	T2 traditional gender role beliefs[d]
	n	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
Gender							
Girls/women	168	1.07 (0.97)	51.01 (15.05)	-.22 (0.93)	-.19 (0.92)	21.90 (4.63)	3.02 (1.68)
Boys/men	132	1.60 (1.08)	58.14 (16.97)	.28 (1.02)	.25 (1.04)	21.51 (5.17)	3.53 (1.37)
Parenthood							
Children	149	1.34 (1.04)	53.64 (15.38)	.03 (0.99)	-.03 (0.94)	21.81 (4.68)	3.43 (1.64)
No children	151	1.26 (1.07)	54.65 (17.17)	-.03 (1.01)	.03 (1.05)	21.66 (5.06)	3.05 (1.48)
Gender × parenthood groups							
Women with children	85	1.19 (1.01)	49.59 (13.48)	-.11 (0.96)	-.28 (0.83)	21.88 (4.50)	3.22 (1.74)
Men with children	64	1.53 (1.05)	59.03 (16.18)	.22 (1.00)	.30 (0.99)	21.70 (4.95)	3.71 (1.45)
Women without children	83	0.94 (0.93)	52.47 (16.47)	-.34 (0.88)	-.10 (1.01)	21.93 (4.79)	2.81 (1.60)
Men without children	68	1.66 (1.10)	57.31 (17.76)	.34 (1.05)	.19 (1.09)	21.32 (5.39)	3.35 (1.28)

Note. [a] scored 0-3; [b] scored 0-100; [c] scored 0-28; [d] rated 1: 'strongly disagree', 4: 'neutral', 7: 'strongly agree'.

2.94, p = .090, η_p^2 = .035; secondary school *EM* = -.34, *SE* = .10; adulthood *EM* = -.10, *SE* = .11).

Table 3
Correlations Among Key Study Constructs for Males/Females

	T1 aspired mathematical careers (*z*-scores)	T2 actual mathematical careers (*z*-scores)	T1 prior achievement
T1 aspired mathematical careers (*z*-scores)	-		
T2 actual mathematical careers (*z*-scores)	.04 / .11	-	
T1 prior achievement	.20* / .10	.09 / .10	-
T2 traditional gender role beliefs	-.11 / .04	.06 / .06	.05 / -.04

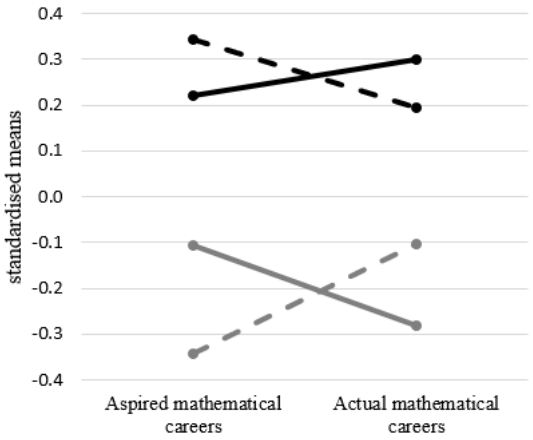
Note. *p < .05.

The role of traditional gender role beliefs in gender × parenthood mathematical career trajectories

A next repeated-measures ANCOVA added traditional gender role beliefs to prior achievement as a second covariate. Results showed that traditional gender role beliefs did not explain significant variance in mathematical career trajectory (F(1,294) = .18, p = .674, η_p^2 = .001). Other results were similar to the preceding analysis: a) a significant three-way interaction between mathematical career trajectory, gender, and parenthood (F(1,294) = 4.48, p = .035, Wilk's Λ = 0.985, η_p^2 = .015) (see Figure 1c); b) no significant two-way interactions between gender and parenthood for aspired (F(1,294) = 2.80, p = .096, η_p^2 = .009) or actual mathematical careers (F(1,294) = 1.49, p = .224, η_p^2 = .005), or between mathematics career trajectory and gender (F(1,294) = .44, p = .508, η_p^2 = .001) or parenthood (F(1,294) = .54, p = .464, η_p^2 = .002); c) a significant main effect of gender (F(1,294) = 34.47, p < .001, η_p^2 = .099) showing boys'/men's (*EM* = .27, *SE* = .06) higher mathematical career choices than girls'/women's (*EM* = -.21, *SE* = .06); and d) prior achievement was a significant covariate (F(1,294) = 8.02, p = .005, η_p^2 = .027). Separate repeated-measures ANCOVAs still showed a near-significant increase in mathematical career choice for women without children with a moderate effect size (F(1,80) = 2.93, p = .091, η_p^2 = .035; secondary school *EM* = -.34, *SE* = .10; adulthood *EM* = -.10, *SE* = .11). As there were no meaningful differences comparing these results with preceding analyses, there was no support for traditional gender role beliefs as a mediator of relations between gender, parenthood and mathematical career trajectory.

Figure 1a

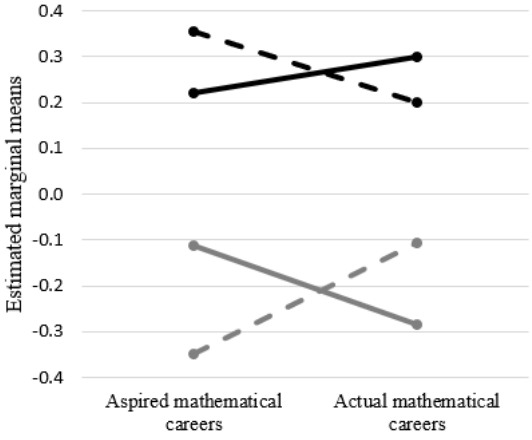
Gender × Parenthood Effects on Aspired and Actual Mathematical Careers.



Note. Standardised aspired and actual mathematical career scores.

Figure 1b

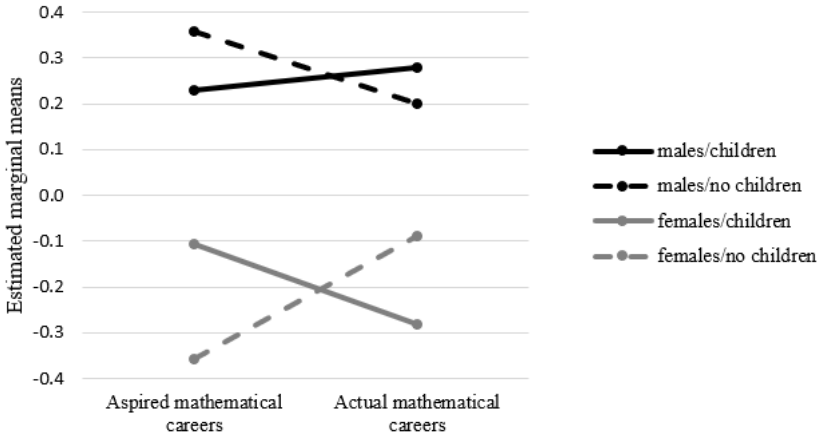
Gender × Parenthood Effects on Aspired and Actual Mathematical Careers Controlling for Prior Achievement.



Note. Standardised estimated marginal means controlling for prior achievement.

Figure 1c

Gender × Parenthood Effects on Aspired and Actual Mathematical Careers Controlling for Prior Achievement and Traditional Gender Role Beliefs.



Note. Standardised estimated marginal means controlling for prior achievement and traditional gender role beliefs.

DISCUSSION

Our long-term investigation of women's and men's mathematical career choices over the timespan of approximately 20 years (secondary school until mid-30's years of age) enabled us to discern their different mathematical career trajectories using contemporary data. We set out to examine how parenthood could affect mathematics-related career choices (aspired mathematical careers in adolescence; actual careers in adulthood) for women and men over and above the effects of prior achievement, using longitudinal data. Additionally, we explored whether traditional gender role beliefs would mediate these relations. Our hypotheses were that women would aspire to and subsequently pursue less mathematically-intensive careers than men; women who had children would pursue less mathematically related careers than those they had aspired to in secondary school; women without children may least endorse traditional gender role beliefs and conversely men with children the most; and traditional gender role beliefs may mediate relations between gender × parenthood and mathematical career trajectory.

We note that scientific conclusions should not depend solely on crossing a particular *p*-value threshold but along with the effect size to better indicate strength and robustness (American Statistical Association: Wasserstein & Lazar, 2016). While the change in mathematical career trajectory for women without children did not meet the threshold of $p \leq .05$, effect sizes are considered 'moderate' (Cohen, 1988). Taking these together and in light of the extended timeframe, we consider these effects deserving of further investigation.

Counter to our hypotheses, women who had children did not stand out as showing decreased mathematics-relatedness in their actual versus aspired career choice. Although mathematical career choices of women with children did not significantly differ at either timepoint from women who did not have children, it was only the latter group whose trajectory trended to increase, but was not explained by traditional gender role beliefs. Perhaps the 'chilly climate' was less of an issue for women who did not have children. This finding corroborates previous findings that show women in mathematical STEM careers were less likely to be mothers (Blackwell & Glover, 2008). Regardless of traditional gender role beliefs, gendered structures such as greater parental leave for women than men (Australian Government Department of Human Services, 2019) may reinforce traditional divisions of labour (Perales et al., 2018) and influence career choices (Barth et al., 2015; Burge, 2013). That is, even if women do not subscribe to traditional gender role beliefs, gender role stereotypes embedded in societal structures such as working conditions may steer them away from mathematical careers.

Overall, men had higher mathematics-related career choices than women, despite similar prior achievement. This finding supported our hypothesis and echoes previous findings that highlight women's lower mathematical participation compared to men (e.g., Chen & Ho, 2012; National Science Foundation, 2017 in the U.S. and Department of Education and Training, 2018 in Australia), which was the impetus for our study. Our findings showed that men who had children were more likely to endorse traditional gender beliefs than women without children (supporting hypothesis H3). This replicates previous findings that individuals with children endorsed more traditional gender role beliefs than those without (e.g., Perales et al., 2018), particularly for men –

since traditional gender role beliefs work to their advantage compared to women (e.g., Blakemore et al., 2005; Friedman & Weissbrod 2005).

However, counter to our expectations and central hypothesis, traditional gender role beliefs did not mediate the relationships between gender × parenthood and mathematical career trajectory. We should point out that on average, all four gender × parenthood groups disagreed with traditional gender role beliefs, with average ratings below 4 ('neutral' on a 1 'strongly disagree' to 7 'strongly agree' scale), which might explain why traditional gender role beliefs did not explain variance in mathematical trajectories. Previous research based on older data suggested that traditional gender role beliefs influenced women's mathematical career choices (e.g., Dicke et al., 2019). Perhaps older data, or data from different populations or demographics, may show stronger agreement with traditional gender role beliefs, and our contemporary data may reflect a shift away from such beliefs to explain the difference in findings. Only prior achievement emerged as a significant covariate in subsequent ANCOVA models, explaining variance in mathematical career trajectories such that individuals with higher prior achievement were more likely to choose mathematics-related careers.

Practical Implications

Parenthood has long impacted women's career choice (e.g., Weisgram & Diekman, 2017; Wilkins & Lass, 2018), as has the endorsement of traditional gender role beliefs (e.g., Dicke et al., 2019). Although in our study we found that women without children disagreed most with traditional gender role beliefs (on which men with children scored highest), we did not find supporting evidence that traditional gender role beliefs explained the relationship between gender × parenthood and mathematical career trajectories. Trends in the data brought positive news such as women who had children were achieving mathematical careers they previously aspired to, and women without children were attaining careers that were more mathematical than those they had aspired to in adolescence. In addition, our contemporary data suggest a possible shift away from traditional gender role beliefs, perhaps explaining why they did not explain relations between gender x parenthood groups and mathematical career choice trajectories.

However, more work is needed to support women's mathematical aspirations and improve workplace environments, considering that men are still more likely to aspire to and succeed in mathematical careers than women. Policymakers, educators and employers should continue to work towards creating more gender equitable environments in mathematical industries. For example, politicians and employers can work towards an extended and mandated paid parental leave for fathers/spouses, which may encourage and normalise men to be more involved with parenting responsibilities and domestic labour. Mathematics-related industries could also provide greater support for mothers by providing free childcare and family-flexible arrangements. Educators could raise awareness of these initiatives to girls interested and capable in mathematics, to change perspectives on the compatibility of mathematical occupations and starting a family. To create a stronger and more gender equitable mathematics-intensive STEM workforce, policymakers, employers, and educators must continue to advance and promote family-friendly initiatives that support women's mathematical career choices and career success.

Limitations and Future Research Directions

Further studies that span a similarly long timeframe are needed to examine other potential explanations for choices away from mathematical careers, by women who had earlier aspired towards them. Although the current study takes steps in this direction, these findings would need to be replicated by further studies utilising contemporary data, together with additional potential explanations. Like all studies, our study had limitations that should be taken into consideration when interpreting the findings. First, women who did not have children in the sample may have been planning to start a family and thus have factored in the responsibilities of parenthood to their career choices. This might be the case particularly for women from higher socioeconomic backgrounds who tend to have children a little later, in their mid to late 30's (van Roode et al., 2017). To capture a more accurate picture of the impact of parenthood on women's career choices, future studies could gather data at several timepoints with an extended timeframe on individuals' plans to start a family.

Second, low proportions of data (< 7% for traditional gender role beliefs and 10% for prior achievement) were not missing completely at random. Fortunately, proportions of data that were missing for retained participants were quite low despite the timeframe, and therefore unlikely to bias results to a large extent. Third, partners' careers and gender role beliefs were not included, which may play an important role in career trajectories. Fourth, there was not much variance in traditional gender role beliefs within the sample, possibly because they were recruited initially from upper-middle class secondary schools, which made it difficult to examine the impact of holding strong traditional gender role beliefs. Finally, our study participants were not mainly females who aspired to highly mathematical careers in adolescence. Future studies could target mathematically-gifted samples of adolescents who are aspiring to mathematical careers, to enable concentrated testing of the intersection of later parenthood with traditional gender role beliefs in potentially influencing such women to opt out of their earlier career aspirations in adulthood.

To better understand women's lower representation than men's in mathematical careers, our key study contributions lie in detecting a shift away from traditional gender role beliefs using contemporary data, and identifying the trend for mathematical career trajectories to increase, among women without children. Further longitudinal studies are required to replicate these findings especially among mathematically motivated and capable women and men who may exhibit greater diversity in their traditional gender role beliefs.

AUTHOR NOTE

Lili Toh https://orcid.org/0000-0002-1329-1076
Helen Watt https://orcid.org/0000-0003-2026-0849

We have no conflict of interest to disclose. The STEPS study (Study of Transitions and Education Pathways; www.stepsstudy.org) was supported by Australian Research Council grants ARF/DP110100472 (2011-2015) and FT170100153 (2017-2021) to Watt, which supported Toh's doctoral scholarship and development of this manuscript. Please direct correspondence to Lili Toh and Helen Watt: School of Education and Social Work, Building A35 Manning Road, The University of Sydney, NSW 2006 Australia. Watt additionally holds an Honorary Professorship at Monash University. E: ltoh7188@uni.sydney.edu.au, helen.watt@sydney.edu.au .

REFERENCES

Abele, A., & Spurk, D. (2011). The dual impact of gender and the influence of timing of parenthood on men's and women's career development: Longitudinal findings. *International Journal of Behavioral Development, 35*(3), 225–232. https://doi.org/10.1177/0165025411398181

Australian Government Department of Human Services. (2019). *How much you can receive.* https://www.humanservices.gov.au/individuals/services/centrelink/parental-leave-pay/payment-rates/how-much-you-can-receive

Baumgardner, J. (2011). *Fem: Goo Goo, Gaga and Some Thoughts on Balls*. Perseus Book Group.

Barth, J., Guadagno, R., Rice, L., Eno, C., & Minney, J. (2015). Untangling life goals and occupational stereotypes in men's and women's career interest. *Sex Roles, 73(*11-12), 502–518. https://doi.org/10.1007/s11199-015-0537-2

Berardo, D., Shehan, C., & Leslie, G. (1987). A residue of tradition: Jobs, careers, and spouses' time in housework. *Journal of Marriage and Family, 49*(2), 381–390. https://doi.org/10.2307/352307

Bernard, J. (1972). *The future of marriage*. Basic Books.

Bianchi, S. M., Milkie, M. A., Sayer, L. C., & Robinson, J. P. (2000). Is anyone doing the housework? Trends in the gender division of household labor. *Social Forces, 79*, 191–228.

Blackwell, L., & Glover, J. (2008). Women's scientific employment and family formation: A longitudinal perspective. *Gender, Work & Organization, 15*(6), 579–599. https://doi.org/10.1111/j.1468-0432.2007.00385.x

Blakemore, J., Lawton, C., & Vartanian, L. (2005). I can't wait to get married: Gender differences in drive to marry. *Sex Roles, 53*(5-6), 327–335. https://doi.org/10.1007/s11199-005-6756-1

Burge, S. (2013). Cohort changes in the relationship between adolescents' family attitudes, STEM intentions and attainment. *Sociological Perspectives, 56*(1), 49–73. https://doi.org/10.1525/sop.2012.56.1.49

Brown, E. R., & Diekman, A. B. (2010). What will I be? Exploring gender differences in near and distant possible selves. *Sex Roles, 63*, 568–79.

Chen, X., & Ho, P. (2012). *STEM in postsecondary education: Entrance, attrition, and coursetaking among 2003–04 beginning postsecondary students (NCES 2013-152).* National Center for Education Statistics.

Clarkberg, M., & Moen, P. (2001). Understanding the time-squeeze: Married couples' preferred and actual work-hour strategies. *American Behavioral Scientist, 44*(7), 1115-1136.

Curry, C., Trew, K., Turner, I., & Hunter, J. (1994). The effect of life domains on girls' possible selves. *Adolescence, 29*, 133–50.

Department of Education and Training. (2018). uCube. http://highereducationstatistics.education.gov.au/

Dicke, A.-L., Safavian, N., & Eccles, J. S. (2019). Traditional gender role beliefs and career attainment in STEM: A gendered story? *Frontiers in Psychology, 10*(1053), 1-14. https://doi.org/10.3389/fpsyg.2019.010530

Eagly, A. H. (1987). *Sex differences in social behavior: A social-role interpretation*. Hillsdale: Erlbaum.

Eagly, A. H., Wood, W., & Diekman, A. B. (2000). Social role theory of sex differences and similarities: A current appraisal. In T. Eckes & H. M. Trautner

(Eds.), *The developmental social psychology of gender* (pp. 123–174). Lawrence Erlbaum Associates Publishers.
Eccles, J. S. (1987). Gender roles and women's achievement-related decisions. *Psychology of Women Quarterly, 11*, 135-172.
Else-Quest, N., Hyde, J. S., & Linn, M. (2010). Cross-national patterns of gender differences in mathematics: A meta-analysis. *Psychological Bulletin, 136*(1), 103–127. https://doi.org/10.1037/a0018053
Erdamar, G., & Demirel, H. (2014). Investigation of work-family, family-work conflict of the teachers. *Social and Behavioral Sciences, 116*, 4919–4924.
Ferriman, K., Lubinski, D., & Benbow, C. P. (2009). Work preferences, life values, and personal views of top math/science graduate students and the profoundly gifted: Developmental changes and gender differences during emerging adulthood and parenthood. *Journal of Personality and Social Psychology, 97*(3), 517. https://doi.org/10.1037/a0016030
Fouad, N., Fitzpatrick, M., & Liu, J. P. (2011). Persistence of women in engineering careers: A qualitative study of current and former female engineers. *Journal of Women and Minorities in Science and Engineering, 17*(1), 69-96.
Friedan, B. (1966). *The feminine mystique.* Harmondsworth: Penguin Books.
Friedman, S. R., & Weissbrod, C. S. (2005). Work and family commitment and decision-making status among emerging adults. *Sex Roles, 53*, 317–25.
Frome, P., Alfeld, C. J., Eccles, J. S., & Barber, B. L. (2006). Why don't they want a male-dominated job? An investigation of young women who changed their occupational aspirations. *Educational Research and Evaluation, 12*(4), 359-372. https://doi.org/ 10.1080/13803610600765786
Grandey, A. A., & Cropanzano, R. (1999). The conservation of resources model applied to work–family conflict and strain. *Journal of Vocational Behavior, 54*, 350–370.
Greenhaus, J. H., & Beutell, N. J. (1985). Sources of conflict between work and family roles. *Academy of Management Review, 10*, 76–88.
Greenhaus, J. H., Collins, K. M., Singh, R., & Parasuraman, S. (1997). Work and family influences on departure from public accounting. *Journal of Vocational Behaviour, 50*, 249–270.
Greenhaus, J. H., Parasuraman, S., & Collins, K. M. (2001). Career involvement and family involvement as moderators of relationships between work-family conflict and withdrawal from a profession. *Journal of Occupational Health Psychology, 6*(2), 91–100.
Greenstein, T. N. (1996). Husbands' participation in domestic labor: Interactive effects of wives' and husbands' gender ideologies. *Journal of Marriage and the Family, 58*, 585–95.
Hall, R. M., & Sandler, B. R. (1982). *The classroom climate: A chilly one for women?* Association of American Colleges.
Hammer, L. B., Bauer, T. N., & Grandey, A. A. (2003). Work–family conflict and work-related withdrawal behaviors. *Journal of Business and Psychology, 17*, 419–436.
Hawthorne, G., & Elliott, P. (2005). Imputing cross-sectional missing data: comparison of common techniques. *Australian and New Zealand Journal of Psychiatry, 39*(7), 583–590. https://doi.org/10.1111/j.1440-1614.2005.01630.x
Herman, C., Lewis, S., & Humbert, A. (2013). Women scientists and engineers in European companies: Putting motherhood under the microscope. *Gender,*

Work & Organization, 20(5), 467–478. https://doi.org/10.1111/j.1468-0432.2012.00596.x

Hewlett, S. A., Buck Luce, C., Servon, L. J., Sherbin, L., Shiller, P., Sosnovich, E., & Sumberg, K. (2008). *The Athena factor: Reversing the brain drain in science, engineering, and technology (Harvard Business Review Research Report).* Harvard Business Publishing.

Hobfoll, S. E., Freedy, J., Lane, C., & Geller, P. (1990). Conservation of social resources: Social support resource theory. *Journal of Social and Personal Relationships, 7*(4), 465–478.

Hochschild, A., & Machung, A. (1989). *The second shift: Working parents and the revolution at home.* Viking.

Hoffnung, M., & Williams, M. (2013). Balancing act: Career and family during college-educated women's 30s. *Sex Roles, 68*(5-6), 321-334. https://doi.org/10.1007/s11199-012-0248-x

Holland, J. L. (1985). *Making vocational choices: A theory of vocational personalities and work environments.* Prentice Hall

Hyde, J. S., Fennema, E., & Lamon, S. J. (1990). Gender differences in mathematics performance: A meta-analysis. *Psychological Bulletin, 107,* 139-155.

Irving, Z. (2008). Gender and work. In D. Richardson & V. Robinson (Eds.), *Introducing gender and women's studies*. Macmillan.

Jean, V. A., Payne, S. C., & Thompson, R. J. (2015). Women in STEM: Family-related challenges and initiatives. In M. J. Mills (Ed.), *Gender and the work-family experience: An intersection of two domains* (pp. 291-311). Springer International Publishing. https://doi.org/10.1007/978-3-319-08891-4_15

Johnstone, M., Lucke, J., & Lee, C. (2011). Influences of marriage, motherhood, and other life events on Australian women's employment aspirations. *Psychology of Women Quarterly, 35*(2), 267-281. https://doi.org/10.1177/0361684310388502

Lindberg, S. M., Hyde, J. S., Petersen, J., & Linn, M. C. (2010). New trends in gender and mathematics performance: A meta-analysis. *Psychological Bulletin, 136,* 1123–1135. https://doi.org/10.1037/a0021276.

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*(12), 2217–2232. https://doi.org/10.1177/0956797614551371

Munro, E. (2013). Feminism: A fourth wave? *Political Insight, 4*(2), 22–25. https://doi.org/10.1111/2041-9066.12021

Myers, T. A. (2011). Goodbye, listwise deletion: Presenting hot deck imputation as an easy and effective tool for handling missing data. *Communication methods and measures, 5*(4), 297–310. https://doi.org/10.1080/19312458.2011.624490

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

Perales, F., Jarallah, Y. & Baxter, J. (2018). Men's and women's gender-role attitudes across the transition to parenthood: accounting for child's gender. *Social Forces, 97*(1), 251.

Roth, P. L. (1994). Missing data: A conceptual review for applied psychologists. *Personnel Psychology, 47*(3), 537-560. https://doi.org/10.1111/j.1744-6570.1994.tb01736.x

Sax, L. J., Lehman, K. J., Barthelemy, R. S., Lim, G., & Lim, G. (2016). Women in physics: A comparison to science, technology, engineering, and math education over four decades. *Physical Review Physics Education Research, 12*(2), 020108–1. https://doi.org/10.1103/PhysRevPhysEducRes.12.020108

Schlenker, E. (2015). The labour supply of women in STEM. *IZA Journal of European Labor Studies, 4*(1), 1-17. https://doi.org/10.1186/s40174-015-0034-1

Singh, R., Zhang, Y., Maggie Wan, M., & Fouad, N. (2018). Why do women engineers leave the engineering profession? The roles of work-family conflict, occupational commitment, and perceived organizational support. *Human Resource Management, 57*, 901-914. https://doi.org/10.1002/hrm.21900

Stage, F. K., & Maple, S. A. (1996). Incompatible goals: narratives of graduate women in the mathematics pipeline. *American Educational Research Journal, 33*(1), 23-51.

Tao, H. (2011). An empirical model on the fair and the second fair division of household labor. *Journal of Socio-Economics 40*(2), 141–149.

Thanacoody, P. R., Bartram, T., & Casimir, G. (2009). The effects of burnout and supervisory social support on the relationship between work-family conflict and intention to leave. *Journal of Health Organization and Management, 23*(1), 53–69.

Thoits, P. A. (1992). Identity structures and psychological well-being: Gender and marital status comparisons. *Social Psychology Quarterly, 55*, 236–256.

U.S. Department of Labor Employment and Training Administration. (1998). *O*NET Data Collection Program.* https://www.dol.gov/agencies/eta/onet/data-collection

van Ginkel, J. R., & Kroonenberg, P. M. (2014). Analysis of variance of multiply imputed data. *Multivariate Behavioral Research, 49*(1), 78–91. https://doi.org/10.1080/00273171.2013.855890

van Roode, T., Sharples, K., Dickson, N., & Paul, C. (2017). Life-course relationship between socioeconomic circumstances and timing of first birth in a birth cohort. *PloS one, 12*(1), e0170170–e0170170. https://doi.org/10.1371/journal.pone.0170170

Versey, H. S. (2015). Managing work and family: Do control strategies help? *Developmental Psychology, 51*(11), 1672-1681. https://doi.org/10.1037/a0039607

Villablanca, A. C., Beckett, L., Nettiksimmons, J., & Howell, L. P. (2011). Career flexibility and family-friendly policies: An NIH-funded study to enhance women's careers in biomedical sciences. *Journal of Women's Health, 20*, 1485–1496.

Voydanof, P. (2005). Work demands and work-to-family and family-to-work conflict: Direct and indirect relationships. *Journal of Family Issues, 26*(6), 707–726.

Ware, N. C., & Lee, V. E. (1988). Sex differences in choice of college science majors. *American Educational Research Journal, 25*, 593-614.

Weisgram, E. S., & Diekman, A. B. (2017). Making STEM "family friendly": The impact of perceiving science careers as family-compatible. *Social Sciences, 6*(2), 61-81. https://doi.org/10.3390/socsci6020061

Williams, J. C., Blair-Loy, M., & Berdahl, J. L. (2013). Cultural schemas, social class, and the flexibility stigma. *Journal of Social Issues, 69*, 209-234.

Williams, W. M., & Ceci, S. J. (2012). When scientists choose motherhood: a single factor goes a long way in explaining the dearth of women in math-

intensive fields. How can we address it? *American Scientist*, 100(2), 138-145. https://doi.org/10.1511/2012.95.138

Wilkins, R. & Lass, I. (2018) *The household, income and labour dynamics in Australia survey: Selected findings from waves 1 to 16*. Applied Economic & Social Research, University of Melbourne.

APPENDIX A

Longitudinal Study Sample Comparison with Initial Attrited Sample, Other Retained Sample and Included Sample

	Included sample *n* = 300	Other retained sample *n* = 76	T1 attrited sample *n* = 991			
	n (%)	*n* (%)	*n* (%)	χ^2	*df*	*p*
Gender				22.34	2	< .001
women	168 (56.00)	35 (46.10)	402 (40.60)			
men	132 (44.00)	41 (53.90)	589 (59.40)			
T1 factors	*M* (SD) (*n*)	*M* (SD) (*n*)	*M* (SD) (*n*)	*F*(2, 1138)		*p*
secondary school math career aspirations	1.30[a] (1.05) (*n* = 300)	1.29[a] (1.07) (*n* = 48)	1.31[a] (1.07) (*n* = 793)	.015		.985
	M (SD) (*n*)	*M* (SD) (*n*)	*M* (SD) (*n*)	*F*(2, 1143)		*p*
prior achievement	21.83[c] (4.73) (*n* = 271)	20.47[bc] (5.63) (*n* = 66)	19.94[b] (5.49) (*n* = 809)	12.879		< .001

Note. 'Included sample' were participants retained at follow-up who answered questions about key dependent variables: secondary school mathematical career aspirations, current or most recent occupation, and whether or not they had children. 'Other retained sample' were retained at follow-up but did not respond to the questions for the key variables. 'T1 attrited sample' were not retained at follow-up. *n*s for T1 factors reflect participants who responded to their secondary school mathematical career aspirations and completed the grade 9 mathematics achievement test. Matched superscripts indicate non-significant mean differences ($p < .05$, Tukey post hocs).