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(How) Does Gender Matter in the Choice of a STEM Teaching Career and Later Teaching Behaviours?

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ABSTRACT
We examine beginning women and men STEM (Science, Technology, and Mathematics) secondary teachers' initial motivations for choosing to teach, and subsequent reported teaching style during early career, among a sample recruited from four Australian teacher education programs during first year. Beginning STEM teachers (*N* = 245, 53% women at Time 1; *N* = 96, 58% women at Time 2) were compared with non-STEM teachers recruited from the same programs (*N* = 619, 70% women at Time 1; *N* = 258, 76% women at Time 2). Motivations were assessed using the FIT-Choice scale, and teaching style using the Teaching Style Scale. Gender differences in initial motivations appeared similar for women and men among STEM and non-STEM specialisms. More positive motivational profiles were evident for women than men, and for non-STEM than STEM teachers, with consequences for their reported teaching style during early career. Men and STEM teachers were more motivated than women and non-STEM teachers, to choose teaching as a fallback career. Our findings suggest implications to enhance effective efforts to recruit and support future STEM teachers who will be central to future students' STEM learning and engagement.

KEYWORDS
STEM teacher motivations; Teacher gender; Teaching style

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INTRODUCTION

In Australia and many other countries, there has been an enduring problem of attracting and sustaining sufficient numbers of high-quality and well-qualified STEM (Science, Technology, Engineering and Mathematics) teachers (OECD, 2005, 2011). A similarly pronounced lack of supply in STEM teachers has been evident for some time in a number of OECD countries (Lawrance & Palmer, 2003); a situation that is all the more concerning given the pressing need for STEM-related skills in the modern world, both in careers and everyday life. There are complex, intersecting explanations for why this problem is not easily addressed.

First, teachers who were recruited 40 years ago are now eligible to retire, exacerbating existing teacher shortages (MCEETYA, 2002; OECD, 2005, 2011). Half the teaching force in OECD countries in 2000 was aged over 40 (European Commission, 2000); in Australia in 2001 the median age of teachers was 43 years and 44% were older than 45 years (DEST, 2003). Second, competing high-status and salary career options available to STEM graduates mean it is difficult to replace retiring teachers; of those who study advanced STEM, relatively few wish to teach (McInnes, Hartley, & Anderson, 2001). Third, fewer individuals are pursuing STEM studies at all, and women drop out earlier and at a greater rate than men (Ainley, Kos, & Nicholas, 2008). Fourth, although teaching is a feminised profession, reliance upon a sufficient supply of suitably qualified women STEM teachers to meet projected shortfalls is optimistic, given women's lower representation in STEM studies and alternative career prospects for competitively achieving STEM graduates. Without proper planning and careful management to ensure the education system provides a sufficient flow of knowledge workers through the STEM "pipeline", Australia could find itself in a similar situation to Norway where some secondary schools can no longer offer science (Lyng & Blichfeldt, 2003), creating a downward spiral of suitably qualified STEM professionals – including teachers.

In Australia and the United States, STEM teacher candidates tend to be older, from lower socioeconomic backgrounds, with a higher percentage from prior careers, mostly in STEM domains (Watt, Richardson, & Pietsch, 2009). A "disproportionate number" of STEM teachers are men aged over 45 (Dow, 2003b). To address the existing shortages of STEM teachers, recruitment campaigns could target older graduates working in STEM-related careers as a fruitful pool from which to attract qualified people with diverse experiences into a teaching career. However, expedient adoption of measures to recruit a sufficient number of STEM teachers could attract "reluctant" or less interested and enthusiastic recruits into the profession. This may have unintended long-term consequences for these teachers and their students. Possibly lower quality teaching behaviours and interactions with students may turn young people away from future interest and participation in the STEM disciplines. It is timely to examine who is choosing a teaching career in STEM; for what reasons; are those reasons different for men and women; and, does it matter for their later teaching behaviours? These are the core questions

addressed by our longitudinal study in which we collect data from STEM and non-STEM prospective teachers at the start of their teacher education (Time 1) and again during early career teaching (Time 2).

STEM Participation

Participation in advanced sciences and mathematics education has declined significantly in many Western countries over the last few decades, to the point where there is grave concern about the viability of those disciplines to sustain economic growth and development (for example, Jacobs, 2005; National Science Board, 2003, 2010; National Science Foundation, 2002; OECD, 2006); this concern exists also in Australia (Ainley, Kos, & Nicholas, 2008; ACER, 2005; Barrington, 2006; Bell, 2010; Dobson & Calderon, 1999; Dow, 2003a, b; FASTS, 2002; National Committee for the Mathematical Sciences of the Australian Academy of Science, 2006; Productivity Commission, 2007; Rennie, 2010). Unfortunately, university graduates from the STEM disciplines are not particularly attracted to teaching as a career; and STEM disciplines are not popular among those already enrolled in teacher education (Lawrance & Palmer, 2003). The lack of enthusiasm by STEM graduates for a teaching career may be a direct function of the general shortage of STEM professionals, opening up the number and type of high-status and more lucrative career options available to graduates in those fields, intensifying the difficulties of attracting new graduates and career switchers into a career teaching in STEM (Harris & Jensz, 2006).

Gender differences in STEM participation continue to fuel the concern of researchers who have an interest in gender equity. Fewer girls and women are retained in the STEM pipeline progressively through senior high school, university studies, and career choices. Women drop out of the STEM disciplines even when their achievement in those disciplines is equal to or higher than that of males (Jacobs, 2005). In both the United States (e.g., Eccles (Parsons), 1984; Eccles, 1985; Jacobs, 2005) and in Australia this has been well documented in the case of mathematics (see Watt 2005, 2006; Watt, Eccles, & Durik, 2006). Several have argued that many girls prematurely restrict their educational and career options by discontinuing their mathematical training in high school or soon after (Bridgeman & Wendler, 1991; Heller & Parsons, 1981; Lips, 1992; Meece, Wigfield, & Eccles, 1990; Watt, Shapka, et al., 2012), having important ramifications for women's wellbeing from both economic and psychological perspectives. First, gender differences in earning potential are important because women are more likely than men to be single, widowed, or single heads of households, needing to support themselves and other dependents financially without assistance from a partner or significant other (Meece, 2006). Second, women (and men) need to develop and deploy their talents and abilities in their work outside the home, which substantially impacts their life satisfaction and general psychological wellbeing (Eccles, 1987; Meece, 2006).

The under-representation of women (or over-representation of men) in STEM careers results in those careers tending to reflect the values of male professionals who are in the majority. In turn, this reinforces the gender imbalance through girls' and women's perceptions regarding the culture of those careers. This is most

noticeable in relation to the ways in which such careers accommodate — or fail to accommodate — the familial obligations women often carry, which may affect girls' and women's aspirations towards those careers in the first place, stunt their development and progression should they enter, and deter them from persisting. Entrenched gender differences in STEM participation, alongside the highly feminised occupation of teaching, renders STEM teaching an important career choice to examine.

Teaching Career Choices

People have different reasons that lead them to choose teaching as a career. Some future teachers will choose this career path to improve the society in which they live, others to work with children, and others to secure family-flexible work hours (Richardson & Watt, 2006). Understanding teachers' motivations for the profession is important in relation to the recruitment of new teachers, their retention, and the learning experiences they provide for their students. The motivations that lead people to enter the teaching profession are likely to subsequently influence their professional engagement and the ways they relate to and teach their students (Watt, Richardson, & Devos, 2013). Addressing these issues is especially important for teachers of STEM disciplines where shortages have resulted in less qualified teachers, teachers teaching outside their specialisms, and a reduced curriculum in many schools (McKenzie, Kos, Walker, & Hong, 2008), compromising the quality of STEM teaching and impacting student motivations, enrolments and future aspirations. There is a strong need to understand why women and men choose to teach STEM subjects and whether STEM teachers are differently motivated than other future teachers, in order to attract and retain them in the profession. It is also important to discover possible consequences for their future teaching behaviours, to ensure positive development for their students' STEM skills and engagement. It is especially important for girls to benefit from positive role models and awareness of STEM career pathways during and beyond secondary school.

Much research has been conducted concerning why people choose to teach. A seminal review conducted by Brookhart and Freeman (1992) highlighted *intrinsic*, *extrinsic* and *altruistic* motivations as the most important groups of reasons influencing teachers' career choice. To facilitate comparisons of teaching motivations, we previously developed an integrated model grounded in the Eccles et al. (1983; Eccles, 2005, 2009) expectancy-value theory (see Watt & Richardson 2007, 2008, 2012; Figure 1). The Factors Influencing Teaching Choice (FIT-Choice) framework provides an integrated and theoretically guided, psychometrically sound framework, developed and validated in the Australian context (Watt & Richardson, 2007) and subsequently across other sociocultural contexts including samples from the U.S., Germany and Norway (e.g., Watt, Richardson, et al., 2012). Intriguingly, teaching motivations were more similar than they were different across those contexts, whereas perceptions about the teaching profession reflected objective country differences, such as differences in teacher salary.

The FIT-Choice model taps "altruistic"-type motivations that have been emphasised in the teacher education literature (e.g., Book & Freeman, 1986; Brown, 1992; Lortie, 1975; Moran, Kilpatrick, Abbott, Dallatt, & McClune, 2001; Serow & Forrest,

1994), as well as more personally utilitarian motivations, intrinsic motivations and ability-related beliefs. Measured motivation factors include social influences, positive prior teaching and learning experiences, perceived teaching abilities, intrinsic value, personal utility values (job security, time for family, job transferability), social utility values (shape future of children/adolescents, enhance social equity, make social contribution, work with children/adolescents) and the negative motivation of choosing teaching as a fallback career. We have provided a review elsewhere (Watt & Richardson, 2007, 2008) of how FIT-Choice factors map to expectancy-value theory, Social Cognitive Career Theory (SCCT; see Lent, Lopez, & Bieschke, 1993), and to key findings within the existing teacher education literature.

Social utility value factors resemble altruism as variously described in the teacher education literature (Book & Freeman, 1986; Brown, 1992; Fox, 1961; Joseph & Green, 1986; Serow, Eaker, & Ciechalski, 1992). Positive prior teaching and learning experiences, especially in relation to former influential teachers, have also been linked to choosing a teaching career (Book & Freeman, 1986; Fielstra, 1955; Lortie, 1975; Richards, 1960; Richardson & Watt, 2005; Robertson, Keith, & Page, 1983; Wright, 1977), as have various quality of life issues such as having time for family and job security (Bastick, 1999; Jantzen, 1981; Richardson & Watt, 2006; Robertson et al., 1983; Tudhope, 1944; Yong, 1995), which are assessed by our personal utility value factors. In prior research, such quality of life reasons have frequently been nominated as extrinsic, although that label obscures the distinction between quality of life issues and other factors that we distinguish as socialisation influences. Researchers have previously seen "extrinsic" quality of life motivations as detrimental to producing teachers who are fully engaged with and committed to the profession (e.g., Sparkes, 1988; Woods, 1981).

Intrinsic value and perceived ability have been less a focus in the teacher education literature, although in the motivation literature they are the main focus of several models including in the expectancy-value model, and ability-related beliefs have been the focus in the career choice literature more generally. In response to claims in the teacher education literature and the public media that entrants into teacher education may have failed to be accepted into their career of choice or otherwise unable to pursue their first-choice career, we developed the fallback career subscale (see Book, Freeman, & Brousseau, 1985; Haubrich, 1960; Robertson et al., 1983). All parts of the model are proposed to work together to predict choice of a teaching career and professional engagement outcomes.

The development of an agreed framework to measure teachers' motivations offers many advantages, for example to be able to compare their motivations across different samples and settings. A recent journal Special Issue was dedicated to comparisons of teaching motivations using the FIT-Choice scale across diverse cultural settings including Turkey, the U.S., China, the Netherlands, Croatia,

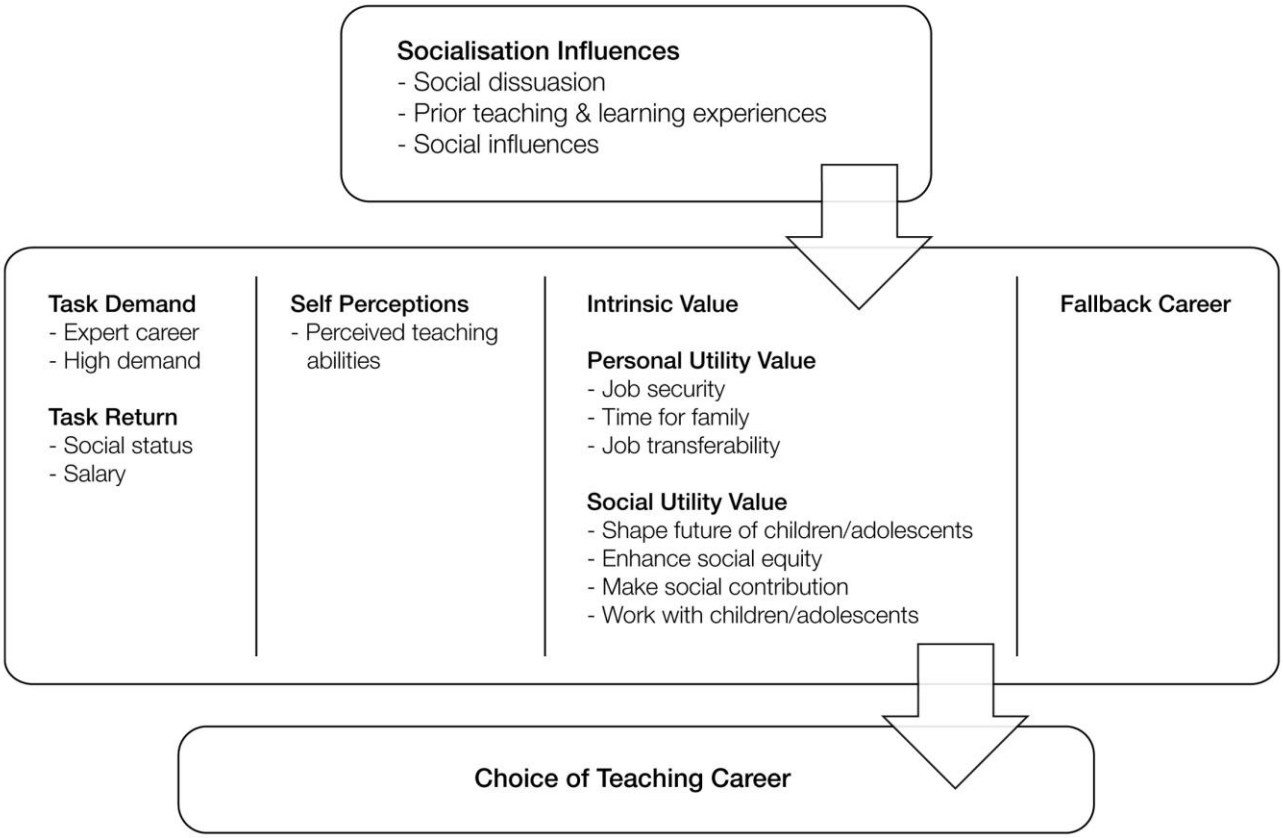

Figure 1. FIT-Choice empirically validated theoretical model.

Germany and Switzerland (Asia-Pacific Journal of Teacher Education, vol. 40 no. 3, 2012). There were many similarities and some differences in future teachers' motivations across these samples. Yet, little is known about how teachers' motivations and teaching style may differ as a function of teacher gender or subjects taught – the focus of our present study.

The Present Study

There is a lack of empirical evidence about whether women and men choose to teach for similar or different reasons, and whether they display similar or different teaching styles. Similarly, there is little evidence concerning whether STEM teachers display particular characteristics relative to teachers of other specialisms. Numerous studies and surveys have shown that the teaching profession is becoming increasingly feminised, attributed to factors including low pay (Blount, 1999; Johnson, 2008), poor social status (Cushman, 2005), public suspicion of men wanting to work with children (Cushman, 2005; Johnson, 2008), and the association of teaching children with an extension of mothering (Carrington, 2002). The kinds of men who have self-selected into teaching may therefore display few gender differences compared with women teachers. Yet, STEM domains are typically male-dominated and sex-stereotyped; as a consequence the percentage of men who teach STEM is higher than in the whole population of teachers. Women STEM teachers have completed a degree in a male-dominated domain, and are now

teaching STEM subjects. In a highly competitive job market facing a crisis in the availability of tertiary-trained workers (Birrell & Rapson, 2006), particularly in STEM, the women who *do* persist or excel in those domains can earn a higher salary and occupational status in careers other than teaching. The trend towards increasing numbers of women entering teaching together with lower female participation in STEM disciplines, is likely to intensify the shortfall in STEM teachers.

How then do gender differences appear among STEM teachers, and do they differ from other teaching disciplines? Given the detractors we have outlined from teaching STEM and STEM-trained individuals' potential for finding other more lucrative work, why do people choose a teaching career in STEM? In this study, we address these two core questions:

1. do future teachers' initial motivations to teach vary by gender and/or discipline (STEM versus non-STEM)?; and

2. does this matter in terms of subsequent teaching style during early career?

METHOD

Sample and Procedure

The data form part of the larger continuing FIT-Choice project (www.fitchoice.org). Participants initially came from four Australian universities at the start of their teacher education programs. The same participants were contacted a first time at the beginning of their teacher education program, a second time just prior to degree completion, and a third time during their early teaching career. In the present study we focus on the first and last timepoints. There were substantially fewer women (53% vs. 67-84%) and English speaking background (ESB) future STEM teachers (78% vs. 81-90%), relative to proportions from the full sample. Only future secondary teachers who have STEM or other disciplinary specialisations, were selected for the present study. At the first timepoint (Time 1), there were 864 future secondary teachers in the sample; among them 245 in STEM (52.7% women) and 619 non-STEM (69.7% women). At the last timepoint (Time 2) the sample retained 354 early career secondary school teachers; 96 in STEM (58.3% women) and 258 non-STEM (75.9% women). Because of different degree timeframes (e.g., 4—5 year Bachelor vs. 1—2 year graduate-entry degrees), individual intermissions or part-time variations, and time needed to track continuing participants following their degree completions, early career teachers had up to 7 years professional experience.

Measures

Motivations for choosing teaching (Time 1).

Participants' motivations to teach were assessed using the FIT-Choice scale at Time 1. The scale measures the extent to which future teachers' career choice was motivated by each of their:

- Ability beliefs (3 items, α = .83);
- Intrinsic career value (3 items, α = .69);
- Personal utility value: Job security (3 items, α = .85), Time for family (5 items, α = 82), and Job transferability (3 items, α = .66);

- Social utility value: Shape future of children/adolescents (3 items, α = .84), Enhance social equity (3 items, α = .87), Make social contribution (3 items, α = .84), and Work with children/adolescents (3 items, α = .89);
- Prior teaching and learning experiences (3 items, α = .58);
- Social influences (3 items, α = .81); and
- Fallback career choice (3 items, α = .68).

All motivation items were prefaced by "I chose to become a teacher because…", which participants rated on a Likert-type scale ranging from 1 (not at all important) to 7 (extremely important). The above reliability coefficients refer specifically to the present secondary subsample in which Cronbach's alpha coefficients appeared lower than psychometric validation in the full sample (Watt & Richardson, 2007).

Teaching style (Time 2).
The Teaching Style Scale (Watt & Richardson, 2007) is an economical self-report measure, which teachers rated at Time 2, in relation to 4 core dimensions. Positive expectations (6 items, α = .94) measure the extent to which teachers hold positive expectations towards their students, for example, "To what extent do students in your classes feel you expect them to try to do their very best?". The Relatedness subscale (7 items, α = .90) measures caring relationships with students, for example, "To what extent do students in your classes feel that you really care about them?". The Structure subscale (3 items, α = .81) measures the extent to which teachers have clear expectations and procedures, for example, "To what extent do students in your classes feel there are clear expectations about student behaviour?". Negativity (7 items, α = .77) taps negative and aggressive interactions, for example, "To what extent do students in your classes feel that you make sarcastic comments to misbehaving students?". All items were rated from 1 (not at all) to 7 (a lot); Cronbach alphas refer specifically to the present secondary subsample.

RESULTS

Motivations for Choosing Teaching

Across the prospective secondary teacher sample at Time 1, highest rated teaching motivations on the 7-point scale were Ability beliefs (*M* = 5.58, *SD* = 1.01), Shape future of children/adolescents (*M* = 5.41, *SD* = 1.26), Make social contribution (*M* = 5.36, *SD* = 1.30), and Intrinsic value (*M* = 5.25, *SD* = 1.16). Lowest rated motivations were Fallback career (*M* = 2.24, *SD* = 1.29), Social influences (*M* = 3.22, *SD* = 1.64), Time for family (*M* = 3.79, *SD* = 1.48), and Job transferability (*M* = 4.25, *SD* = 1.51). Work with children/adolescents (*M* = 5.05, *SD* = 1.38), Prior teaching and learning experiences (*M* = 5.09, *SD* = 1.51), Job security (*M* = 4.90, *SD* = 1.45), and Enhance social equity (*M* = 4.87, *SD* = 1.43) were moderately rated. Yet, were these motivations similar or different according to future teachers' gender and specialism (STEM/non-STEM)?

Table 1
Descriptive Statistics for Motivations and Teaching Style by Gender and STEM

	Gender		Specialism	
	Men *M (SD)*	Women *M (SD)*	STEM *M (SD)*	non-STEM *M (SD)*
Motivations	n = 275	n = 528	n = 225	n = 578
Ability	5.52 (1.05)	5.61 (0.98)	5.55 (1.00)	5.59 (1.01)
Intrinsic value	[a]5.08 (1.15)	[a]5.34 (1.15)	5.20 (1.17)	5.27 (1.15)
Job security	4.82 (1.51)	4.94 (1.42)	4.91 (1.41)	4.89 (1.47)
Time for family	[a]3.66 (1.47)	[a]3.86 (1.48)	[b]4.00 (1.45)	[b]3.71 (1.48)
Job transferability	4.27 (1.49)	4.24 (1.52)	4.13 (1.42)	4.30 (1.54)
Shape future	5.39 (1.32)	5.43 (1.24)	5.45 (1.22)	5.40 (1.28)
Enhance social equity	4.70 (1.47)	4.96 (1.40)	4.71 (1.42)	4.93 (1.43)
Make social contribution	5.30 (1.38)	5.40 (1.26)	5.37 (1.28)	5.36 (1.31)
Work with child./adolescents	[a]4.72 (1.38)	[a]5.23 (1.34)	4.99 (1.44)	5.08 (1.35)
Prior teaching & learning	4.84 (1.46)	5.21 (1.52)	4.84 (1.51)	5.18 (1.50)
Social influences	3.43 (1.63)	3.11 (1.63)	3.42 (1.67)	3.15 (1.62)
Fallback career	[a]2.41 (1.32)	[a]2.15 (1.26)	[b]2.44 (1.38)	[b]2.16 (1.24)
Teaching style	n = 86	n = 219	n = 82	n = 223
Pos. expectations	[a]5.70 (0.95)	[a]6.01 (0.98)	5.97 (0.76)	5.91 (1.05)
Relatedness	[a]5.38 (0.90)	[a]5.73 (0.93)	5.55 (0.75)	5.66 (0.99)
Structure	5.31 (0.94)	5.47 (1.14)	5.54 (0.87)	5.38 (1.15)
Negativity	[a]2.63 (0.91)	[a]2.28 (0.85)	2.50 (0.91)	2.34 (0.87)

[a, b] *Note*. Paired superscripts denote statistically significant differences for [a]gender, [b]STEM, indicated per motivations and teaching style MANOVAs respectively.

Gender and STEM Influences

MANOVA revealed that women reported stronger motivations than men for the desire to Work with children/adolescents (F (1,799) = 18.93, p < .001, partial η^2 = .023), Time for family (F (1,799) = 5.27, p < .05, partial η^2 = .007), Intrinsic career value (F (1,799) = 7.15, p < .01, partial η^2 = .009) and positive Prior teaching and learning experiences (F (1,799) = 4.83, p < .05, partial η^2 = .006). Conversely, men reported significantly stronger motivations from the negative Fallback career motivation (F (1,799) = 6.73, p < .01, partial η^2 = .008), endorsing more highly than women that they chose a teaching career because they were unsure of what career they wanted, were not accepted into their first-choice career, or as a last-resort career — fortunately, mean scores of both groups were low (men: M = 2.41, SD = 1.32, women: M = 2.15, SD = 1.26). Men were also more motivated by Social influences to choose teaching (F (1,799) = 4.55, p < .05, partial η^2 = .006).

STEM future teachers reported significantly higher Fallback career motivations than non-STEM future teachers (F (1,799) = 6.66, p = .01, partial η^2 = .008); they were more motivated by Time for family (F (1,799) = 7.38, p < .01, partial η^2 = .009), and less by Prior teaching and learning experiences (F (1,799) = 4.46, p < .05, partial η^2 = .006). Table 1 presents summary scores for men/women and STEM/non-STEM on all motivation factors.

The interaction of gender with STEM specialism approached significance for Job transferability (see Figure 2; F(1, 799) = 3.66, p = .056, partial η^2 = .005); there was a trend for women future STEM teachers to be less motivated by travel-related opportunities than others. Intriguingly, no other interaction effects of gender with STEM approached significance, meaning that influences of gender and STEM operated independently, and that gender differences are robust among STEM and non-STEM future teachers.

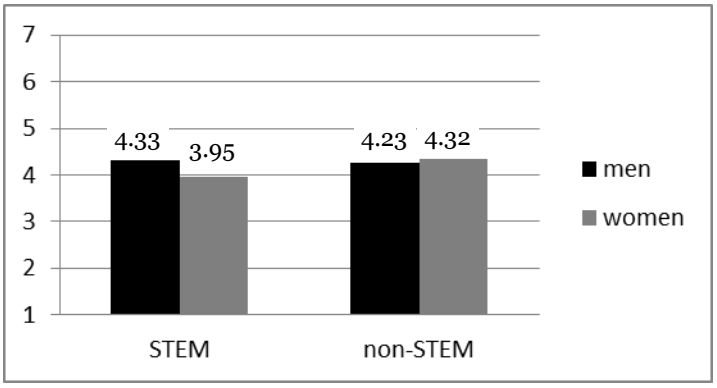

Figure 2. Job transferability motivations according to gender and specialism.

Teaching Style

During participants' subsequent early career teaching, women reported higher scores than men on teaching style dimensions of Relatedness ($F(1, 301) = 5.53$, $p < .05$, partial $\eta^2 = .018$) and Positive expectations ($F(1, 301) = 6.10$, $p < .05$, partial $\eta^2 = .020$). Men, on the other hand, reported higher Negativity, concerning more negative interpersonal interactions with their students ($F(1, 301) = 5.41$, $p < .05$, partial $\eta^2 = .018$). No gender differences appeared on the Structure dimension. There was no main effect of STEM/non-STEM on dimensions of teaching style, nor any interaction effects between gender and STEM, meaning that gender differences were consistent for STEM versus non-STEM teachers. Table 1 presents summary scores for men/women and STEM/non-STEM on all teaching style dimensions.

Relationships between Motivations and Teaching Style

Among STEM teachers, relationships between their motivations (Time 1) and dimensions of teaching style (Time 2) were found to be harmful ones, stemming from motivations of fallback career and dimensions of personal utility value. Choosing teaching as a fallback career, or for its job security, subsequently associated with greater negativity towards students manifested as sarcasm and negative reactions to mistakes ($r = .23$, .32 respectively for fallback and job security, $p < .05$); and, choosing teaching for reasons of job transferability correlated with later lower levels of relatedness with students ($r = -.25$, $p < .05$). These results raise concerns about the vulnerability of some beginning teachers; we have seen already that men and STEM teachers were more likely to choose teaching as a fallback career, and that there was a trend for men STEM teachers to be more motivated by job transferability.

DISCUSSION

Our longitudinal study of beginning women and men STEM teachers was a subset of a larger sample of beginning teachers. As such, we could compare gender characteristics for the STEM versus non-STEM subsamples, allowing us to distinguish what was similar or different. Importantly, we found only main effects of gender and STEM on motivations for choosing teaching as a career at entry to teacher education. Thus, gender differences appeared similarly among both STEM and non-STEM prospective teachers. Because STEM is generally perceived as a male stereotyped domain, we might have assumed that the women who enter into STEM teaching would be differently motivated; but this was not the case. Men and women choosing to become STEM teachers did not differ along gender lines any more than other future secondary teachers. Some positive motivations were rated higher by women than men (e.g., work with youth, intrinsic value); whereas men displayed more negative profiles (e.g., fallback career). However, future women and men teachers had essentially many of the same high motivations including ability beliefs and altruistic "social utility" motivations; although women were more highly intrinsically motivated than men, men's intrinsic motivations were also high.

STEM future teachers reported significantly more than non-STEM future teachers, that they chose teaching as a fallback career, and as a career compatible with family life. Such a finding may seem less than positive if it is interpreted that STEM

teachers are interested in a teaching career because they perceive it to be less demanding than other occupations. It may well be that these teachers are aware of the demanding nature of many other careers but at the same time are wanting a job that allows them to make a positive social contribution, promote a discipline in which they are passionately interested, and achieve an equitable balance with other valued demands in their lives. These findings are interesting because STEM careers are generally characterised by a heavy workload involving long hours. It may be that some prospective STEM teachers wish to escape those aversive characteristics of STEM careers (i.e., long working hours, difficult balance between work and private life, low family flexibility). Perhaps future STEM teachers aim to avoid such characteristics by choosing teaching, allowing them to combine their interest in STEM with a family-flexible career. But, those who defaulted into STEM teaching as a fallback career subsequently reported more negativity in their interactions with students, which is definitely cause for concern. It may be important to ensure that those who are less than enthusiastic about working with youth and/or have defaulted into teaching as a fallback career option do not find their way into the teaching profession.

Other researchers have shown that teachers' intrinsic motivations such as teaching enjoyment (Frenzel et al., 2009) and enthusiasm (Kunter et al., 2008), positively impact their instructional behaviours and students' engagement. On the other hand, being motivated to choose teaching as a fallback career, or for reasons of personal utility value (job security and job transferability) demonstrated negative relationships to early career teachers' reported teaching style, supporting previous suggestions of such motivations being possibly "detrimental" (e.g., Sparkes, 1988; Woods, 1981; Yong, 1995). Without well-educated teachers capable of drawing children and adolescents into a fascination with STEM fields, there will be little chance of sustaining the numbers who remain in the pipeline. The importance of positive STEM teacher role-models was underlined by high ratings in our study for the motivation of positive prior teaching and learning experiences to become a teacher. The pipeline metaphor seems especially appropriate to STEM disciplines, in that later knowledge development is highly dependent on earlier knowledge frameworks. If children miss out earlier on, it will be all the more difficult for them to engage effectively with the higher levels of STEM study.

Motivations for choosing teaching as a career are multidimensional and complex. This raises the question of how to make a teaching career more attractive to men, at the same time as assuring sufficient numbers of high quality women (and men) graduates from STEM disciplines enter teaching. Identifying highest rated motivators for future STEM teachers offers the possibility to enhance targeted recruitment efforts; at the same time, understanding different motivations for men and women offers possibilities to attract more men into STEM (and non-STEM) teaching. Whether negative motivations can be altered and positive ones inculcated and fostered by teacher education, early career induction and support programs, and attractive school working conditions, remains an open question imperative for researchers, policymakers and employing authorities to address. Until then, rather than selecting future teachers on the basis of initial career motivations, it seems both wise and prudent to attend to excellence in teacher education and optimising

support structures in school working environments especially for beginning teachers, to promote their positive teaching motivations and behaviours.

When there are shortages of tertiary educated people available to the labour market, as we are currently experiencing in Australia, it would not be surprising to find that individuals with good STEM qualifications may aspire to earn higher salaries in more lucrative workplaces than teaching. Attracting people into STEM teaching from other careers may help to address supply issues in the short term, but without concurrent enhanced pay and working conditions in schools, their retention is not guaranteed. To increase the supply of well-qualified youth through the STEM pipeline during schooling and into university, member countries of the OECD have developed targeted policies. Many of these countries are experiencing acute shortages and serious challenges in attracting high quality STEM teachers. Promises of a technological revolution and rapid economic development will seem hollow if children and adolescents are dissuaded from scientific / mathematical fields of career by teachers who chose teaching as a fallback career when they were not able to get into their preferred degree program.

There are pressing issues in relation to recruitment and maintenance of the STEM teaching workforce. We need to first focus on whether and how the shortage of STEM teachers can be met in the short and longer term; and secondly, whether those who are attracted into teaching in those disciplines have sufficient ability, personal interest in and enthusiasm for the sciences, mathematics and technology to enliven and sustain the learning and interest of children and adolescents. It is not acceptable that in Australia for instance, 25% of mathematics and science teachers have no higher education in those domains (National Committee for the Mathematical Sciences of the Australian Academy of Science, 2006). To effectively engage children and adolescents in STEM requires teachers with sophisticated and contemporary content knowledge, pedagogical expertise, as well as positive motivations for teaching.

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