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Why Become a Teacher? Exploring Motivations for Becoming Science and Mathematics Teachers in Australia

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Abstract: There is an identified shortage of mathematics and science teachers across Australia and many of these teachers leave the profession within 3 to 5 years of graduating. This paper provides important insights on what motivates people to become science and mathematics teachers in Australia. Data drawn from two surveys, one investigating why students might become a teacher and the other examining why teachers joined the profession, are explored to provide unique insight into an area of need. Using descriptive statistics and Spearman's rho, results suggest contribution to society and love of subject area to be among the top motivators for becoming a teacher. Financial reward and parental occupation were found to be less selected motivators. Although differences existed between the two cohorts suggesting motivations may change, similarities provide focus for future recruitment and retention of science and mathematics teachers for higher education institutions and education policy makers.

Introduction

There is a well-documented crisis within Australian schools predicted to worsen in coming years, that is, the shortage of science and mathematics teachers (Australian Government Productivity Commission, 2012; Weldon, 2015). This problem is most acute in the state of Queensland, where 76 % of secondary principals reported mathematics and science classes taught by teachers without relevant science or mathematics majors (Australian Education Union, 2016). This shortage adds urgency and impetus for increasing the number of pre-service science and mathematics teachers (Guarino, Santibanez, & Daley, 2006; Plunket & Dyson, 2011). There are no simple solutions to this issue, with barriers to a teaching career beginning with personal experiences in high school (Lyons et al., 2012; Queensland Audit Office, 2013; Office of Queensland Chief Scientist, 2016). Providing incentives for prospective teachers, and, in particular, making mathematics and science teaching an attractive option, have been proposed as potential strategies to alleviate this issue.

The challenge of attracting students to teaching degrees and retaining qualified science and mathematics teachers has been intensifying. Over the past two decades there has been increased interest in exploring the motivations driving individuals to choose teaching as a career. Uncovering motivations can drive recruitment and retention directions, directly assisting with increased numbers of science and mathematics teachers. The motivations that influence the choice of teaching as a career are usually broken down into intrinsic and extrinsic factors, where the former are seen as the most important reasons behind deciding to teach (e.g., Brookhart & Freeman, 1992; Queensland College of Teachers, 2015; Sinclair, 2008; Watt & Richardson, 2008). Numerous studies indicate the highest rated motivations for selecting teaching include the desire to make a social contribution, supporting and influencing future generations, enjoyment of working with children, perceived teaching abilities and influence of others (e.g., Hellsten & Prytula, 2011; Kilinc & Seymen, 2014; Richardson & Watt, 2006). Despite this research, policy-makers and employing authorities have historically overlooked the values, beliefs and motivations of those entering teacher education programs, and insufficiently explored the importance of these motivations in shaping beginning teachers' aspirations for professional engagement (Feiman-Nemser, 2001), instead offering superficial incentives which may initially attract students, but fail to keep graduate teachers in the sector. Teacher motivations matter, as beginning teachers' perceptions can impact their subsequent professional engagement, development, quality of their work (Watt & Richardson, 2008), and, eventually, retention levels (Borman & Dowling, 2008).

Largely, exploration of motivations in this area focus on a broad, general sample of teachers. It is important to specifically explore motivations around choosing mathematics and science teaching as a career in the climate of teacher shortages. Whilst there exists much in the literature about why people choose to become teachers, there is an insufficient understanding of why people choose to become science and mathematics teachers, especially within the Australian context. This research focuses on developing a greater understanding of motivations for becoming a science and mathematics teacher as a part of understanding relationships between higher education policy, structure, curriculum and recruitment in initial teacher education.

Having a deeper understanding of the motivations of teachers and those who may become teachers is, we argue, foundational to making choices that result in higher attraction and retention. This paper presents empirical evidence of motivations of early career teachers in Australia and explores potential motivators of those currently studying science, technology, engineering and/or mathematics (STEM) undergraduate degrees to become teachers, a population of potential teachers who have not been sufficiently studied. Combining learnt information from both populations provides this paper with unique insight into initial motivations, continued motivations and those motivations that remain strongly apparent across both groups of teachers.

Background

The Shortage of Science and Mathematics Teachers

There is a shortage of STEM teachers nationally, with Australia's Office of the Chief Scientist (2012) providing strategies and funding opportunities to try to address the problem that "the pool from which mathematics and science teachers are drawn needs to be broadened" (p. 28). To characterise this, in the discipline of Mathematics, the Australian Mathematical Sciences Institute (AMSI) considers a qualified mathematics teacher to be one who has at least two years of tertiary education in mathematics. By this definition, 40% of Years 7-10 students and 20% of Years 11 and 12 students are being taught mathematics by unqualified teachers (Australian Mathematical Sciences Institute, 2013). Similar figures are obtained in a separate survey by the Australian Council of Deans of Science (Harris & Jensz, 2006) and the claim is further supported by the findings that the incidence of 'out of field' teaching in science and mathematics is higher in Australia than in comparable countries (Marginson, Tytler, Freeman, & Roberts, 2013). Thus, considering why people become science and mathematics teachers is of importance in order to entice future teachers.

What Motivates People to Become Science and Mathematics Teachers?

Extensive research has been conducted on why people select teaching as a profession. However, there is limited research on what motivates students to choose science and mathematics teaching. Eick (2002), in a study of the career choices and retention of secondary science teachers, found that individuals who felt strongly about education had intrinsic interests in the subject matter of science, the act of teaching, and found working with students personally rewarding. He recommended examining students' values and beliefs from life experiences as a means for understanding their career choice. Luft, Wong and Semken (2011) examined the experiences of students participating in a recruitment course for a secondary teacher education program at a large United States university. Findings suggested the participants were motivated by a desire to work with children and/or a desire to share their understanding/enjoyment of science with others. They also tended to have prior positive experiences as tutors, coaches, or teachers. Thus, the researchers recommended emphasising these motivations and prior experiences when selecting participants in a recruitment program.

Tomanek and Cummings (2000) examined what would motivate science majors to consider teaching. Their findings suggested many science majors could be influenced to consider teaching through opportunities to interact with students, to earn teacher certification without abandoning their academic science major, and through regular discussions about the rewards and challenges of teaching. Likewise Guarino et al. (2006) identified ease of entry and overall compensation (salary, benefits, working conditions, and personal satisfaction) as considerations in the career decision making process. It is important to consider how to embed these motivations within courses. Despite the importance of identifying effective recruiting strategies, little is known about these students' decisions to teach science and the efficacy of recruitment programs (Luft et al., 2011), particularly in Australia.

Theorising Higher Education Impacts Upon Attraction and Retention

Three gaps can be identified in the literature relating to science and mathematics teacher motivations. The first is that whilst much is known about teacher motivations, in general, not enough is yet known specifically about what motivates Australian undergraduate students to enrol into a science or mathematics teaching degree – the motivations for attraction. The second is that not enough is yet known about the way that motivations of science and mathematics teachers change after entering the profession. It is expected that there is a difference between the motivations prior to choosing to become a teacher (motivations related to attraction) and the motivations subsequent to becoming a teacher during the challenging early years in the profession and their ability to reflect upon motivations (motivations related to retention), yet there is at present only limited evidence of these shifts in motivation (Müller, Alliata, & Benninghoff, 2009). Finally, theoretical developments are required to guide higher education institutions in using the understanding of teacher motivations to guide recruitment programs and attracting students who will remain in the profession. If higher education institutions wish to attract science and mathematics pre-service teachers to courses in a way that graduate teachers are be retained in the profession, then how should research into motivations impact upon policy, teaching, and marketing decisions?

The motivations that influence student attraction are tied in complex ways to motivations for staying within the profession as an early career teacher. The way that universities *explicitly* select students with specific motivations has the potential to influence the future retention of a cohort. Similarly, the way that universities *implicitly* select students (such as through marketing) may similarly influence future retention of a cohort. Finally, the experiences of a teacher throughout the entire process of considering a teaching degree, choosing a teaching degree, studying to become a teacher, and graduating, can change their motivations, for example, through changing knowledge, affect, and values.

Psychological Motivations

There is a depth of psychological research into motivation that can be applied to understanding attraction and retention in the teaching profession. Müller et al. (2009) draws upon Kanfer (1990) to identify three main paradigms for motivation in relation to workers in professions (e.g., teachers). The first paradigm involves *need-motive-value* approaches which theorise that motivation of workers is explained by needs and values that need to be satisfied, such as in Maslow's hierarchy of needs (Maslow, 1943) and Herzberg's dual-factor theory (Herzberg, Mausner, & Snyderman, 2011). The second paradigm involves *cognitive-choice* approaches which attempt to explain motivation of workers through expectation of reward and the subjective value of objectives, such as in expectancy theory (Vroom, 1964). The third paradigm involves *metacognitive* approaches which attempt to understand the processes that influence the objectives chosen by a worker, such as control theory (Carver & Scheier, 1982) and social learning theory (Bandura, 1977).

In this study Müller et al.'s (2009) research is followed in adopting the need-motive-value paradigm, in an effort to understand the internal and external forces that impact upon individual motivations to commence a teaching degree and to remain in the teaching career during the early career stage. This approach is similar to the three-factor model of Scott and Dinham (2003) which places emphasis upon the third outer domain, where teachers' dissatisfaction and amotivation has its origin in the wider environment outside the school; the extrinsic, non-school factors. In contrast, the Factors Influencing Teaching Choice (FIT-Choice) model is based upon Expectancy-Value theory (a cognitive choice approach) which considers relationships between effort and performance, performance and outcomes, and outcomes and rewards (Richardson & Watt, 2006). In this study questions inspired by the FIT-Choice model are used, but the different theoretical approach leads us to look to the basic psychological needs of teachers rather than to their expectation of reward.

The distinction between intrinsic and extrinsic motivation has its origins in Cognitive Evaluation Theory (Deci & Ryan, 1975), a precursor to self-determination theory (SDT). SDT is a general theory about the fundamental elements of human intrinsic motivation (Ryan & Deci, 2000) and it has been used empirically in the education context previously to demonstrate the value of intrinsic motivation (Deci, Vallerand, Pelletier, & Ryan, 1991; Niemiec & Ryan, 2009; Reeve, 2012). SDT is a theory of intrinsic motivation that emphasises the importance of fundamental human psychological needs of competence (feeling capable of carrying out tasks), relatedness (feeling connected to other humans), and autonomy (being able to carry out tasks in a way that is in harmony with beliefs of the individual).

There have been recent attempts to integrate SDT with the theory of planned behaviour (TPB) (Hagger & Chatzisarantis, 2009), a theory of motivation that focuses upon the relationship between an individual's behaviours and their beliefs (Ajzen, 1991). In TPB an individual's beliefs are modelled using three factors: (a) their *attitudes* towards the behaviour, such as their beliefs around likely outcomes; (b) their perception of *social normative pressures* regarding the behaviour, and (c) their *perceived behavioural control*, their perception of how able they are to carry out the behaviour in question. Integration of the two theories is based upon the use of TPB to understand how beliefs influence behaviours and SDT to understand why certain beliefs are pursued (Hagger & Chatzisarantis, 2009). In attempting to theorise our findings relating to teaching motivations we draw upon both TPB and SDT; which have respectively been used for preservice teacher attrition (Bouwma-Gearhart, 2010) and in-service engagement (Klassen et al., 2012).

The question of teacher attraction and retention in Australia has been explored within the context of rural schooling, where it has long been recognised as a wicked problem (Downes & Roberts, 2017). In addressing this issue, Kelly and Fogarty (2015) make use of the framework of Kollmuss and Agyeman (2002) to propose a model for teacher attraction and retention that is based upon motivational theory, Figure 1, which recognises the intrinsic factors of knowledge, emotions, and attitudes that affect the decision to enter into the teaching career. Thus, the model is based upon both TPB and SDT as per Kollmuss and Agyeman's (2002) work. Intrinsic and extrinsic factors are present even at the decision to enter into a teaching degree. Studies of teachers (that are not focussed explicitly on maths or science) show that teachers are more likely to change their behaviours in response to appeals to intrinsic motivations such as making an altruistic contribution to society than extrinsic motivations such as financial reward (Hanushek, Kain, & Rivkin, 1999; Watt et al., 2012).

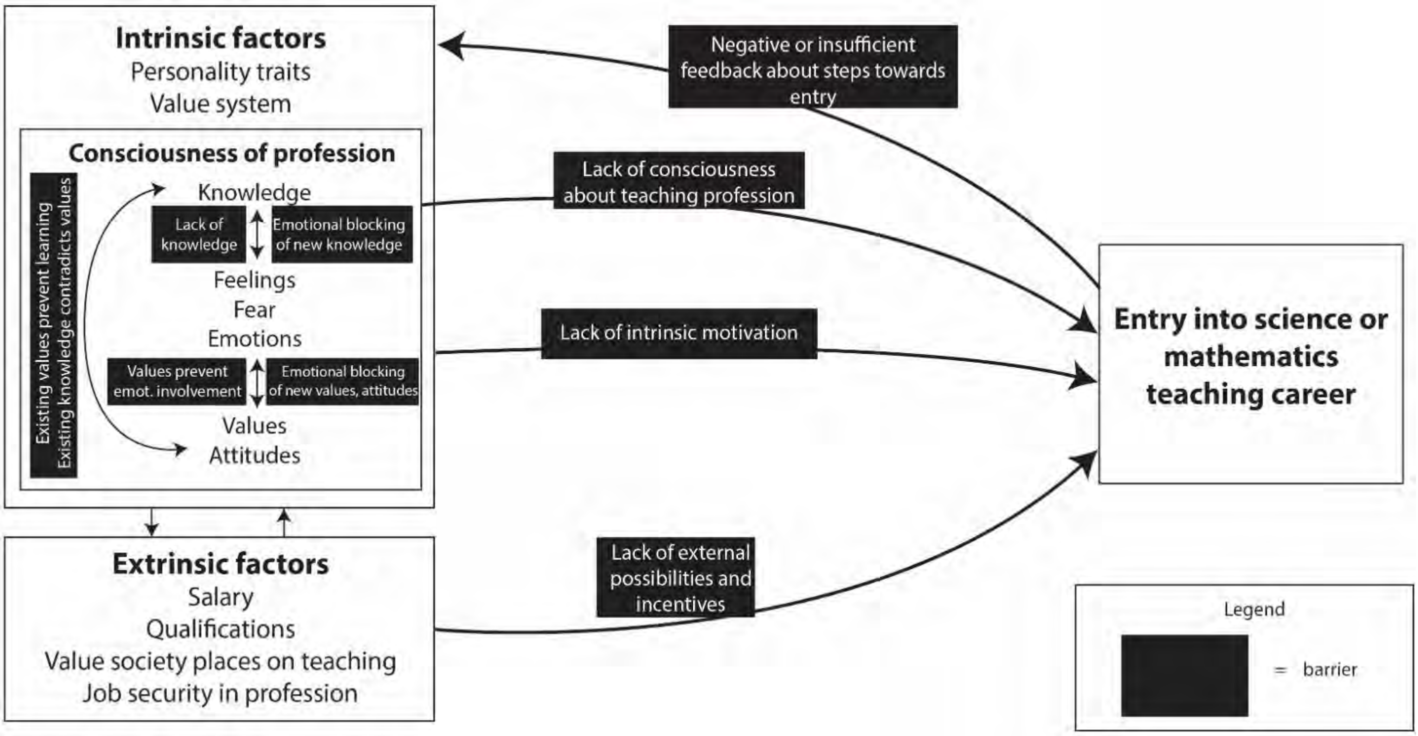

Figure 1: Motivational factors pertaining to the behaviour of entering into a science or mathematics teaching career, adapted from (Kollmuss & Agyeman, 2002) and (Kelly & Fogarty, 2015)

An alternative model, Figure 2, attempts to explain how undergraduate teaching students come to make a decision enter into the teaching profession, where there are clear parallels between the two models. This model was used in a two-phase study of teachers in Flanders, where 251 teachers gave responses first as students and then as recent graduates (Rots, Aelterman, Devos, & Vlerick, 2010). It is informed by the theory of planned behaviour and based explicitly upon the social learning theory of career decision making (Mitchell, 1996). The results showed that teachers who were committed to teaching were more likely to enter the profession; and also that a positive initial motivation is associated with a teaching commitment (Rots et al., 2010, p. 1626). It also showed that teaching self-efficacy was associated with teaching commitment, where a sense of teaching competence is related to teachers being more likely to enter into the profession.

In summary, the scholarly literature contains a range of ways in which psychological motivation theories have been used to understand teacher decisions to enter the profession and remain engaged. This brief review provides the basis to observe some useful distinctions within the literature. Firstly, there is a distinction between behaviours (which can be observed), and motivations (which cannot be directly observed but which influence behaviours) and where motivations are defined as the forces leading to behaviours (Müller et al., 2009). Secondly, there is a distinction between types of motivations, where some are intrinsic (originating within the individual) and others are extrinsic (originating outside of the individual). Finally, the specific motivations that influence teachers at the stages of pre-teaching, undergraduate (pre-service), and early career (in-service), have been identified and used to formulate models in a number of places within the literature (e.g., Dinham & Scott, 2000; Kelly & Fogarty, 2015; Müller et al., 2009; Richardson & Watt, 2006; Rots et al., 2010). Whilst there are differences between the models, there are several commonalities that emerge: the influence of teacher education, relationships with other people especially other teachers (e.g., faculty, colleagues, mentors), external factors such as salaries and environment, and individual beliefs, emotions and attitudes.

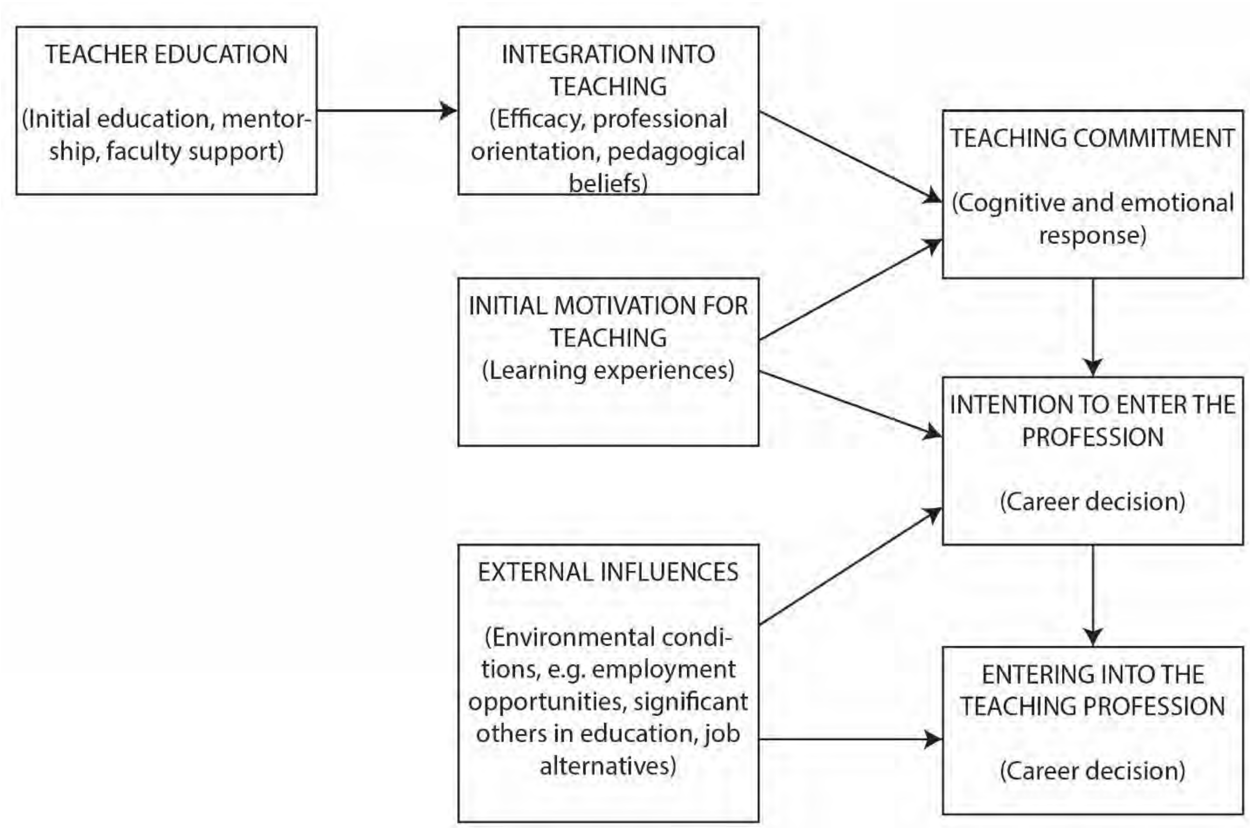

Figure 2: Model to explain graduate entrance into the teaching profession (adapted from (Rots et al., 2010) following (Mitchell, 1996)).

Method

This paper addresses the research question: *What are the potential motivators for people to become science and mathematics teachers?* This is explored by examining unreported data from two sources: (a) a survey that asks non-education STEM undergraduate students the reasons why they might want to take education subjects at university/become a teacher; and (b) a large national survey of science and maths early career teachers.

Data

Undergraduate STEM Student Career Trajectory Survey

The undergraduate (UG) survey was developed as part of a national initiative funded by the Chief Scientist of Australia, called Enhancing the Training of Mathematics and Science Teachers program (ETMST). The Queensland wide *Step Up* initiative sought to gain insight into the number of students interested in a potential career in STEM teaching.

Survey design was guided by pre-existing collection instruments such as *Starting out in STEM* (Lyons et al., 2012), *Motivations for choosing teaching as a career: An International comparison* (Watt et al., 2012) and *FIT-CHOICE* (Watt & Richardson, 2007). Depending on participant selection of interest, a possible 17 questions were included as part of this survey. This analysis was interested in the question *How influential are the following in driving your ideas behind being a secondary maths/science school teacher?* Participants responded on a 5-point Likert scale from *not at all influential* to *extremely influential* for a range of potential motivators, such as *career structure* and *past teachers*. Demographic details were also collected.

Data for this study were drawn from a population of students (n = 1,245) in their first year of a STEM undergraduate degree at a metropolitan university in 2014. All students in a compulsory first year unit were invited to participate in the online survey and it was promoted through email and during classes. Institutional ethical approval for this study was granted by a university human research ethics committee. Students gave informed consent.

Two hundred and seventy-four students participated in the UG survey, a response rate of 22%. The majority of students were enrolled in an engineering course (64.6%, n = 177). Sixty-one percent of respondents were male. Demographic information for this survey is presented in Table 1.

	n	%
Enrolled Course*		
Science	85	31
Engineering	177	64.6
Mathematics	11	4
Other	2	0.7
Female	106	38.7
Aboriginal and/or Torres Strait Islander	3	1.1
Total	274	

* Students may be enrolled in a double degree

Table 1: Descriptives of UG survey respondents (*n*=274)

Staff in Australia's Schools

This paper also draws upon data from the Staff in Australia's Schools (SiAS) 2010 which was conducted by the Australian Centre for Educational Research (ACER) on behalf of the Australian Government Department of Education, Employment and Workplace Relations and the data are drawn from a total survey population of 4,599 primary teachers (final response rate 34%), and 10,876 secondary teachers (response rate 32%) (McKenzie, Rowley, Weldon, & Murphy, 2011). Of this total of 15,475 teachers 2,477 were identified as early career teachers (ECTs) after self-reporting that they had been teaching for a total of less than five years, representing 16% of all responses. The sample was selected using a two-stage process of first selecting schools, and then selecting teachers within schools to ensure that larger schools were not disproportionately represented (McKenzie et al., 2011, p.4). The survey was promoted through "publications, media releases, and information sheets distributed to school authorities in the states and territories, Advisory Committee members, and to professional associations of teachers and school leaders" (McKenzie et al., 2011, p.7). Invitations to first schools (first stage) and then teachers (second stage) were sent by email, and were supported by a website and a freecall 1800 number. Some teaching authorities in their respective jurisdictions communicated with schools to promote the survey (McKenzie et al., 2011, p.8). The survey authors estimate that for any sample estimate the population value (of teachers Australia wide) is *probably* within one standard error of the sample estimate, and *almost certainly* within 1.96 standard errors of the sample estimate. The full dataset for the SiAS is available on request through the Australian Data Archives with record numbers 01278.

The SiAS 2010 survey included 51 questions and was designed by updating previous surveys such as the SiAS 2007 (McKenzie, Kos, Walker, Hong, & Owen, 2008) and those surveys conducted from 1963 to 1999 by the Australian College of Educators (Dempster, Sim, Beere, & Logan, 2001). In addition to demographic questions, the main question used in this analysis is Q10 "*Which of the following factors were important to you in your decision to become a teacher?* (Please tick all boxes that apply)" for which there were 19 possible responses as well as "other".

The entire population (n = 14,535) was restricted to include only teachers in secondary schools (n = 10,283). For this population, we restricted the data set firstly to only select those teachers who are currently teaching STEM and who are an ECT and we define ECT as any teacher who has been teaching <5 years (Table 2). This resulted in 583 teachers being included in this study. Demographic information revealed 35% (n = 208) of participants were female.

	Current STEM teacher	*Other*	*Total*
ECT (<5 yrs)	**583**	1092	1675
Other (>5yrs)	2914	5694	8608
Total	*3497*	*6786*	*10283*

Table 2: Secondary teachers that are ECTs and current STEM teachers

Analysis

Potential motivations were extracted from each dataset. Motivations in both surveys were rated by participants on a 5-point Likert scale. Using previously established protocols (e.g., DeAngelis, Wall, & Che, 2013; Tatar & Horenczyk, 2003), the items were dichotomised. Although this produces limitations regarding variance and power (see Cohen, 1983), for the purpose of examining motivations across two datasets this is considered an acceptable process. From the UG dataset, a list of 11 potential motivators emerged. From the ECT dataset, a total of 19 motivators emerged. These are presented in Table 3.

Undergraduate survey motivations	*Early Career Teacher survey motivations*
Personal reward	Personal fulfilment
Contribution to society	Desire to work with young people
Love of subject/area	I enjoyed school
Career structure	Influence of past teachers
Job security	Desire to pass on knowledge
Financial reward	Teaching makes a worthwhile social contribution
Work-life balance	I am passionate about education
High school achievement	I enjoy my subject areas
Parental occupation	Opportunity to work overseas
School experience	Teaching is suited to my abilities
Past teachers	I was awarded a bursary or scholarship
	High likelihood of gaining employment after graduating
	Security of employment
	Status of teaching profession in the community
	Starting salary
	Salary for experienced teachers
	Future opportunities for career advancement
	Working conditions (e.g. flexibility, leave entitlements)
	Family role models

Table 3: Motivations from each dataset

To compare datasets, it was important to have a list of motivators that were consistent between datasets. Initially, the lists emerged from literature which can be considered an initial coding of data (Miles & Huberman, 1994) and enabled researchers to use deductive thematic analysis (Clarke & Braun, 2008). Following protocols set by Miles and Huberman (1994) for qualitative data analysis, two researchers began looking for patterns amongst the codes. The individual items on the lists were underpinned by common themes, and were able to be collapsed into overarching factors. Thematic codes were compared and inter-coder reliability was calculated as over 80%, which is acceptable (Lombard, Snyder-Duch, & Bracken, 2002). This process resulted in 11 items exploring motivations and influences.

To provide information regarding motivations, descriptive statistics in the form of frequencies and percentages were calculated. To examine relationships between rankings for each cohort, Spearman's rho was used. Spearman's rho (r) is a widely used standardized measure of the strength of the relationship between two variables (Field, 2013). The test does not rely on assumptions of a parametric test (Field, 2013), and is useful in analysis of ordered categorical data (Whitley & Ball, 2002). It has been widely used in previous studies investigating associations between variables (e.g., Bos, Groeneveld, Bruggen, & Brand-Gruwel, 2016; So & Watkins, 2005).

Results

Undergraduate Motivations

For undergraduate STEM students responding to the question *how influential are the following in driving your ideas behind being a secondary maths/science school teacher?* strong motivators were *contribution to society* (80.8%; n = 147), *love of subject area*

(78.6%; *n* = 143), *work-life balance/holidays* (78.6%; *n* = 143), *personal reward* (75.8%; *n* = 138) and *past teachers* (74.2%; *n* = 135). And, as illustrated in Table 4, these are the top five influences driving ideas behind being a maths/science teacher.

Interest in becoming a teacher	*n*	%
Contribution to society	147	80.8
Love of subject/area	143	78.6
Work-life balance/holidays	143	78.6
Personal reward (or personal satisfaction)	138	75.8
Past teachers	135	74.2
Job security	124	68.1
School experience	123	67.6
Career structure	114	62.6
High school achievement	103	56.6
Financial reward (salary and benefits)	89	48.9
Parental occupation	58	31.9

Table 4: Motivations for UG STEM students who may want to become teachers

Early Career STEM Teacher Motivations

For early career teachers responding to the question *Which of the following factors were important to you in your decision to become a teacher?,* strong motivators for becoming a teacher were *love of subject area* (77.2%; *n* = 450), *personal reward* (65.4%; *n* = 381), *contribution to society* (55.6%; *n* = 324), *past teachers* (53.2%; *n* = 310) *and work-life balance (*49.6%; *n* = 289*)*. As illustrated in Table 5, these are the top five influences driving ideas behind being a maths/science teacher.

Description	ECT (n=583)	
	n	%
Love of subject/area	450	77.2
Personal reward (or personal satisfaction)	381	65.4
Contribution to society	324	55.6
Past teachers	310	53.2
Work-life balance/holidays	289	49.6
School experience	233	40
Job security	228	39.1
Parental occupation	122	20.9
Career structure	85	14.6
Financial reward (salary and benefits) – starting	54	9.3
Financial reward (salary and benefits) - experienced	40	6.9

Table 5: Motivations for Early Career Teachers to become teachers

Comparison of Motivations Between Samples

Based on the results of this study, there is a significant difference between UG survey respondents motivations and ECT respondents motivations, r_s= .84, *p*<.05. For the top 5 responses, examination of Table 6 suggests identical motivators influencing decisions. However, the importance of these shifted between cohorts. Examining Table 6, results suggest:

- Top influence differs between the groups. For undergraduates it is *contribution to society* and for ECT it is *love of subject area*.
- The importance of *work/life balance* is less of a motivator for ECTs compared to undergraduates.
- *Personal reward* is higher for ECTs compared to undergraduates.

For the remaining categories, of interest is that *parental occupation* is stronger for early career teachers, and *career structure* is stronger for UG survey respondents. The least motivating factor was identified as *financial reward* for early career teachers, whereas *parental occupation* was listed as the least motivating factor for the UG cohort.

Description	UG (N=182)		ECT (N=583)	
	n	Rank	*n*	Rank
Contribution to society	147	1	324	3
Love of subject/area	143	2.5	450	1
Work-life balance/holidays	143	2.5	289	5
Personal reward (or personal satisfaction)	138	4	381	2
Past teachers	135	5	310	4
Job security	124	6	228	7
School experience	123	7	233	6
Career structure	114	8	85	9
Financial reward (salary and benefits) – starting	89	9	54	10
Financial reward (salary and benefits) - experienced	89	9	40	11
Parental occupation	58	11	122	8

Table 6: Comparison between cohorts on motivations regarding becoming/being a maths/science teacher

Discussion

What Motivates People to Become Science and Mathematics Teachers?

When tasked with investigating motivations for teaching, undergraduate STEM discipline cohorts are often overlooked. With teacher shortages reaching crisis point, it is important for higher education institutions to understand what might motivate STEM cohorts to consider teaching as a career. This represents an under-studied area of teacher development – time spent in university prior to enrolment in a teaching course. For undergraduates (who were not yet enrolled in an education degree) the strongest potential motivator was an altruistic belief that becoming a teacher will make a significant contribution to society (81% of respondents). Second to this was a love of subject area (79%), ranked equally alongside work-life balance (79%). A majority of undergraduates also listed personal reward (76%), past teachers (74%), job security (68%), school experience (68%) and career structure (63%). This suggests that, in relation to the model presented in Figure 1, there is significant intrinsic motivation for the undergraduate students to become STEM teachers. A corollary of this is that consciousness raising about the profession, addressing negative perceptions of the profession, and making extrinsic factors (such as salary and working conditions) more appealing, are places that policy makers might look if they wish to increase rates of STEM undergraduates looking towards a career in teaching.

Which Motivations are still Relevant for Early Career Teachers?

For early career teachers, a change in motivations was noted. This change may, in part, be due to realities of teaching setting in, thus motivations shift. This part of the present study replicated other studies of in-service teachers self-reporting their motivations for joining the profession. The findings showed that motivations of mathematics and science early career teachers were similar to those of the general teaching population, reported by Watt et al. (2012). There is a recurring result that early career teachers are more likely to be influenced by intrinsic motivators (e.g., personal reward or a love of subject area) than by extrinsic motivators (e.g., financial reward or longer holidays). This was echoed by the current study.

Comparing motivations between those at undergraduate level and those at the early career teacher stage reveals both continuity and change. The motivation of contributing to society drops from first to third ranking with a drop from 81% to 56% of respondents. One interpretation of this is that the *reality shock* of entering the classroom leads many teachers to realise that their altruistic ideals take second place to the day-to-day realities of surviving in the classroom (Maxwell, Harrington, & Smith, 2010; Helsel DeWert, Babinski, & Jones, 2003; Veenman, 1984). Similarly, the motivator of a work-life balance drops from 79% (UG) down to 50% (ECT) which we attribute to teachers coming to understand the significant demands of a full-time teaching workload. A similar story is likely to be behind the large differences that were seen in the motivation for financial reward, with starting salary as motivator dropping from 49% UG down to 9% ECT, and experienced salary as motivator dropping from 49% down to 7%. Career structure as a motivator dropped from 63% down to 15%. Again, we interpret these as the reality shock of entering the profession. Job security, whilst affected (from 68% to 39%) remained a significant motivator – potentially indicative of a sentiment that teachers still feel they maintain security of employment. One possible reason for this drop, drawing upon SDT (Deci & Ryan, 1975), is that teachers' basic psychological needs (e.g., autonomy, relatedness, and competence) are not being met within the profession—their intrinsic motivation becomes less of a factor in their day-to-day work and they rely upon extrinsic factors to remain within the profession. Further discussion of teachers' sustained intrinsic motivation lies outside the scope of this paper, but is addressed from the perspective of *quality retention* in the work of Day and Gu (2009).

In contrast, the motivator of a love of subject area does not change substantially from its result in undergraduate pre-teaching students (78%) to early career teachers (77%). For mathematics and science teachers it appears that a love of subject area is the foundation that remains after reality shock has passed. This, then, has further implications for recruitment of teachers through discipline courses. In particular, recruiting STEM disciplines with a love of subject area has the potential to alleviate teacher shortages, a key goal in the sector.

The sense of personal reward or satisfaction experienced minimal change, only dropping from 76% down to 65%. With studies suggesting that intrinsic motivations are strongly correlated with retention (e.g., Ashiedu & Scott-Ladd, 2012), this finding is of importance for the sector. In the early stages of teaching careers, research suggests graduate teachers feel isolated and, on occasion, quite stressed. This, in turn, may lead to burnout and high teacher turnover with the first 3 to 5years being the most critical. By understanding that personal reward and satisfaction motivates teachers, highlighting factors supporting this motivation to educators during times of stress may be of benefit.

A final result is that the listing of past teachers as a motivator drops from 74% UG to 53% ECT. Clearly the actual experiences of past teachers has not changed in this time as both UG and ECT are post-secondary; however, the interpretation of memories seems to have shifted for these early career teachers. Many interpretations are possible: Perhaps early career teachers are feeling a generalised lack of motivation that is being indicated here. Perhaps with their newfound understanding of the profession they have a different opinion on their prior role models. The continuing presence of this motivator for a majority of early career teachers suggests that the influence of past teachers remains a significant part of the formation of their professional identity, as described by Flores and Day (2006).

Psychological Motivations Relevant to Higher Education Policy

The motivations to enter the profession stated by science and mathematics teachers in the study appear to fit with theoretical understandings from the literature. In the study, changing motivations were observed between pre-teaching and early career stages. From SDT we have an expectation that the basic psychological needs of competence, relatedness and autonomy will be present at any stage within the career progression and acting to provide intrinsic motivation. In this study, the motivations of *personal reward* (generalised intrinsic motivation) and *love of subject area* (indication of self-perceived competence) relate most strongly to these basic psychological needs, and indeed these become the two most significant motivators amongst early career science and maths teachers. The third ranked motivation, *contribution to society*, can also be interpreted as an intrinsic motivator of relatedness; although it should be noted that this motivator could have been interpreted in many ways.

In contrast, the extrinsic motivators have a decreasing influence between the two cohorts that were studied. Where the circumstances change, or where realities become more apparent, these extrinsic motivators are quick to drop away to where they are ranked below the intrinsic motivators. Indeed, one way to interpret the rankings from early career teachers is as positions 1-3 related to intrinsic motivators, 4 related to memories of past teachers, and 5-11 related to the realities of extrinsic factors within the teaching profession; where holidays and school experiences are a part of the reality, but financial rewards and career structure are critically viewed by in-service teachers.

As described in numerous studies of teacher motivations within the literature, there is a need for policy makers to attend to both intrinsic and extrinsic factors. Whilst there is no one model that can claim to show definitively how these factors relate to each other and to teacher final behaviours, there is enough of a consensus within the literature (e.g., between Figure 1 and Figure 2) for policy makers to ensure that all aspects of motivation are considered. For example, referring to the model in Figure 1, for an undergraduate student to decide to enter the profession as a maths or science teacher they must first have *knowledge* about this possibility. How many university STEM academics present teaching within STEM disciplines as a potential career for their students? They also need to have *values* and *emotions* that are consonant with this behaviour, which are both informed by knowledge and can be influenced by feedback. And even if an academic has knowledge about becoming a STEM teacher, and positive values and emotions relating to it, external factors can be influenced through policy to increase the likelihood of an undergraduate student taking a teaching degree, and then going on to enter the profession (Rots et al., 2010), as shown in Figure 2.

Implications for Policy and Practice

Whilst previous research has examined motivations for selecting a career in teaching in general, little research has focussed on motivations for science and mathematics teachers. With results suggesting the importance of particular motivations in this space, the higher education sector should adjust recruitment and policy documents to attract additional students to this area. Providing evidence on what motivates students to become teachers, including data on what continues to motivate graduate teachers, is important not only to the higher education sector, but also the school sector and for STEM undergraduate students.

Results suggest that certain motivators remain constant for both those who may become a teacher and graduate teachers. Higher education institutions must appeal to these motivators in their recruitment in order to raise the number of graduate STEM teachers, but also to prevent staff turnover. For example, appealing to *love of subject area* should be consistent in marketing programs, over motivations such as financial reward which are not highly ranked as important. By developing recruitment that harnesses understanding of motivations, STEM undergraduate students may also be provided with exposure to the teaching sector, providing them with increased understanding of other career trajectories. For the school sector, this may increase teacher availability. This research suggests the higher education sector needs a more holistic view towards recruitment in pre-service teacher education courses, focussing on more than one motivator, and correctly identifying motivators, which is important to consider in recruitment policy and practice.

Limitations and Future Research

Limitations must be considered when drawing conclusions from this work. Firstly, the undergraduate student sample was male dominated, with self-selection into the sample. Secondly, respondents could select multiple reasons for an interest in a career in teaching. Thirdly, the sample may not have had an interest in teaching, so in future research it would be of benefit to draw participants from an undergraduate preservice teacher course to draw further conclusions about motivations. Future research could consider these limitations in their design and conduct further studies on relevant populations. There is potential for researchers to study motivations longitudinally, to explore whether these change over time.

Conclusion

There is an identified shortage of science and mathematics teachers in Queensland and Australia. To assist in addressing this shortage, it is important to examine why people might want to become teachers, and to harness this information to inform recruitment into STEM preservice teacher courses. This research provides information on what might motivate a student to become a teacher, providing crucial information for the higher education sector and education policy makers. Higher education can target specific populations and provide more tailored resources for STEM undergraduate students. Love of subject area should be the focus for convincing STEM undergraduates to consider teaching as a career and help address the national shortage of teachers in mathematics and science areas.

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