International Journal of
Gender, Science and Technology

Selected papers presented at the 2nd Network Gender & STEM Conference, 3–5 July 2014, in Berlin, Germany

In association with

NETWORK GENDER & STEM
educational and occupational pathways and participation

Gendered Teacher Expectations of Mathematics Achievement in New Zealand: Contributing to a Kink at the Base of the STEM Pipeline

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ABSTRACT

Women remain under-represented in mathematics-related domains, despite demonstrating that their ability in these domains is equal to that of men. Teacher expectation has been identified as one factor that may explain differences in student outcomes, and student gender has been influential in shaping such expectation. However, while the association between teacher gender and mathematics achievement has been explored, there exists a paucity of studies that have probed how teacher gender relates to teacher expectations of mathematics 1903achievement. The current study was conducted with a sample of elementary schools in New Zealand, a national context where the implementation of policies advocating educational gender equity has been criticized as ineffective. Differentiated male and female teacher expectations, and the influence of teacher–student gender match and mismatch on teacher expectations of student achievement in mathematics, were explored using hierarchical linear modelling. In addition, the study explored whether such teacher expectations supported an intention to foster educational gender equity, or reflected stereotypical gender norms that ran counter to that intent. The current study found that teacher gender was associated significantly with teacher expectations of student achievement in mathematics, revealing possible implications for males in the teaching profession, and for female students' future involvement in mathematics and related fields.

KEYWORDS

Teacher expectations; gender; mathematics; STEM

Gendered Teacher Expectations of Mathematics Achievement in New Zealand: Contributing to a Kink at the Base of the STEM Pipeline

Women and girls remain consistently under-represented in science, technology, engineering and mathematics (STEM) fields (Watt, 2010), despite interventions and policy changes (Karp & Niemi, 2000; Tate, 1997) that have accounted for the closing of the gender gap in mathematics achievement. Further, young women's avoidance of STEM subjects and careers continues to occur within a contemporary educational climate that has been suggested by many (e.g., Helbig, 2012; Martinot, Bagès & Desért, 2012) to advantage female students. Research (e.g., Halpern, Benbow, Geary, Gur, Hyde & Gernsbacher, 2007) has suggested that the influence of societal and cultural messages and expectations (e.g., parental expectations, and the stereotyping of mathematics as masculine), explains why fewer females than males opt for mathematics-related fields. Among such socio-cultural influences, teacher expectations have been found to mediate stereotypical messages about gender and achievement (Younger & Warrington, 2008). Moreover, as teacher gender has affected teachers' subjective evaluations of their students (Ehrenberg, Goldhaber & Brewer, 1995), and teacher assessment of student competence (Hopf & Hatzichristou, 1999), it is worth considering whether teacher gender might influence teacher expectations of student achievement in mathematics. Specifically, the current study investigated whether teacher gender was associated with teacher expectations of student mathematics achievement in a way that potentially contributes to reducing the aspirations of young women to enter STEM fields.

Teacher Expectations of Student Achievement

Differential teacher expectations have been named among the factors that shape differences in students' academic outcomes. From the seminal research of Rosenthal and Jacobsen (1968) to that of more recent times (e.g., Rubie-Davies, 2010), teacher expectations have been found to influence students' sense of self-efficacy and their academic outcomes in either positive or negative ways. Page and Rosenthal (1990) found that teachers' stereotypical beliefs about Asian and male superiority in mathematics were expressed in teaching behaviours associated with an increased learning opportunity for those groups. Teachers observed instructing Asian and male students displayed higher-quality teaching behaviours than when mathematics students were female and White (Page & Rosenthal, 1990). The authors suggested that through such behaviours teachers could consciously and unconsciously communicate indications of perceived ability to students that could be transformed into self-fulfilling prophecies. Self-fulfilling prophecies come into being when teacher beliefs embodied as teacher behaviours influence students' own beliefs about themselves, and result in student behaviours that match the original teacher beliefs.

The stereotyping of particular groups may help explain why some teachers form particular expectations for certain groups (Hatchell, 1998) and why those groups are also more susceptible to stereotype effects (Steele, 1997). Gender-related stereotypes in STEM-related subjects are commonly held (Li, 1999), and these may bias teacher expectations of student achievement in STEM fields. The widely known mathematics stereotype (discussed below) may also make female students more susceptible to the effects of these biased teacher expectations, influencing what students believe about their own STEM field abilities, and ultimately their academic outcomes (Eccles & Wigfield, 1985). Thus teacher expectations based on stereotypical gender beliefs have the potential to become self-fulfilling prophecies for students, founded on inaccuracies and promoting inequity.

Teacher expectations have been found to be strongly predicted by *student gender* (Dusek & Joseph, 1985; Jussim, Eccles & Madon, 1996). However, little is known about the influence of *teacher gender* on teacher expectations of student achievement in mathematics. Further, it is not known whether teacher expectations of student mathematics achievement vary when there is a teacher–student gender match or mismatch. The stereotypical gender beliefs and attitudes that teachers have held for their male and female mathematics students, and beliefs about gender-role conformity, within the New Zealand context are discussed below as possible influences on teachers' gendered expectations. In addition, research that has investigated student mathematics achievement outcomes for same- and opposite-gender teacher–student dyads is considered with regard to students nested in the classrooms of male and female teachers.

Teachers' Gendered Beliefs about Student Ability in Mathematics

Certain subjects, roles, and activities have been stereotypically gender-typed masculine or feminine, with mathematics being historically associated with masculinity (Li, 1999; Neugebauer, Helbig & Landmann, 2011). The gendering of mathematics as a masculine domain has been associated with teacher expectations that boys rather than girls would find mathematics more useful and enjoyable (e.g., Beilock, Gunderson, Ramirez & Levine, 2010), and teachers' stereotypical beliefs about mathematics have been related to student perception of personal ability in that domain (Tiedemann, 2000). Similarly, teachers' tendency to overrate boys' mathematics capabilities, higher expectations of boys' mathematics achievement, and more positive attitudes towards boys than girls in mathematics have been associated with the gendering of mathematics as a masculine content domain (Li, 1999; Tiedemann, 2000). In a meta-analysis of studies conducted in a wide range of countries, Li noted that teachers' gendered beliefs were expressed as teacher behaviours (such as higher rates of teacher–male student interaction) that advantaged boys. She also reported that beliefs for teachers of both genders reflected the stereotypical gendering of mathematics as a masculine domain.

A climate of beliefs about mathematics that favours boys has existed in New Zealand. Fry (1985) reported that in the 1970s a dichotomy of subject choice (with girls choosing arts subjects and boys dominating sciences) still reflected the gender prescription that had shaped the New Zealand curriculum since the late 1880s. Within this gendered curriculum, New Zealand girls have received the messages that they were not expected to be able students in mathematics and science, and have consequently abandoned ideas of success, adopting a stance of learned helplessness in these subjects (Bradstreet, 2000). More recent research (Martinot et al., 2012) has reported that the gender stereotyping of mathematics (although diminishing in France) continues to disadvantage girls in a range of OECD countries, suggesting this is an international problem. Indeed, the authors specifically identify New Zealand as an example of a country where stereotypical gender beliefs concerning the lower ability of girls in mathematics are still likely to exist, and claim that this corresponds to a gender achievement gap (albeit reduced) that disadvantages girls in mathematics.

Teacher Gender and Teacher Beliefs about Gender-Role Conformity

Teachers' beliefs have been linked to their stereotypical expectations of sex role and gender (Dusek & Joseph, 1985) and teachers have actively endorsed gender-role conformity (Martino & Pallotta-Chiarolli, 2003). Specifically, research investigating Swedish, New Zealand and British teacher beliefs (e.g., Cushman, 2010) has suggested that male teachers may hold stereotypical gender views with more strength than their female counterparts. In a similar vein, the attitudes of British male elementary-school teachers have strongly reinforced ideas of stereotypical masculine gender norms, possibly in order to affirm masculine identity within the traditionally feminine domain of teaching (Skelton, 2003).

Further, male and female teachers' educational styles have differed, demonstrating conformity to normative gender roles (Brophy, 1985). Brophy reported that male teachers preferred compliant students and interacted more frequently with boys (although they were more critical of them). In contrast, female teachers created class climates that were more collaborative, asked questions of their students rather than lecturing them, and evidenced a more student-centred style than the teacher-centred style associated with male teachers (Brophy, 1985). He suggested that female teacher behaviours matched traditionally expected female gender roles such as nurturing, while male teacher behaviours aligned with the agentic gender-role stereotypically associated with males. Thus, ideas of gender conformity also seemed to influence teachers' own style. However, as much of the above research (e.g., Brophy, 1985) was conducted in Western countries, caution must be observed in applying ideas of gender and gender-role conformity across contexts.

Measures to reduce gender discrimination in educational settings have been implemented, with evidence of success in some countries. In Greece, for example, the eradication of single-sex education and gender-stereotypic images in school texts was followed by an increase in the percentage of female students graduating from high school (noted to occur before such an increase in other industrialized countries), and an almost equal representation of male and female students at university (Hopf & Hatzichristou, 1995). Moreover, in Sweden, reforms to promote educational gender equity have concentrated on equitable treatment of males and females independent of essentialist (gender-dichotomized) conceptualizations of gender, successfully challenging gender-role conformity (Cushman, 2010).

In New Zealand, however, the implementation of educational policy changes advocating scholastic gender equity have been claimed as largely ineffective, and gender equity awareness has been all but ignored in teacher education programs

(Cushman, 2010). An explanation may lie within New Zealand's specific gender context: essentialist ideas of gender-specific characteristics (e.g., the possession of physical strength and stoicism for men) have been emphatically valued (Ferguson, 2004), gender-role conformity has been promoted, especially for males (Rout, 1997), and issues of gender equity have received attention later than in other countries (Williams & Sheehan, 2001). Thus it could be suggested that, in New Zealand, a less gender-equitable educational climate might exist than in some other countries.

Taken together, the research discussed above indicates that teachers might expect more of their male than their female mathematics students, and that teacher gender-stereotypical bias may be greater for male than female teachers. Further, specifically within the New Zealand context, male teachers' expectations of their students' achievement in mathematics may reflect a conservatism induced by societal expectations of conformity to masculine gender-role expectations. However, whether students might benefit or not from teacher expectations experienced within same- or opposite-gender teacher–student dyads remains to be considered.

Teacher Gender and Student Mathematics Outcomes

Evidence suggesting the influence of teacher gender match and mismatch on student outcomes has been mixed and inconclusive. For example, in research that explored the effect of teacher gender on students' attitudes to and opinions on mathematics (Francis et al., 2008), no significant teacher–student gender interaction was found at all. Further, researchers have alternatively confirmed (e.g., Dee, 2007), and refuted (e.g., Driessen, 2007), claims that a teacher–student gender match influences student achievement in mathematics, while others (e.g., Ammermüller & Dolton, 2006) have found that both male and female students benefit from a teacher–student gender match in mathematics in the United Kingdom, but not in the United States, indicating the importance of context.

More recent research (Cho, 2012), incorporated a critical overview of extant theoretical and empirical studies to comprehensively address the debate surrounding the advantage of teacher–student gender match for student academic achievement. Utilizing the 1995 to 2007 assessment waves of the Trends in Mathematics and Science Study (TIMSS) database, Cho employed a fixed effects model, finding no influence of teacher–student gender match on student achievement (including that in mathematics) in 15 OECD countries. She contested Dee's results, explaining that his database (the United States' National Educational Longitudinal Study [NELS] of 1988) limited generalizability of findings compared to the TIMSS, and citing methodological issues as compromising accuracy. Importantly, Cho found that the isolated cases where there were positive correlations between teacher–student gender match and student outcomes could be explained by teacher quality rather than teacher gender.

Her findings were corroborated in other contexts, and with other databases. Thus, Driessen's (2007) study of 5,181 Dutch elementary students and their 251 teachers revealed no influence of teacher gender match or mismatch on student mathematics achievement, attitude or behaviour. This finding was also supported in Carrington, Tymms and Merrell's (2008) study of 413 classes (300 with female teachers) of British 11-year-old students; Holmlund and Sund's (2008) research with upper-secondary-school students in 69 Stockholm schools; and Burusic, Barbarovic and Seric's (2012) study, comprising 48,232 fourth- graders (49.14% girls) and 46,196 eighth-graders (48.64% girls) from all 844 elementary schools in Croatia.

Nevertheless, other research (Helbig, 2012) found that although male teachers may not advantage boys' mathematics learning, girls may benefit from female teachers in mathematics. Further, research including students from five Indian states (Chudgar & Sankar, 2008) revealed that students taught by female teachers achieved higher scores in mathematics. This result was replicated in a Catalan study (Escardibul & Mora, 2013) involving 387 secondary-school students in a blind-scored international mathematics test, an investigation of 3,446 students from 110 Israeli public schools (Klein, 2004), and a study of 49,415 Washington fourth-graders (Krieg, 2005). Notably, Krieg suggested that differential treatment of students depended on *teacher* not student gender.

Comparing the NELS data of 1988 and 1990, Ehrenberg and colleagues asserted that, while teacher gender had little to do with how much students learned, a teacher–student gender match was associated with higher subjective evaluations of mathematics students. Further, Hopf and Hatzichristou investigated a sample of 1041 Greek elementary-school students, and their 36 (29 male, and 7 female) teachers, finding that female teachers evaluated student behaviour more positively than male teachers. Similarly, a natural experiment involving senior Israeli students' matriculation scores, calculated as the average of school-based non-blind (potentially subjective) and blind scores (Lavy 2004), revealed that discrimination against boys (not girls) in mathematics was linked to teacher gender. Importantly, the total amount of teacher bias observed by Lavy was attributable to the male teachers alone. In sum, no advantage of a teacher–student gender match or mismatch was found in the majority of studies (e.g., Burusic et al., 2012; Cho, 2012). However, teacher gender appeared to affect student mathematics outcomes, with students with female teachers being advantaged in a range of contexts (e.g., Escardibul & Mora, 2013), compared to those with male teachers.

In order to isolate the influence of teacher gender and teacher–student gender match and mismatch on teacher expectations, other potentially influential variables were controlled for in the present study. Socio-economic status (SES) (e.g., Auwarter & Arguete, 2008), prior achievement (e.g., Rubie-Davies, Weinstein, Huang, Gregory & Cowan, 2014), and student ethnicity (e.g., Baron, Tom & Cooper, 1985) were identified as key variables which could potentially cloud the specific influence of teacher gender on teacher expectations. Teacher expectations of student academic success have been positively and significantly related to teacher perceptions of student SES (Auwarter & Arguete, 2008). Further, greater expectation of achievement has been associated with students with greater academic ability (Tach & Farkas, 2006). Similarly, it has been found that teachers have higher expectations for their Asian students than for those from other ethnicities (Goyette & Xie, 1999). Moreover, Goyette and Xie found that teacher expectations had the power to heighten academic self-perception and achievement for Asian students. Such variables may have occluded the ability to view the specific role that teacher gender (particularly as opposed to student gender) might play in teacher expectations.

The Current Study

The current study sought to investigate whether teacher gender predicted teachers' expectations of their students' academic achievement in mathematics. Beyond the general question of whether teacher gender mattered, the issue of the teacher–student gender match/mismatch was statistically considered via hierarchical linear modelling. Further, to understand the discrete contributions of teacher–student gender match and mismatch to teacher expectations of their students in mathematics, the socio-economic level of the school, student ethnicity, and demonstrated ability were entered into the hierarchical linear models first. Lastly, the study sought to investigate whether teacher expectations reflected the gender equity advocated in New Zealand educational policy.

The current study hypothesized that, when socio-economic status, prior achievement and ethnicity were statistically accounted for, a) teachers would expect to see greater achievement on the part of their male rather than their female mathematics students, reflecting gender stereotypes associated with mathematics; b) teacher expectations would not advantage students where there was a teacher–student gender match or mismatch; c) teacher gender would influence teacher expectations of student achievement in mathematics such that male teachers would demonstrate lower expectations than female teachers; and d) teacher expectations would reflect gender-role conformity rather than the policy of educational gender equity advocated in New Zealand.

METHOD

The unique context of the current study enabled data to be collected across a wide range of cultures and from a large sample size. Data collection occurred in the initial phase of a wider three-year longitudinal intervention study that investigated whether teacher expectations of their elementary-school students could be raised and sustained, and how this might affect student achievement outcomes (see Rubie-Davies, Peterson, Sibley & Rosenthal, 2015). Exploration of the baseline data allowed for investigation of student and teacher gender as a factor in teacher expectations. In addition, the current study augmented a central aim of the longitudinal study in investigating what it was about *teachers'* (rather than *students'*) behaviour and beliefs that shaped expectations (Rubie-Davies, 2015).

Participants

Following ethical approval, 12 New Zealand elementary schools comprising a range of SES levels (where SES is based on a 10-point scale, with 1 assigned to the poorest schools and 10 the most affluent) were recruited for the study. Participant demographic information is presented in Table 1.

Table 1
Participant Demographic Information at Student Level, Teacher Level, and Teacher Level by School

Student level (*N* = 1905)

Gender	Male 50.1%	Female 49.9%				
Ethnicity	NZ European 43.7%	Māori 17.8%	Pacific Island 15.9%	Asian 14.5%	Other 8.1%	
Age	7 years 8.1%	8 years 18.4%	9 years 19.2%	10 years 19.9%	11 years 17.3%	12 years 17.1%

Teacher level (*N* = 85)

Gender	Male 27.1 %	Female 72.9%

Gender distribution by school type

SES	School ID	Teacher % by gender (M/F)	% Male students in class	% Female students in class
Low SES				
	A–C	M 28	50	50
		F 72	46	54
Mid SES				
	D–I	M 31	47	53
		F 69	50	50
High SES				
	J–L	M 11	47	53
		F 89	55	45

Note: Low SES levels 1-3; Mid SES levels 4-7; High SES levels 8-10.

Measures

Two measures were used in this study, one to measure teachers' expectations and one to measure students' achievement. These will be described below.

Teacher expectation measure

A teacher expectation measure (Rubie-Davies, 2015) was administered four weeks into the academic year, allowing teachers to estimate the level that they believed each student would achieve in mathematics by the year's end. Previous research (Raudenbush, 1984) has shown that teachers form their expectations for students early in the school year, and that these then remain relatively stable (Kuklinski & Weinstein, 2000). Teachers' expectation levels were based on national curriculum levels, and were indicated on a 1–7-point Likert scale measured thus: 1 = *very much below average,* 2 = *moderately below average,* 3 = *slightly below average,* 4 = *average,* 5 = *slightly above average,* 6 = *moderately above average,* 7 = *very much above average*.

Student achievement

Student achievement in mathematics was measured using e-asTTle (e-asTTle Project Team, 2009). e-asTTle is an online assessment tool designed to assess students' progress in reading, mathematics and writing. Customized numeracy tests, which are aligned with the national curriculum levels 1–6, can be created and analyzed with e-asTTle.

The current version of e-asTTle was verified in national norming trials from 2009–2010, and all items were calibrated using item response theory (IRT) (Embretson & Reise, 2000). The published standard error of measurement for any e-asTTle test is 15 points, with a standard deviation of 100 for each year level (see e-asTTle website: http://e-asttle.tki.org.nz/). The IRT process ensures confidence that tests are consistent across e-asTTle test levels, and affords comparison of students' total scores, even when different tests are administered to different students.

Since expected scores differ by year level, the published normative expectation was subtracted from each student's overall total mathematics score to control for maturational differences. This process generates a 'standardized' score indicating the distance from the norm, and aligns achievement across year levels without affecting the standard deviation of the scale. In the current sample, average achievement was approximately equivalent to the normative sample (M = -6.14, SD = 77.2).

Procedures

Participating teachers completed the expectation measure approximately four weeks into the school year but before they had access to standardized test results for that year. Shortly afterwards, the e-asTTle tests for mathematics were completed by the students. In order to ensure that teachers' opinions about their students were subjective (see Raudenbush, 1984) rather than informed, teachers were asked not to refer to students' prior achievement information.

With a view to measuring student achievement in this study, the teachers selected tests created for the study in paper and pencil form. The tests had been designed at each curriculum level (e.g., Level 2, Level 2/3, Level 3, Level 3/4, Level 4, Level 4/5), and the teachers decided how many tests they needed at each of the curriculum levels, for the approximate levels of achievement of their class. Once all tests had been completed, they were marked by the research team. The overall total scores for mathematics generated by the e-asTTle computer system were used in this study ('centred', as above) to represent student achievement.

Data collection for this study occurred between February and March 2011, and analyses were carried out using IBM SPSS v 22.0 (2013) and MLwiN v 2.32 (Rasbash, Charlton, Browne, Healy & Cameron, 2015).

Analysis Procedures

Two-way between-group analyses of variance (ANOVAs) were conducted to investigate whether there were gender differences in student achievement in mathematics, and whether teachers' expectations for boys were different from those for girls. The interaction effect between student and teacher gender was also explored.

To investigate the relation between gender and teacher expectations while controlling for student achievement, hierarchical linear modelling (HLM) was employed. HLM is a multilevel regression framework that incorporates information about how the data are hierarchically structured, within the model. Educational data generally violate the independence assumption owing to the degree of similarity among students within a particular classroom, or attending a particular school (Osborne, 2000). Within the HLM framework, students in the same school can be conceptualized as nested within schools, with students at level one and schools at level two. In the current study, since the focus is on teacher expectations, classrooms have been treated as level two within the hierarchy. It is possible to include school as a third hierarchical level, but this was unnecessary since only a small proportion of additional variance was explained at the school level after the inclusion of classrooms (<1%).

As noted in the Introduction, socio-economic status (SES) (e.g., Auwarter & Arguete, 2008), prior achievement (e.g., Rubie-Davies et al., 2014), and student ethnicity (e.g., Baron et al., 1985) were considered likely to cloud the specific influence of teacher gender on teacher expectations. Therefore, each of these variables was entered into the models first, prior to the inclusion of the gender variables. Since achievement had already been 'centred' against the normative expectations, it was not centred further. Socio-economic status was centred at the school level, so that the intercept could be interpreted in terms of attending a school with an average, aggregate socio-economic profile. Ethnicity was entered as a polytomous categorical variable, with Māori, Pasifika (Pacific Island) and Asian students as binary dummy variables, and NZ European and 'other' students as the reference category. Gender was included in a similar manner. Since there were four possible scenarios (male teacher, male/female student; female teacher, male/female student), the most common category was included as the reference category (female teacher and female student), and the other three groups were included as binary dummy variables.

RESULTS

Teacher Expectations of Student Achievement in Mathematics

Table 2
Means and Standard Deviations for Teacher Expectations of Achievement Level (TEAL), and Student Achievement (SA), in Mathematics, by Teacher and Student Gender

Teacher Gender	Mathematics TEAL/SA	Student Gender	*N*	*M (SD)*
Male	Mathematics TEAL	Boys	352	4.33 (1.36)
		Girls	309	4.28 (1.21)
Female		Boys	883	4.84 (1.45)
		Girls	879	4.88 (1.35)
Total		Boys	1235	4.69 (1.45)
		Girls	1188	4.72 (1.34)
Male	Mathematics SA	Boys	272	-4.23 (73.05)
		Girls	246	-16.75 (71.51)
Female		Boys	682	-6.57 (85.50)
		Girls	705	-2.57 (71.84)
Total		Boys	954	1423.58 (101.34)
		Girls	951	1424.20 (94.41)

The two-way between-groups analyses of variance (ANOVAs) indicated that there was no difference in overall achievement levels by student gender (F = 1.2, p = .27). Achievement was marginally lower in classrooms with male teachers, but this was not significant (F = 2.15, p = .14). There was, however, a significant interaction effect (F = 4.22, p = .04), with average achievement among girls in classrooms with male teachers significantly lower than boys' achievement in classrooms with male teachers. In classrooms with female teachers, this pattern was reversed, although the difference was small and not statistically significant (see Table 2 for descriptive statistics).

With regard to teacher expectations, overall there was no difference in teacher expectations for boys compared with girls ($F = .01$, $p = .92$), nor was there an interaction effect between teacher and student gender ($F = .66$, $p = .42$). There was, however, a significant effect of teacher gender, with male teachers typically having lower expectations of students' mathematics achievement ($F = 79.19$, $p < .001$). These results suggest that teacher expectations (TEAL) differ as a function of teacher gender, rather than student gender, even though girls appear to be achieving lower scores in classrooms with male teachers. To investigate this further, while controlling for other possible confounding variables, a series of HLMs were conducted. The results are presented in Table 3.

Table 3
HLM Predicting TEAL from Teacher–Student Gender Match and Mismatch, and Student Achievement in Mathematics

Parameter	Unconditional Model	Final Model
	Fixed effects	
Intercept	4.701 (0.088)	5.182 (0.201)
Level 1		
(student-specific)		
e-asTTle Maths vs. Norm	-	0.0094*** (0.0003)
Māori	-	-0.029 (0.059)
Pasifika	-	0.067 (0.065)
Asian	-	0.315*** (0.062)
(student–teacher gender match/mismatch)		
Male Teacher–Male Student	-	-0.554** (0.187)
Male Teacher–Female Student	-	-0.59*** (0.188)
Female Teacher–Male Student	-	-0.042 (0.047)
Level 2		
(class-specific)		
School SES (centred)	-	-0.067* (0.027)
Between class variance (σ^2_{u0})	0.667*** (0.106)	0.526*** (0.086)
Between student variance (σ^2_{e})	1.299*** (0.038)	0.741*** (0.025)
Variance Partition Coefficient $\left(\frac{\sigma^2_{u0}}{\sigma^2_{u0}+\sigma^2_{e}}\right)$	0.339	0.415
-2*log likelihood	7755.9	5,067.6

Note: Parameter estimates are unstandardized, owing to missing achievement data; Model 1 N = 2,423 and Model 2 N = 1,903
*$p < .05$, **$p < .01$, ***$p < .001$

To control for individual differences in achievement, after fitting the unconditional model, mathematics achievement was added first. This was followed by the possible confounding variables of school socio-economic factors (school SES) and student ethnicity. The quadrant relating to gender (the three dummy variables for student/teacher gender with female students in a classroom with a female teacher as the reference group) was entered last.

The results indicated that higher achievement in the standardized mathematics test was strongly associated with higher teacher expectations. While the parameter estimate appears very small, this is owing to the TEAL scale being markedly smaller (7 points) than the e-asTTle scale (~1000 point). The effect can be more easily quantified by converting to standard deviation units (SDU). The published standard deviation for the e-asTTle tool is 100, suggesting that, on average, a difference of 1 SDU translated into a difference in teacher expectation ratings of almost one point (on the 7-point scale). Several other covariates remained associated with teacher expectations, after controlling for achievement differences. While school SES was only marginally significant at the intercept, teachers in the most affluent schools within the sample (SES rating of 10) typically had significantly lower expectations than those in the most deprived schools within the sample (SES rating of 3). The average estimated TEAL difference between low and high SES schools in the sample is .47 (7 * .067). Expectations of NZ European, Other, Māori and Pasifika students were similar, but significantly higher for Asian students (TEAL difference = .32).

As with the ANOVA results, there were significant differences in expectations relating to *teacher,* rather than *student*, gender. On average, male teachers had lower expectations of both boys (TEAL difference = -.55) and girls (-.59). Conversely, female teachers' expectations were higher for both boys and girls.

DISCUSSION

No difference was found in overall teacher expectations of boys' and girls' mathematics achievement, nor did teacher expectations differ when there was a teacher–student gender match or mismatch. However, male teachers demonstrated lower expectations of mathematics achievement for students of both genders. These findings indicate that, for the current study, it was not student mathematics gender stereotypes but characteristics associated with teacher gender that shaped teacher expectations.

The finding central to the current study, that teacher rather than student gender influenced teacher expectations of student mathematics achievement, has implications for male teachers and their students. Given the idea that teacher expectations can result in self-fulfilling prophecies (e.g., Rubie-Davies, 2010), students in the classes of male teachers seemed potentially more at risk of lower future mathematics achievement than students with female teachers. This suggestion invites consideration of possible links between teacher gender, the practices of low- and high-expectation teachers (i.e., those who hold respectively low or high expectations of achievement for all the students in their class: Rubie-Davies, 2015, pp. 85–89), and differentiated outcomes for students in the classes of male or female teachers. Teaching behaviours observed by Brophy (1985) for male and female teachers, and those identified by Rubie-Davies (2015, pp. 85–89) for low- and high-expectation teachers (i.e., teacher-centred and student-centred respectively), seem to align. Further, female teachers' students seemed advantaged when it came to achievement in mathematics (e.g., Escardibul & Mora, 2013), and male students benefit from an opposite-gendered teacher–student relationship (Duffy, Warren & Walsh, 2001). The findings of the current study augment those mentioned above, indicating the need to further investigate interrelationships between teacher gender, teacher expectations, teaching style and, ultimately, student outcomes.

The central finding of the current study raised concern not only for the experience of students in male teachers' classes, however, but also for the male teachers themselves. Masculine identity has been threatened for males working in feminine roles (Bosson, Taylor & Prewitt-Freilino, 2006), and men have been pressured to define masculinity by eschewing behaviours considered feminine (Martino & Pallotta-Chiarolli, 2003), for example, nurturing and collaboration. Further, male primary-school teachers have been encouraged to model traditional masculine roles such as assertion and discipline (Skelton, 2003).

We suggest that such scenarios could be intensified by the gender-role conformity and gender-role modelling expected and applauded for male staff in New Zealand schools (e.g., Ferguson, 2004). It may be possible then that male teachers' expectations reflected a reactionary stance promoted by a particular context of expected gender-role conformity that potentially limited both their teaching habitus and the learning experience of their students. The central finding of the current study reinforced assertions (e.g., Cho, 2012) that increasing the numbers of male teachers would not benefit boys' learning in a feminized educational climate. More importantly, however, the need for identity-safe educational environments (e.g., Steele, 1997) in which thought and activity are free of gender-role expectations was highlighted for both staff and students in New Zealand schools.

An incidental finding further evidenced the need to facilitate gender-identity safety in New Zealand schools. Female students' mathematics scores were found to be significantly lower than those of male students, in the classes of male teachers. However, as male teachers' expectations in mathematics did not differ for their male and female students, it seems possible that other forces were at play. It is possible that the presence of a male teacher may have served to remind female students of the stereotype that implies their inferior ability in mathematics, triggering stereotype threat (e.g., Steele, 1997). Steele explained that stereotype threat works to compromise performance (and can result in disengagement from the threatening domain), as one grapples with the concern of personally confirming a negative stereotype associated with a group to which one belongs. We stress that this incidental finding reflects an average of results. Nevertheless negative implications could be suggested for some girls' involvement with mathematics as schooling progresses if they have a male teacher, especially as, in many national contexts (e.g., Sweden: Holmlund & Sund, 2008), male secondary-school mathematics teachers outnumber their female colleagues. In this scenario, the finding that a same-gender teacher might benefit girls' mathematics achievement (e.g., Helbig, 2012) seems worth considering. However, ensuring gender-safe scholastic environments (i.e., where scholastic choice is free of essentialist gender-role prescriptions) for female mathematics students in New Zealand seems a more enduring solution.

Further incidental findings were revealed. First, teacher expectations were higher overall for students with high mathematics achievement scores, supporting other research (e.g., Tach & Farkas, 2006) which found that more was demanded of students perceived as high achievers. Second, it was found that, after controlling for achievement differences, teachers in low SES schools expected more of their students than did those in higher SES groups, in sharp contrast to the findings of extant research (e.g., Auwarter & Arguete). An explanation should be given (see Rubie-Davies, Flint & McDonald, 2012) that teaching status in New Zealand is not associated with higher SES schools, as it can be in other countries (e.g., the United States: see McCaslin & Good, 2008). Further, teacher salaries are centrally funded in New Zealand, incentives are sometimes offered to teach in lower SES schools, and these schools receive more funding than their higher SES counterparts (Rubie-Davies et al., 2012). Thus, teachers who wish to make a difference (frequently those who are experienced and of high quality) often choose to teach in low SES schools, and considerable academic gains are made by their students per annum (Rubie-Davies, 2006). Third, in accord with existing research in other global contexts (e.g., Goyette & Xie, 1999), in mathematics, teacher expectations were higher for Asian students than for students of other ethnicities. Thus the current study augmented research on teacher expectation conducted in other national contexts, but also underlined the unique contribution of context to such research.

Importantly, the findings of the current study revealed a contradiction in terms, contrasting with the aim of gender equity advocated in New Zealand educational policy. A scholastic scenario that seemed at odds with a policy of gender equity was evidenced. This seemed to reflect male teachers' personal attitude to gender roles within a feminine gender-typed environment, rather than expectations reflecting a gender bias towards students' achievement in mathematics. Policy reforms are called for that uniformly address essentialist attitudes to gender in every sector of New Zealand society. Such reforms must refer to research that points to the reality of gendered attitudes and their consequences, as evidenced in New Zealand schools. Moreover, effective reforms that challenge the belief systems contributing to gender-inequitable and therefore identity-unsafe scholastic climates, and teacher education that raises teachers' awareness of their own behaviour (Younger & Warrington, 2008), seem fundamentally necessary to implement change.

LIMITATIONS AND FUTURE DIRECTIONS

Some limitations, such as missing data, were found for the current study. Of the 2423 students in the overall sample, 520 (21.5%) could not be included. Exclusion occurred for 518 students because they did not sit the e-asTTle mathematics test, while one student who sat the test did not provide his/her ethnicity, and another had no expectation data. Students without an e-asTTle achievement score were typically absent on the test day (38%), or unable to be tested as they were considered unable to cope with testing (e.g., special needs students; 58%). The remaining students had left the school before the test period, or were unable to be matched owing to inconsistencies between the student's official name and that used for the questionnaire data.

Chi-square analyses conducted to assess the distribution of missing data showed that there were no significant differences in the proportion of missing students by student or teacher gender, or student ethnicity. There were, however, differences by school SES, with more-affluent schools more likely to provide all data ($p < .01$). In addition, an independent samples *t*-test revealed that teachers typically had lower expectations of students who did not sit the e-asTTle mathematics test (average TEAL difference = .24, $p = .001$). These differences are unlikely to be of concern, since they follow the usual pattern of missing data within a schooling environment, but do warrant consideration.

Although the small sample of male teachers (27.1%) participating in the study was representative of the proportion of male teachers in New Zealand schools (e.g., Harker & Chapman, 2006), caution should be observed in generalizing the results of the analyses to other populations. Further, the lower proportion of male teachers observed for high SES schools in the current study necessitates caution when generalizing results to other high SES schools.

The current study revealed negative implications for mathematics achievement for students of both genders in male teachers' classes, and an additional situational press for girls. However, variables that may have mediated teacher expectations (e.g., teacher beliefs about stereotypical gender conformity, and student beliefs about mathematics ability) were not explored or controlled for. Nor were student perceptions of societal expectations that shape preference for scholastic domain (see Watson, 2012) measured. Further, we acknowledge that the extent to which such forces could have been experienced and endorsed by participants as 'threats in the air' (Steele, 1997) was not assessed.

Future researchers might consider that, as the effects of teacher gender on student mathematics outcomes (e.g., Neugebauer et al., 2011) have been investigated largely in developed-world countries, generalizability to developing-world contexts cannot be assumed. Neugebauer and colleagues observed that variations in equitable educational opportunity, proportional representation of male and female teachers in schools (e.g., a male majority of teachers in most African countries, and a female-teacher dominance for schools in OECD countries), and attitudes to gender equity, constitute important contextual differences. An exploration of the relationship between teacher gender and teacher expectations of student mathematics ability across developing-world contexts would valuably augment extant research. In addition, how teacher gender might affect teacher expectations in other content domains, specifically those gender-typed as feminine (e.g., reading), warrants exploration.

CONCLUSION

Teacher gender was found to influence teacher expectations, with negative implications for students taught mathematics by male teachers. Teachers' expectations have been found to mediate different levels of encouragement, instigate career direction (Ehrenberg et al., 1995), and induce self-fulfilling prophecies (Hatchell, 1998). Therefore, comparatively disadvantaged mathematics futures were projected for students with male teachers (and notably girls) in the current study, particularly so given Rubie-Davies and colleagues' (2014) suggestion that even small, subtle messages may accumulate over time to influence student outcomes. Longitudinal results will shed further light on the current findings, and will evaluate whether an intervention to raise teachers' expectations of all their students might also reduce differentially gendered teacher expectations and improve student outcomes. Importantly, raising teachers' gender awareness must be emphasized as integral to improving teacher quality, and enhancing the equitable future participation of female students in mathematics and related fields.

ACKNOWLEDGEMENTS
The current study was made possible by the awarding of a Marsden Fast Start Grant and a grant from the Cognition Institute, to the second author.

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