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Girls' and boys' perceived mathematics teacher beliefs, classroom learning environments and mathematical career intentions

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ABSTRACT

This longitudinal study examined the effects of students' perceived mathematics teachers' beliefs (expectations about students' ability and mathematics prestige), classroom goal orientations (mastery and performance-approach), and own mathematics motivational beliefs (success expectancies and task values) at grade 10 (T1), on girls' and boys' career intentions in mathematical fields at grade 11 (T2). Data were collected from 438 students (213 boys) in 5 metropolitan schools in Sydney and Melbourne, Australia. Multilevel SEM revealed links between teacher beliefs, learning environments, student motivations, and mathematical career intentions; different predictors operated at individual and classroom levels. Girls perceived lower teacher expectations than boys, but higher teacher mathematics prestige beliefs. Teachers' expectations and students' motivations were positively related to students' reported prior (grade 9) mathematics achievement. Teacher expectations promoted student-perceived mathematics classroom mastery-goal orientation (MGO) and performance-approach goal orientation (PGO); teachers' mathematics prestige beliefs also promoted PGO. MGO enhanced students' mathematics value, which in turn predicted, together with PGO, their mathematical career plans. Mathematics career plans were positively predicted by aggregate teacher mathematics prestige beliefs and aggregate classroom MGO.
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1. Introduction

Statistical reports show a persistent shortage of individuals entering advanced education in STEM disciplines (science, technology, engineering, and mathematics) among many countries of the OECD (2013), Australia (Marginson, Tytler, Freeman, & Roberts, 2013) and the USA (National Science Board, 2014). In the United States, for example, apparent increases in certain natural science degrees (i.e., physical sciences and mathematics) and in engineering degrees are related to the size of the college-age cohort rather than to a rise in the proportion of students who major in those fields (National Science Board, 2014). Instead, there has been a decline in degrees in certain STEM domains since 2000, such as computer sciences which only stabilized since 2005 (National Science Board, 2014). Across OECD countries, a similar situation has been reported indicating that only one-quarter of tertiary students pursue programs in science, engineering, manufacturing and construction fields (OECD, 2013, p. 294). Particularly among young women in OECD countries (OECD, 2013) participation is low in academic degrees and vocational training in STEM disciplines such as mechanical and electrical engineering, and European statistics reveal an underrepresentation of women (32%) in the labor force in science and engineering (European Commission, 2009). A similar situation exists in Australia concerning low participation in tertiary engineering degrees and a severe gender imbalance in STEM enrolments (AWPA, 2012; Bell, 2010; Marginson et al., 2013).

The trend of decreased participation and gendered career development in STEM has already begun in secondary school, when particularly girls decide not to choose advanced mathematics and science courses (Eccles, Vida, & Barber, 2004; Nagy et al., 2008; Watt, 2005). Drawing on Eccles and colleagues' expectancy-value framework (Eccles, 2005, 2009; Eccles et al., 1983) a large number of studies from the U.S. (e.g., Eccles et al., 2004; Jacobs & Simpkins, 2005; Simpkins, Davis-Kean, & Eccles, 2006), Australia (e.g., Watt, 2005, 2006; Watt et al., 2012) and Europe (Bøe, 2012; Köller, Daniels, Schnabel, & Baumert, 2001; Nagy, Trautwein, Baumert, Köller, & Garrett, 2006; Noack, 2004; Roeder & Gruehn, 1996) have demonstrated the salience of students' motivational beliefs—in terms of expectancies for success and task values—for course choices and career intentions. Students' motivational beliefs are strongly influenced by their learning environments (Anderman & Anderman, 2000; Eccles, 2004; Eccles & Roeser, 2009, 2011; Eccles, Wigfield, &

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Schiefele, 1998) which are frequently examined in terms of classroom goal structures (Anderman & Midgley, 1997; Meece, Anderman, & Anderman, 2006; Urdan, Midgley, & Anderman, 1998), whether mastery (focused on learning and understanding) or performance oriented (focused on competition and grades). Teachers' ability expectations also function as salient predictors of students' own success expectancies (Bohlmann & Weinstein, 2013; Jussim & Eccles, 1992; Jussim, Robustelli, & Cain, 2009) and interest (Madon et al., 2001; Wentzel, Battle, Russell, & Looney, 2010).

Although it is well investigated how each of teachers' beliefs and the classroom environments they create promote or reduce students' positive motivations, and how students' motivations predict their career intentions, there are gaps that need to be addressed. First, relationships between pairs of these sets of factors have been examined, rather than their simultaneous operation; including these factors within the one study allows us to explore their interactions in predicting mathematical career intentions. Second, although multilevel analyses of the effects of classroom environments on student motivations have been undertaken (Lau & Nie, 2008; Wolters, 2004), we ask whether patterns of influence may operate differently at each of the student and classroom levels for the included factors. Taken together, whether and how teacher beliefs and classroom environments indirectly impact gendered career intentions via students' motivations is not yet known, nor how these levels may operate differently at individual student versus collective classroom levels.

Our study examined the mechanisms through which student-perceived teachers' beliefs about student ability and mathematics prestige shape students' perceptions of their mathematics class learning environment (mastery or performance-approach), their motivational beliefs (success expectancies and task values), and mathematics-related career intentions. Multilevel analyses distinguished individual from classroom level effects for each of the predictive factors. Additionally, the role of student gender and prior mathematical achievement was taken into account in perceptions of teachers' beliefs, classroom environment, motivational beliefs, and mathematics-related career intentions.

2. Literature review

2.1. Perceived teacher beliefs, learning environments, and students' motivations

The Eccles and colleagues' expectancy-value framework posits that individuals' choice of and persistence in a given task are predicted by her or his success expectancies and subjective valuing of the task (Eccles, 2005; Eccles et al., 1983). Success expectancies are defined as individuals' beliefs about how well they will do on upcoming tasks (Eccles et al., 1998). Task values are beliefs about the quality of a task, differentiated into four components: interest (*intrinsic value*), perceptions of usefulness and relevance (*utility value*), personal importance of doing well (*attainment value*), and the negative aspects of engaging in the task, such as performance anxiety or lost opportunities (*cost*). Intrinsic, attainment and utility value are sometimes combined to form a global task value factor (e.g., Eccles, Wigfield, Harold, & Blumenfeld, 1993; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002).

Success expectancies and task values are influenced by individuals' perceptions of socializers' beliefs and attitudes (Eccles & Jacobs, 1986; Eccles & Wigfield, 2002; Eccles et al., 1998). Perceived teachers' ability expectations strongly predicted students' own success expectancies in late elementary school (Roeser, Blumenfeld, Eccles, Harold, & Wigfield, 1993) and early high school (Wang, 2012); in adolescence, when students begin to detach from their parents, teachers' beliefs gain increasing influence (Eccles et al., 1993; Jussim & Eccles, 1992; Jussim et al., 2009). Both the level and development of students' mathematics self-efficacy beliefs were also positively predicted by mathematics teachers' mastery goal emphasis, even after controlling for parental goal emphasis (Friedel, Cortina, Turner, & Midgley, 2010).

While research often focuses on the impact of teachers' ability expectations on students' competence beliefs and performance (e.g., Bohlmann & Weinstein, 2013; Jussim & Eccles, 1992), less often are teachers' beliefs examined as antecedents of students' values. Research concerning the relationship between teachers' and students' motivations has shown that student-perceived teachers' enthusiasm (Frenzel, Goetz, Pekrun, & Watt, 2010) and teachers' interest in mathematics (Wentzel, 2002) impact students' mathematics interest. Value transmission processes are suggested by Frenzel, Goetz, Lüdtke, Pekrun, and Sutton (2009) who showed that the relationship between teacher enjoyment of teaching mathematics and student enjoyment during mathematics classes was mediated by teachers' displayed enthusiasm. In other words, teachers' behavior mediates the relation between teachers' and students' beliefs. We therefore examined whether learning environments created by the teacher provide a process mechanism to link teachers' beliefs (ability expectations, mathematics prestige) to students' own motivational beliefs (success expectancies and task values).

The goal structure and characteristics of the classroom learning environments that teachers create are shaped by their beliefs about the subject they teach (Kunter et al., 2008) and their attitudes toward teaching (Patrick, Anderman, Ryan, Edelin, & Midgley, 2001). Teachers' self-efficacy for instruction and student engagement (Wolters & Daugherty, 2007), considering learning as an active process, and enthusiasm for engaging in academic tasks (Patrick et al., 2001) have each been associated with their creation of a mastery environment. More enthusiastic teachers are perceived by their students to create challenging and adaptive learning situations, and carefully guide students through the learning process (Kunter et al., 2008; Marsh, 1994).

Learning environments are frequently differentiated into those which promote a mastery-goal structure, indicating a focus on gain of knowledge, understanding new tasks, and mastering new skills; and those which promote a performance–goal orientation, indicating a focus on competition, social comparison and demonstration of ability (Ames, 1992; Meece et al., 2006; Midgley et al., 2000). Teachers who foster mastery goal structures emphasize the investment of effort, self-improvement and collaboration (Eccles & Roeser, 2011). Student-perceived class mastery goal structure has been shown to predict students' mathematical intrinsic motivation (Murayama & Elliot, 2009) and positive affect (Ames & Archer, 1988; Urdan & Midgley, 2003), as well as use of effective learning strategies, preference for challenging tasks and beliefs that success follows from own effort in mathematics, English, science, and social studies classes (Ames & Archer, 1988).

Performance oriented learning environments have been distinguished into performance-approach and performance-avoidance (Midgley et al., 2000; Murayama & Elliot, 2009). Performance-approach classroom goal structures represent a focus on demonstrating competence; performance-avoidance concerns avoiding the demonstration of incompetence (Midgley, 2002; Midgley et al., 2000). Teachers who promote performance-approach goal structures emphasize competition and use instructional strategies such as ability grouping, special rewards for high achievers, or public evaluation of performance (Eccles & Roeser, 2011). Research has revealed heterogeneous results concerning the impact of performance-approach classroom structures on students' learning outcomes. Some studies reported negative effects on students' intrinsic motivation and self-concept (Murayama & Elliot, 2009), motivation and engagement (Ryan & Patrick, 2001), and affect in school (Urdan & Midgley, 2003). Karabenick (2004) did not found significant effects of classroom performance-approach structure on students'

help-seeking, and Peng, Cherng, Chen, and Lin (2013) even showed positive effects of performance-approach structure on autonomous motivation. Although those studies show that classroom goal orientation affects students' motivation and learning behavior, less is known about how classroom goal structure may relate to students' career intentions.

Concerning students' career intentions, studies so far have focused on the role of personal goal orientations (Plante, O'Keefe, & Théorêt, 2013), not the contributions of classroom goal structures. Given the high importance of classroom goal structures for students' motivation (Murayama & Elliot, 2009; Ryan & Patrick, 2001), personal goals (Meece et al., 2006; Urdan, 2004), and the demonstrated relationships of these constructs to students' career plans, research is needed to integrate these factors. Given the strong links between motivational beliefs and career plans (Wang, 2012; Watt et al., 2012), and the salient role of learning environments for students' motivational beliefs (Murayama & Elliot, 2009; Urdan & Midgley, 2003), studies have analyzed whether students' success expectancies and task values serve as mediators of the effects of aspects of the learning environment on career plans. Wang (2012) showed that student-perceived teacher social support, ability expectations, teaching for meaning, and promotion of cooperation predicted students' task values (a composite score of mathematics importance and interest), number of mathematics courses taken, and mathematics-related career plans. There remains a need to consider how perceived teacher beliefs may shape perceived classroom characteristics, and thereby students' motivational beliefs and career plans, also considering effects at the individual student and classroom group levels (Lau & Nie, 2008; Meece et al., 2006).

Students' success expectancies as well as their task values (Simpkins et al., 2006; Watt, 2006; Watt et al., 2012) have been shown to predict their mathematics-related career intentions, with some studies suggesting task values as stronger predictors (Bong, 2001; Meece, Glienke, & Burg, 2006). Comparing the effects of single task values on career intentions reveals the particular importance of intrinsic value (Bong, 2001; Watt et al., 2012), and of importance value for girls (Watt et al., 2012); however, these results vary across cultures. Results of Watt et al. (2012) demonstrated that, in the Australian setting, intrinsic value played an important role for students' mathematics participation and career aspirations. In contrast, among United States and Canadian participants, self-concepts and success expectancies were most important. This was interpreted by the researchers in terms of the greater emphasis on own interests, and freedom to choose among mathematics courses, in the Australian context.

Based on previous research (Kunter et al., 2008; Murayama & Elliot, 2009; Roeser et al., 1993) we anticipated that student-perceived teachers' beliefs (ability expectations and mathematics prestige) would relate to students' perceived classroom learning environment (mastery and performance-approach), which, in turn, would predict students' motivational beliefs (success expectancies and task values). We tested whether students' motivational beliefs mediated the links between perceived learning environments and mathematics-related career intentions, examining individual and classroom level predictions.

2.2. Students' individual and classroom-aggregate perceptions

Multilevel data analyses can examine how individual and classroom level perceptions of the learning environment predict students' motivational beliefs and career choices (Meece et al., 2006; Urdan et al., 1998). Classroom aggregated student perceptions of teacher behavior (e.g., clarity and group control; De Jong & Westerhof, 2001), classroom characteristics (e.g., classroom management; Clausen, 2002), and classroom goal structures (e.g., mastery and performance structures; Lau & Nie, 2008) have been found to predict dimensions of students' motivation. Junior high school students' aggregated perceptions of performance approach mathematics classroom goal structure exerted positive direct effects on their mathematics self-efficacy (Wolters, 2004), and in elementary school classrooms students who perceived a greater emphasis on performance goals (indicated by aggregated perceptions) reported more self-handicapping behaviors (Urdan et al., 1998). Although in the latter study aggregated mastery perceptions were unrelated, another study focused specifically on grade 6 mathematics classrooms found that mastery environment did reduce maladaptive behaviors such as self-handicapping and avoidance of help-seeking (Turner et al., 2002).

As both studies focused on U.S. elementary students and used similar measures, the different results are likely due to the mathematics focus in the second study, a domain often rated as particularly difficult by students (Watson, McEwen, & Dawson, 1994). Especially in mathematics classrooms, focusing on the gain of knowledge instead of performance comparisons might have overall positive effects. Research has previously shown that individual students' perspectives influence their motivational development more strongly than classroom-aggregated perceptions (Kunter, Baumert, & Köller, 2007; Meece, Herman, & McCombs, 2003). Consequently, there is a need to consider both levels, to explore potentially different patterns of prediction, when examining the effects of perceived learning environments on students' motivations and career intentions.

2.3. Student gender, prior achievement and perceived teacher beliefs

Within the expectancy-value framework, Eccles and colleagues (1983, 1998) described how gender role stereotypes influence socializers' beliefs. Through gendered communication and behavior, socializers' beliefs shape children's perceptions, influencing their self-schemata, success expectancies, task values and consequent choice behaviors. Given the influence of teachers' beliefs, it is concerning that students report gender-stereotyped teacher ability expectations, particularly in domains of mathematics and science (e.g., Dickhauser & Meyer, 2006; Martin & Marsh, 2005; Wang, 2012). Dickhauser and Meyer (2006) found that girls perceived lower teacher ability expectations toward themselves in mathematics, even when their objective achievement level did not differ from that of boys. However, studies which have focused on general teacher ability expectations (Wentzel et al., 2010), or the domain of information and communication technologies (ICT; Vekiri, 2010), did not find such gender differences. An open research question addressed in the present study is how gender relates to students' perceptions of teacher beliefs and classroom learning environment characteristics, and in turn affects their motivational beliefs and mathematics-related career plans.

Another important background factor that shapes how students perceive their learning environments is their prior domain-specific achievement (Good, 1987; Weinstein, Marshall, Brattesani, & Middlestadt, 1982). High achievers report more positive interactions and better learning settings in terms of higher perceived teacher expectations for their success (mathematics and reading; Roeser et al., 1993), less negative feedback (general; Weinstein et al., 1982), less criticism (general; Good, 1987) and more choice of tasks (mathematics and science; Weinstein et al., 1982); low achievers report lower perceived teacher expectations for their success (mathematics and reading; Roeser et al., 1993). Among high school students from English classrooms, high-achievers perceived lower classroom performance-avoidance structure, and higher mastery goal structure (Urdan, 2004). We included as antecedent factors the effects of student gender and prior mathematical achievement on their perceptions of teachers' beliefs and classroom learning environments.

2.4. Research questions and hypotheses

Based on the preceding review we analyzed the following research questions:

(1) How are students' gender and achievement related to their perceptions of teacher beliefs (ability expectations and mathematics prestige) and mathematics classroom environments (mastery and performance-approach), own motivational beliefs (success expectancies and task values), and mathematics-related career intentions?
(2) How do student-perceived teacher beliefs (ability expectations and mathematics prestige) and mathematics classroom characteristics (mastery and performance-approach) operate at each of the classroom, and the individual student levels, when predicting students' mathematical career intentions?

We hypothesized that student gender and achievement would predict (more positively for boys and high achievers) perceived teachers' beliefs. Student-perceived mathematics teachers' beliefs about students' mathematical ability and mathematics prestige, and students' experienced mastery and performance-approach mathematics learning environments, were expected to relate to students' own motivational beliefs (success expectancies and task values), and thereby predict mathematical career intentions. Classroom climate (Marsh et al., 2012) factors of classroom-aggregate perceived teacher beliefs and learning environments were additionally expected to predict students' motivations and mathematical career intentions. We anticipated that students' motivational beliefs and mathematical career intentions would be higher when they experienced more mastery-oriented learning environments, and in classrooms where the majority of students perceived the same.

3. Method

3.1. Sample

Analyses were based on contemporary survey data from the Study of Transitions and Education Pathways (STEPS; www.stepsstudy.org), collected at two timepoints from 32 classrooms in 5 metropolitan schools in Sydney and Melbourne, Australia (3 Catholic schools: one coeducational, one single-sex boys, one single-sex girls; 2 independent schools: one coeducational, one single-sex girls). Self-report questionnaires were completed by students in classrooms during Term 1 in each of 2012 and 2013. In the present study analyses were conducted with data from those students who had participated in the first data assessment in grade 10 ($NT1 = 438$; of whom $n = 53$ were missing at T2 in grade 11). Missing data were handled using full-information maximum likelihood (FIML) estimation.

3.2. Measures

3.2.1. Individual variables

Prior mathematics achievement was assessed at T1 by students' self-reported marks for mathematics at the end of the previous school year ("What mark did you usually get in Year 9 maths?"). The item was answered on a 11-point Likert scale coded with 1 (<50%), 2 (50–54%), 3 (55–59%), 4 (60–64%), 5 (65–69%), 6 (70–74%), 7 (75–79%), 8 (80–84%), 9 (85–89%), 10 (90–94%), 11 (95–100%). Gender was coded 0 for boys, 1 for girls.

3.2.2. Mathematics motivational beliefs

Students' mathematical success expectancies and task values in mathematics (intrinsic/utility/attainment composite factor) were assessed at T1 by items from Eccles and Wigfield (1995) adapted to the Australian setting (see Watt, 2002, 2004) on 7-point Likert scales ranging from 1 (not at all) to 7 (extremely) (see Table 1). Items from the three subscales (intrinsic value, utility value, and attainment value) were averaged to build three parcels (one parcel each), used as indicators of the latent composite task values factor.

Table 1
ICC values and design effects of observed and latent variables.

	ICC(1)	ICC(2)	deff
Students' mathematics career intentions	.19	.76	3.33
Students' perceived mathematics teacher ability expectation	.09	.59	2.20
Students' perceived mathematics teacher subject-related prestige beliefs	.16	.72	2.99
Performance goal learning environment	.45	.92	2.12
Mastery goal learning environment	.64	.62	2.47

Note: deff = design effect.

3.2.3. Perceived classroom learning environment

Students' perceptions of their mathematics classroom learning environment were assessed in grade 10 with two subscales—perceived performance-approach goal orientation (PGO) and mastery goal orientation (MGO). All items were measured by 7-point Likert scales ranging from 1 (not at all) to 7 (extremely) using items from the Patterns of Adaptive Learning Scales (PALS; Midgley et al., 2000). For mastery orientation, three out of five items from PALS were administered in the interest of total survey length; for performance-approach all items were used (see Table 1).

3.2.4. Perceived teachers' beliefs

Students' perceptions of mathematics teachers' beliefs (ability expectations about students, and prestige beliefs about mathematics) were assessed in grade 10 each by single items ranging from 1 (not at all) to 7 (extremely). Mathematics teachers' ability expectations were assessed by "How well does your teacher expect you to do at maths in high school?"; prestige beliefs by "How high in prestige/status does your teacher think maths is, compared with other school subjects?" (from Watt, 2002).

3.2.5. Mathematics career intentions

Students' occupational aspirations were assessed in grade 11 with "What job would you like to have in the future?". Students' open-ended answers were coded for mathematics-relatedness per nominated career using ONET (Occupational Information Network; National Center for O*NET Development, 2014) to quantify relatedness to "knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications" on a scale ranging from 0 (not mathematics-related) to 100 (completely mathematics-related).

3.3. Data analyses

The intraclass correlation ICC(1) is a ratio calculated by dividing the variance explained at level 1 (individual ratings) by the total variance (levels 1 and 2; Raudenbush & Bryk, 2002, p. 110). ICC(1) is typically interpreted to reveal the extent to which individual ratings are attributable to group membership. ICC(1) ≥ .05 may provide evidence of a group effect (LeBreton & Senter, 2008, p. 838). Another way to assess whether data clustering needs to be taken into account during estimation is the design effect ("deff"), approximately equal to 1 + (average cluster size − 1) × ICC(1) (Kish, 1965). *deff* ≥ 2 indicates that the clustered structure should be taken into account to avoid biased estimates of standard errors (Maas & Hox, 2004). ICC(2) is used when assessing the accuracy of class-mean ratings (level 2).

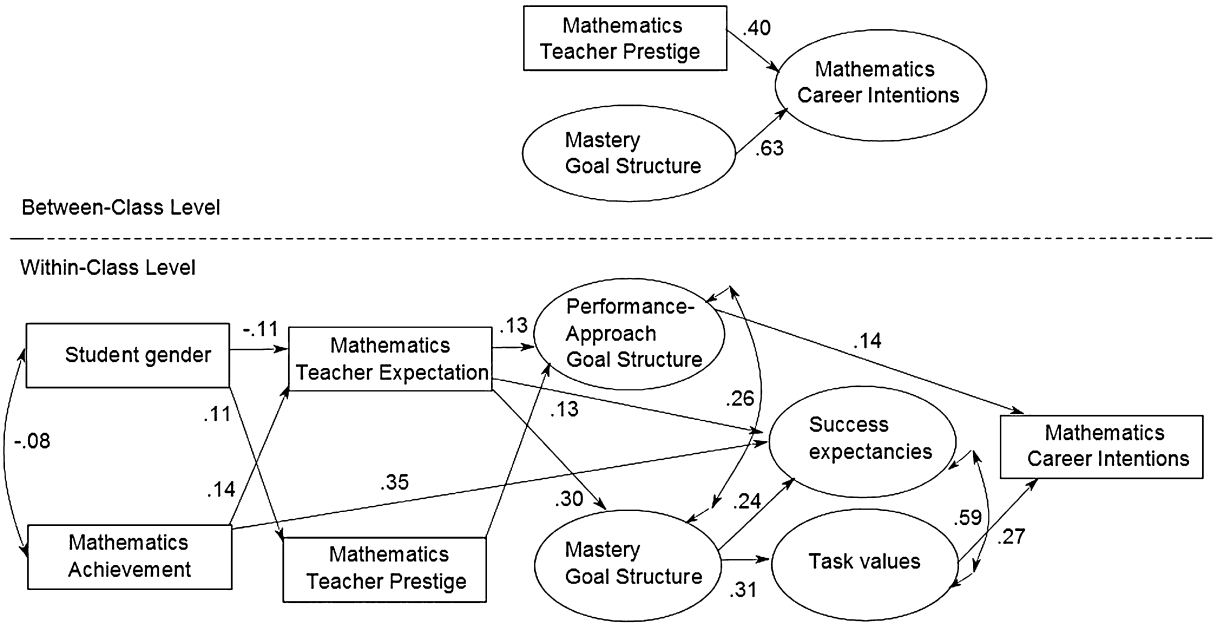

Fig. 1. Empirical multilevel structural equation model for the relations between gender, achievement, perceived teacher beliefs and learning environment and mathematics career intentions. Coefficients are standardized and significant ($p < .05$) or non-significant (n.s.).

It is calculated with the Spearman–Brown formula[1] with Rel = ICC(1) and $k = n$ (average cluster size; Lüdtke, Trautwein, Kunter, & Baumert, 2006, p. 218). ICC(2) values of approximately .70 or higher have frequently been used to justify aggregation (LeBreton & Senter, 2008, p. 839).

Using the two-level basic function of M*plus* version 7, the ICC(1) of the observed variables was calculated from $N = 438$ and 32 classrooms, the average cluster size was $n = 13.53$. ICC(1) and ICC(2) as well as design effect values for latent and observed variables are reported in Table 1. With the exception of students' perceived mathematics teacher ability expectations and classroom mastery goal orientation, all ICC(2) values were above .70, and design effects were all above 2.0, implying that the clustered structure of the sample should be taken into account. To calculate latent means and standard errors TYPE = COMPLEX was used; for confirmatory factor analyses (CFA) and multilevel structural equation modeling (MLSEM), variability at the level of individual students and at the level of classrooms was considered by using the TYPE = TWOLEVEL function of M*plus* (Muthén & Muthén, 1998–2010), to simultaneously estimate effects at the individual level (effects within classes) and effects at the class level (effects between classes). At the within-level (level 1) were students' reported prior achievement, individual perceptions of teacher beliefs (ability expectations and mathematics prestige), perceived learning environments (mastery and performance-approach), own expectancies and values, and mathematics-related career plans. At the between-level (level 2) were classroom average scores of perceived teacher and classroom factors (see Fig. 1). The dependent variable career intentions was decomposed by default into two uncorrelated components: on the within-level (student-explained variance) and the between level (classroom-explained variance; Muthén & Muthén, 2009).

Based on Tanaka (1993), the following criteria were employed to evaluate the goodness of fit of the models: Yuan–Bentler scaled χ^2 (YB χ^2, mean-adjusted test-statistic robust to non-normality), Tucker–Lewis index (TLI), comparative fit index (CFI), root mean square of approximation (RMSEA) with associated confidence intervals, and standardized root mean residual (SRMR). TLI and CFI values greater than .95 (Hu & Bentler, 1999), RMSEA values lower than .05 (Browne & Cudeck, 1993) and SRMR ≤ .08 (Hu & Bentler, 1999) were accepted as indicators of good model fit.

4. Results

4.1. Measurement model

Six latent factors were modeled for constructs measured by multiple items using CFA. On the individual level students' success expectancies, task values, perceived performance-approach learning environment (PGO) and perceived mastery goal learning environment (MGO) were modeled; on the classroom level were aggregated perceived PGO and MGO. To compute composite reliabilities factor variances were set to 1 and latent construct correlations were set to 0 as specified by Bagozzi and Yi (1988). Results of CFA with the four latent factors on the individual level (success expectancies, task values, PGO, MGO) showed a good model fit, $\chi^2 = 108.341$, $df = 48$, CFI = .96, TLI = 0.95; RMSEA = .054, SRMRwithin = .05, SRMRbetween = .01. Standardized loadings and factor reliabilities from this model are presented in Table 2.

4.2. Descriptive statistics

Means and standard deviations for latent and observed constructs are reported in Table 2. Descriptive statistics and intercorrelations among all variables included in SEM modeling for the within-level are reported in Table 3. Results showed significant intercorrelations between mathematics career intentions and each of gender ($\phi = -.11$, $SE = .06$, $p < .05$), perceived PGO ($\phi = .16$, $SE = .05$, $p = .001$), perceived MGO ($\phi = .17$, $SE = .06$, $p < .01$), students' success expectancies ($\phi = .15$, $SE = .06$, $p < .05$) and task values ($\phi = .29$, $SE = .06$, $p < .001$).

4.3. Baseline model

In the hypothesized model, at the individual level, gender and mathematics achievement, perceived teacher beliefs (ability

[1] $\text{ICC}(2) = n \times \text{ICC}(1)/(1 + (n-1) \times \text{ICC}(1))$.

Table 2
Item wording, internal consistencies, standardized loadings (λ) and measurement errors (τ_δ; TD) of latent factors on within-level.

Latent construct	Rel. (ξ_j)	Item wording	λ	TD
Students' ability expectations	.915	**Exp1** How well do you expect to do in your next mathematics task?	.895	.200
		Exp2 How well do you expect to do in school mathematics tasks this term?	.895	.199
		Exp3 How well do you think you will do in your school mathematics exam this year?	.862	.256
Students' task-value in math	.767	**Intr1** How much do you like mathematics, compared with your other subjects at school?		
		Intr2 How interesting do you find mathematics?		
		Intr3 How enjoyable do you find mathematics, compared with your other school subjects?		
		INTRINSIC VALUE (parcel)	.827	.316
		Util1 How useful do you believe mathematics is?		
		Util2 How useful do you think mathematics is in the everyday world?		
		Util3 How useful do you think mathematical skills are in the workplace?		
		UTILITY VALUE (parcel)	.595	.646
		Attain1 Being someone who is good at mathematics is important to me.		
		Attain2 Being good at mathematics is an important part of who I am.		
		Attain3 It is important for me to be someone who is good at solving mathematical problems.		
		ATTAINMENT VALUE (parcel)	.698	.513
PGO in math class	.683	**PGO1** Our mathematics teacher tells us how we compare to other students.	.410	.832
		PGO2 Our math teacher points out those students who get good grades as an example to all of us.	.856	.267
		PGO3 Our mathematics teacher lets us know which students get the highest scores on tests.	.625	.610
MGO in math class	.799	**MGO1** Our mathematics teacher really wants us to enjoy learning new things.	.718	.485
		MGO2 Our mathematics teacher recognizes us for trying hard.	.825	.319
		MGO3 Our mathematics teacher wants us to understand our work, not just memorize it.	.717	.485

Note: PGO = performance goal orientation; MGO = mastery goal orientation.

expectations and mathematics prestige) and perceived classroom learning environments (mastery and performance-approach) were specified as predictors of students' motivational beliefs (success expectancies and task value) and mathematical career intentions. On the classroom-level, aggregate perceived teachers' beliefs and learning environment (mastery and performance-approach) predicted students' mathematics career intentions. The measurement error variances of one PGO item ("Our maths teacher points out those students who get good grades as an example to all of us") and one MGO item ("Our maths teacher recognises us for trying hard") in the between-classes model were initially estimated to values below zero, but, not significantly different from zero, thus subsequently constrained to be zero to achieve model identification (see Hox, 2002, p. 215). The data showed good fit to this model on the within level (level 1), but SRMR indicated a poor fit on the between level (level 2), $\chi^2 = 249.668$, $df = 114$, CFI = .94, TLI = 0.91; RMSEA = .052, SRMRwithin = .04, SRMRbetween = .21. To improve model fit, in a next step all non-significant paths were excluded from the model. This optimized model is illustrated in Fig. 1. The data showed good fit to this model, $\chi^2 = 204.91$, $df = 111$, CFI = .96, TLI = 0.94; RMSEA = .044, SRMRwithin = .05, SRMRbetween = .07. In the optimized model it was no longer necessary to fix the residual error variances on the between level to zero.

4.4. Individual level

At the individual level, girls (β = –0.11, *SE* = 0.04, *p* = .006) and lower achievers (β = 0.14, *SE* = 0.05, *p* = .005) perceived lower teacher ability expectations, with no significant interaction between gender and achievement; there was a weak association between gender and previous mathematics achievement (ϕ = –.08, *SE* = .03, *p* = .011). Girls perceived higher teacher beliefs of mathematics prestige (β = 0.11, *SE* = 0.04, *p* = .016). Lower achievers reported lower mathematics task values (β = 0.30, *SE* = 0.06, *p* < .001) and ability expectations (β = 0.35, *SE* = 0.05, *p* < .001).

Student-perceived teacher ability expectations positively predicted student perceived mathematics classroom learning environments: for performance-approach (PGO; β = 0.13, SE = 0.05, *p* = .015) and mastery goal orientation (MGO; β = 0.30, SE = 0.08, *p* < .001). The uniquenesses for PGO and MGO were positively correlated (ψ = .26, SE = 0.09, *p* < .01); there were no significant interaction effects of PGO × MGO on students' success expectancies (β = –0.07, *p* = .68), task values (β = –0.07, *p* = .63), or career plans (β = 1.498, *p* = .41). Student-perceived teacher prestige beliefs about mathematics positively predicted PGO (β = 0.13, SE = 0.05, *p* = .01); PGO thence predicted students' mathematics career intentions (β = 0.14, SE = 0.05, *p* = .008). MGO predicted students'

Table 3
Descriptive statistics and latent intercorrelations for observed and latent constructs.

	M (*SE*)	Scale	2	3	4	5	6	7	8	9
(1) Gender	—	—	–.08**	–.12**	.11*	–.06	–.15*	–.18*	–.14*	–.12*
(2) Achievement	6.50 (*0.35*)	1–11		.16*	.05	–.01	.02	.39***	.30***	.07
(3) Teacher ability expectation	5.02 (*0.10*)	1–7			.21***	.16**	.30***	.36***	.19**	.05
(4) Teacher prestige beliefs	5.26 (*0.12*)	1–7				.17***	.13	.18*	.12	–.01
(5) PGO	3.11 (*0.22*)	1–7					.30**	.04	.08	.17***
(6) MGO	4.69 (*0.23*)	1–7						.31***	.32***	.16**
(7) Success expectancies	4.84 (*0.13*)	1–7							.67***	.15*
(8) Task values	4.38 (*0.15*)	1–7								.29***
(9) Mathematics career intentions	52.30 (*1.95*)	0–100								

Note: For latent constructs (variables no. 5–8) latent means and standard errors are reported. For observed variables (variables no. 2–4 and 9) means and standard errors are reported. PGO = students' perceived mathematics classroom performance-approach goal orientation; MGO = students' perceived mathematics classroom mastery goal orientation.

* *p* < .05.
** *p* < .01.
*** *p* < .001.

expectancies for success (β = 0.24, SE = 0.07, $p = .001$) and mathematics task values (β = 0.31, SE = 0.06, $p < .001$), which predicted mathematics career intentions (β = 0.27, SE = 0.06, $p < .001$). Student-perceived teacher ability expectations increased students' own expectancies for success in mathematics (β = 0.22, SE = 0.06, $p < .001$). Uniquenesses were significantly interrelated for success expectancies and task values (ψ = .59, $SE = 0.04$, $p < .001$).

4.5. Classroom level

At the classroom level, students' mathematics career plans were positively predicted by class-aggregate student-perceived teacher prestige beliefs about mathematics (β = 0.40, $SE = 0.15$, $p = .006$), and class-aggregate MGO (β = 0.63, $SE = 0.21$, $p < .001$). The two predictors were not themselves correlated (ϕ = 0.03, $SE = 0.15$, $p > .05$). As there was no significant effect of student-perceived PGO and teacher prestige beliefs these two variables were subsequently excluded from the classroom-level part of the model.

4.6. Mediation and indirect effects

In the next step, the hypothesized mediation effects were tested on the individual level. Based on relations in our optimized model (see Fig. 1) to assess mediation we first tested within each of three different model sets whether there were significant direct effects of independent variables on students' mathematical career intentions. In set 1 independent variables were students' gender and achievement; in set 2, perceived teacher ability expectations and prestige beliefs; in set 3, perceived PGO and MGO. No significant direct effects occurred between students' gender or achievement and mathematics career intentions (set 1), nor between perceived teacher ability expectations or prestige beliefs and students' mathematics career intentions (set 2). There was a significant direct effect of perceived teachers' PGO on students' mathematics career intentions (β = 0.13, $SE = 0.06$, $z = 2.07$, $p = 0.04$) (set 3). However perceived teachers' PGO was not significantly related to students' task values or expectancies for success.

Consequently, indirect effects were tested rather than mediation. Results revealed that students' prior mathematics achievement influenced perceived classroom MGO via student-perceived teachers' ability expectations ($\beta_{ind} = 0.04$, $SE = 0.02$, $z = 2.50$, $p = .01$). Students' prior achievement increased their mathematics-related career intentions via task values ($\beta_{ind} = 0.08$, $SE = 0.02$, $z = 3.02$, $p = .001$). Girls perceived slightly lower MGO ($\beta_{ind} = -0.03$, $SE = 0.02$, $z = -2.06$, $p = .04$) and PGO ($\beta_{ind} = -0.01$, $SE = 0.01$, $z = -2.20$, $p = .03$) via their perceived mathematics teacher ability expectations. Lower mathematics teacher ability expectations led to lower success expectancies ($\beta_{ind} = 0.07$, $SE = 0.02$, $z = 3.13$, $p = .002$) and task values ($\beta_{ind} = 0.10$, $SE = 0.03$, $z = 3.13$, $p = .002$) via student-perceived MGO. MGO increased mathematics career intentions via students' task values ($\beta_{ind} = 0.08$, $SE = 0.03$, $z = 3.34$, $p = .001$) (see Fig. 1).

5. Discussion

5.1. Perceived teachers' beliefs, mathematics classroom learning environments, students' motivational beliefs, and subsequent mathematics-related career intentions

Our hypotheses were mainly supported by showing that girls and boys differently perceived mathematics teachers' beliefs, which predicted their perceptions of classroom learning environments and thence their motivational beliefs, which, in turn, affected mathematics-related career intentions. A novel aspect was the key role of task values in the impact of students' perceived mastery learning environments on mathematical career intentions. Previous studies (Turner et al., 2002) already pointed out that mastery-focused mathematics classrooms produce positive effects for the class overall, in terms of mathematical intrinsic motivation (Murayama & Elliot, 2009) and positive affect (Urdan & Midgley, 2003), as well as positive attitudes, use of effective learning strategies, preference for challenging tasks and beliefs that success follows from own effort, in mathematics, English, science, and social studies classes (Ames & Archer, 1988). Our study additionally examined the rarely considered relationships between aggregated and individual perceptions of mathematics classroom goal structure and career plans, to show that mastery contexts are important for students' motivational beliefs and career plans, particularly at the class level. Those mathematics classrooms, in which most students perceive the gain of knowledge and mastery of tasks as important learning goals, facilitate the overall likelihood of students in these classrooms to plan a career in mathematics-related fields.

Using contemporary data, we investigated how adolescents' gender, prior achievement, perceived teachers' beliefs (ability expectations and mathematics prestige) and perceived mathematics classroom learning environments (mastery and performance-approach) impacted students' motivational beliefs (success expectancies and task values) in mathematics, and subsequent mathematics-related career intentions. In line with Eccles and Wigfield (2002) who pointed out the increasing importance of the role of context in current motivation research, our results showed that considering the student-perceived learning environment context was important when explaining students' expectancies, values and career intentions. However, it is unclear without multiple waves of data, the extent to which students' mathematics-related career intentions may in turn promote higher mathematics task values and thus impact perceptions of mastery classroom learning environment.

Perceived classroom learning environment goal orientation functioned differently, depending on the level of analysis. At the individual level, performance-approach goal orientation was positively related to students' mathematics career intentions, whereas at the classroom level it did not impact career intentions and instead mastery goal orientation did. Thus in terms of classroom climate (Marsh et al., 2012), it is more important for students' mathematics career intentions that teachers create a mastery learning environment which highlights the gain of knowledge instead of focusing on performance and competition.

Performance-approach goal classroom environment was positively related to students' career intentions, but only at the individual level. One explanation for this positive effect might be a mediating role of personal goal orientations: Schwinger and Stiensmeier-Pelster (2011) revealed that student-perceived performance approach classroom goals positively predicted personal performance-approach and mastery goals; Plante et al. (2013) showed that personal mastery goals in mathematics predicted mathematics-related career intentions. Both studies focused on direct effects of personal goals on career intentions, and only at the individual student-level; however, our results demonstrated that performance approach goal classroom structure differently impacted students' mathematics-related career plans depending on the level of analysis. At the classroom-level, performance approach structure did not impact students' mathematics-related career plans; at the individual level, there was a weak benefit if students perceived opportunities to demonstrate their competences. Our interpretation is that individual students respond differently to such classroom goal structures—for some students a focus on competition and gain of skills might facilitate their mathematics-related career ambitions, for others there might be a negative effect. This interpretation is strengthened by the relatively low variance in performance approach classroom goal structure explained by class membership, in contrast to the high shared variance for mastery goal structure (see ICC values; Table 1). How individual students

interact differently with their classroom environments is fundamental to deepen understandings of how and why motivations change (Turner & Patrick, 2008). There is a need for further studies which explain the effects of performance-approach classroom goal orientations for different kinds of students at different levels of analysis.

The scientific significance of this study is twofold: first, few studies previously examined the motivational processes through which student-perceived teachers' beliefs and learning environments influence students' mathematics career intentions via mathematical motivations. We took into account how both teachers' beliefs about mathematics and students contributed to the kinds of classroom learning environments that they created. Second, we contribute to this literature by differentiating analysis of individual and classroom-level predictors, for student-perceived teacher beliefs and learning environments at both the student and classroom levels.

5.2. Role of gender and achievement

In line with previous empirical results for mathematics (Dickhauser & Meyer, 2006; Wang, 2012), girls perceived lower mathematics teacher ability expectations for their mathematical success; they also perceived higher teacher mathematics prestige beliefs. Analyses of indirect effects showed that girls' perceptions of lower teachers' ability expectations subsequently led to lower perceptions of classroom mastery and performance-approach goal environments. Through lower MGO, this led to lower mathematical success expectancies, task values, and subsequent lower mathematics-related career plans. These indirect effects contribute to explaining how mathematics classroom characteristics affect girls' mathematical career intentions.

Results of studies addressing gendered perceptions of teachers' beliefs and expectations have varied, depending on the domain-specificity of the studies under scrutiny. Although girls perceive higher general teacher ability expectations in school, studies focusing on mathematics show lower perceived teacher ability expectations for girls than boys (Dickhauser & Meyer, 2006; Wang, 2012; Wentzel, 2002). This may well result from the stereotyping of mathematics as a masculine discipline (Brandell & Staberg, 2008). Although within the last years a "feminization" of mathematics is widely discussed, due to small effect sizes for gender differences in students' cross-national mathematics performance (see Else-Quest, Hyde, & Linn, 2010; Hyde, Lindberg, Linn, Ellis, & Williams, 2008), it is still critical to examine whether corresponding gender gaps in affective and perceptual factors have decreased. In her "gender similarity" hypothesis, Hyde (2005) reported empirical evidence from meta-analyses on gender differences which supports the hypothesis that boys and girls are similar on most, but not all, psychological and achievement variables. Largest gender differences were in the domain of motor performance ($d = 2.18$ for throwing velocity; $d = 1.98$ for throwing distance), with large effect sizes for computer self-efficacy ($d = 0.41$; higher values for boys), and moderate for mathematics anxiety ($d = -0.15$; higher values for girls) and self-confidence ($d = 0.16$; lower values for girls). Effect sizes differed significantly between nations (Else-Quest et al., 2010); compared with other participating countries in The International Mathematics and Science Study (TIMSS), Australia showed above-average effect sizes for gender differences favoring boys in mathematical valuing ($d = 0.17$; weighted mean effect size across countries $d = 0.10$) and self-confidence ($d = 0.19$; weighted mean effect size across countries $d = 0.15$; Else-Quest et al., 2010). Consistent with these previous research findings, girls in our contemporary sample reported lower success expectancies and task values in mathematics. There is longitudinal empirical evidence that girls' mathematical success expectancies (Fredricks & Eccles, 2002; Jacobs et al., 2002; Nagy et al., 2010; Watt, 2004) and values (Fredricks & Eccles, 2002; Frenzel et al., 2010; Watt, 2004) remain lower than those of boys through adolescence.

5.3. Role of classroom-level and individual perceptions of learning environment

Our results are in line with current empirical research highlighting the importance of individual and classroom-level predictors of students' motivation (e.g., Clausen, 2002; De Jong & Westerhof, 2001). When focusing on mathematical career intentions, both levels of perceptions were important in different ways. At the individual level, performance-approach learning environment directly, but weakly, predicted mathematics-related career intentions; mastery learning environment indirectly influenced mathematics-related career intentions via task values. At the classroom level, MGO showed a powerful direct effect; perceived teachers' mathematics prestige beliefs also showed a strong effect. In terms of instructional design, our results are concordant with the body of empirical research which recommends the importance of teachers creating a mastery oriented climate which emphasizes the development of students' abilities, new skills, understanding, mastery of tasks, self-improvement and collaboration (Eccles & Roeser, 2011).

In line with expectancy-value theory (Eccles et al., 1983), students' perceptions of their socializers' beliefs, expectations and attitudes shaped their own expectancies for success and task values, and thus influenced their mathematics-related career intentions. Corroborating previous findings (Roeser et al., 1993; Wang, 2012), we showed that student-perceived mathematics teachers' ability expectations positively predicted students' own success expectancies—however, we highlighted the intervening role of student-perceived classroom goal structures. Results point to a key role of students' perceived mastery learning mathematics environments and own mathematical values for their mathematics-related career intentions.

The outlined indirect effects confirm prior findings (Bong, 2001; Meece et al., 2006; Watt et al., 2012) that task values more strongly predict mathematical career intentions than success expectancies, at least in this Australian contemporary sample. Because in this study we used a composite score for task values (in which intrinsic value predominated compared to utility and attainment values; see loadings in Table 2), and, as interest was previously shown to be important for students' mathematics participation and career plans (Bong, 2001; Watt et al., 2012), this should be taken into consideration in interpreting the strong effect of task values on career plans in this study. Because cultural socialization influences the values students develop (Wigfield, Tonks, & Eccles, 2004), and which processes shape their career intentions (Watt et al., 2012), more comparative studies in more diverse settings are needed to further understand these choice processes.

5.4. Limitations and conclusions

There are several limitations of the study which should be considered when interpreting the results. First, no teacher-reported beliefs were assessed. Thus it is only possible to interpret the paths in this study in terms of students' perceptions of their teachers and learning environments. The Eccles and colleagues' expectancy-value model of achievement motivation (1983) includes socializers' *actual* expectations, beliefs and attitudes, and a large amount of research based on this model includes those variables (e.g., Harackiewicz, Rozek, Hulleman, & Hyde, 2012; Jacobs & Eccles, 1992; Jodl, Michael, Malanchuk, Eccles, & Sameroff, 2001; Simpkins, Fredricks, & Eccles, 2012). The use of student perceptions in this study could also be seen as a strength of this study, as prior findings (Clausen, 2002) showed that aggregated student perceptions of classroom characteristics are stronger predictors for their

motivational development than teacher or observer ratings. Teachers' and students' reports of teachers' behaviors have been found to differ (Spearman & Watt, 2013), with more favorable perceptions by teachers. Concordantly, Urdan et al. (1998) revealed that the correlation between student perceptions of a performance classroom goal structure and teachers' reported use of performance-oriented instructional practices was positive, but not significant. There is a need for future studies to address the accuracy of students' perceptions of their teachers' beliefs by obtaining both student and teacher reports. For educational implications it is important to know whether students perceive their teachers' beliefs accurately, to determine fruitful interventions either to target teachers' attitudes (if students are correct), or how students interpret (if students are incorrect).

Second, although the proposed direction of effects between perceived teacher beliefs, learning environment characteristics, students' motivational beliefs, and career intentions was theory-driven (e.g., Eccles et al., 1983), and based on results of previous research in the field (Dickhauser & Meyer, 2006; Roeser et al., 1993), reverse direction of effects is plausible. In our study, lower achieving students perceived lower mathematics teacher ability beliefs, less mastery-oriented learning environments, and consequently held lower mathematics task values and related career intentions. A possible explanation might be that students who showed higher initial engagement elicited more favorable perceptions and support from their teachers (Skinner & Belmont, 1993), and subsequently performed better in mathematics class. Pulkka and Niemivirta (2013) have shown that (adult) students who held different personal achievement goal orientation profiles (mastery-oriented, success-oriented, indifferent, and avoidance-oriented) perceived the learning environment differently, with mastery-oriented and success-oriented groups evaluating the interestingness of the learning environment, their effort and attainment more positively than the avoidance-oriented students. To analyze processes concerning student moderators of teachers' behaviors in greater detail, multiple waves of data incorporating classroom observation of students' behavior and teachers' responses would be fruitful.

Third, a task value composite score was used instead of testing effects of single task values on career plans. Although task values are interrelated (Wigfield & Eccles, 2000), as was also the case in this study (student-level latent correlations accounting for class membership: attainment–intrinsic: $\phi = .59$; attainment–utility: $\phi = .59$; intrinsic–utility: $\phi = .50$), our results suffer a loss of information by using this composite score, indicated by relatively high measurement errors for utility and attainment value (see Table 2).

Increasingly, the importance of the role of context in motivation research is highlighted (Eccles & Wigfield, 2002; Kaplan & Maehr, 2002; Lüdtke, Robitzsch, Trautwein, & Kunter, 2009; Marsh et al., 2012; Middleton & Spanias, 1999; Nolen, 2007; Turner, 2001). Classroom learning environments contribute to important student outcomes such as achievement (e.g., Dettmers, Trautwein, Lüdtke, Kunter, & Baumert, 2010; Reyes, Brackett, Rivers, White, & Salovey, 2012), self-concept (e.g., Murayama & Elliot, 2009; Trautwein, Lüdtke, Marsh, & Nagy, 2009), motivation and emotion (e.g., Frenzel et al., 2009; Turner et al., 2002). Marsh et al. (2012) highlighted the importance of differentiating contextual constructs (e.g., student gender, class-average achievement) from climate constructs (e.g., teacher enthusiasm). Turner and Patrick (2008) outlined that motivational development and change cannot be understood without considering how and why students interact with their classroom learning environment. In our study, classroom learning environment, operationalized as classroom mastery vs. performance-approach goal orientation, played a central role in predicting students' mathematics career intentions, additional to gender and achievement effects. The results highlight the need to consider context and climate variables as well as interactions between students and their learning environments in future research concerning predictors of motivational beliefs and mathematical career intentions.

Our results are important for teachers and educational policymakers. By carefully planning classroom learning environments that are focused not only on mastering knowledge at the classroom-level, but also enabling balanced levels of competition for individual students, girls' and boys' expectancies, values and career intentions related to mathematics should be promoted. Considering the lower teachers' ability expectations perceived by girls, emphasizing girls' mathematical skills might be an important step to support future mathematical career intentions and thereby the percentage of female workers in STEM disciplines.

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References

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology*, *84*(3), 261–271.
Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation processes. *Journal of Educational Psychology*, *80*(3), 260–267.
Anderman, E. M., & Midgley, C. (1997). Changes in achievement goal orientations, perceived academic competence, and grades across the transition to middle-level schools. *Contemporary Educational Psychology*, *22*(3), 269–298.
Anderman, L. H., & Anderman, E. M. (2000). Considering contexts in educational psychology: Introduction to the special issue. *Educational Psychologist*, *35*(2), 67–68.
AWPA (2012). *Future focus: Australia's skills and workforce development needs*. Canberra: Australian Workforce and Productivity Agency.
Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, *16*(1), 74–94.
Bell, S. (2010). Women in science: The persistence of gender in Australia. *Higher Education Management and Policy*, *22*(1), 47–65.
Bohlmann, N., & Weinstein, R. S. (2013). Classroom context, teacher expectations, and cognitive level: Predicting children's math ability judgments. *Journal of Applied Developmental Psychology*, *34*, 288–298.
Bong, M. (2001). Role of self-efficacy and task-value in predicting college students' course performance and future enrollment intentions. *Contemporary Educational Psychology*, *26*(4), 553–570.
Bøe, M. V. (2012). Science choices in Norwegian upper secondary school: What matters? *Science Education*, *96*(1), 1–20.
Brandell, G., & Staberg, E. M. (2008). Mathematics: A female, male or gender-neutral domain? A study of attitudes among students at secondary level. *Gender and Education*, *20*(5), 495–509.
Browne, M., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136–162). Newbury Park, CA: Sage.
Clausen, M. (2002). *Unterrichtsqualität: Eine frage der perspektive? [Quality of classroom learning environments—A question of perspective?]* (Vol. 29). Muenster: Waxmann.
De Jong, R., & Westerhof, K. J. (2001). The quality of student ratings of teacher behaviour. *Learning Environments Research*, *4*(1), 51–85.
Dettmers, S., Trautwein, U., Lüdtke, O., Kunter, M., & Baumert, J. (2010). Homework works if homework quality is high: Using multilevel modeling to predict the development of achievement in mathematics. *Journal of Educational Psychology*, *102*(2), 467–482.
Dickhauser, O., & Meyer, W. (2006). Gender differences in young children's math ability attributions. *Psychology Science*, *48*(1), 3–16.
Eccles, J. S. (2004). Schools, academic motivation, and stage-environment fit. In R. M. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology* (2nd ed., Vol. 2, pp. 125–153). New Jersey: Wiley.
Eccles, J. S. (2005). Subjective task value and the Eccles et al. model of achievement-related choices. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 105–131). New York, London: Guilford.
Eccles, J. S. (2009). Who am I and what am I going to do with my life? Personal and collective identities as motivators of action. *Educational Psychologist*, *44*, 78–89.

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Eccles, J. S., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J., et al. (1983). Expectancies, values and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motives: Psychological and sociological approaches* (pp. 75–146). San Francisco, CA: Freeman.

Eccles, J. S., & Jacobs, J. E. (1986). Social forces shape math attitudes and performance. *Signs*, *11*(2), 367–380.

Eccles, J. S., Midgley, C., Wigfield, A., Buchanan, C. M., Reuman, D., Flanagan, C., et al. (1993). Development during adolescence. The impact of stage-environment fit on young adolescents' experiences in schools and in families. *American Psychologist*, *48*(2), 90–101.

Eccles, J. S., & Roeser, R. W. (2009). Schools, academic motivation, and stage-environment fit. In R. Lerner & L. Steinberg (Eds.), *Handbook of adolescent psychology* (pp. 404–434). New York: Wiley.

Eccles, J. S., & Roeser, R. W. (2011). Schools as developmental contexts during adolescence. *Journal of Research on Adolescence*, *21*(1), 225–241.

Eccles, J. S., Vida, M. N., & Barber, B. (2004). The relation of early adolescents' college plans and both academic ability and task-value beliefs to subsequent college enrollment. *Journal of Early Adolescence*, *24*(1), 63–77.

Eccles, J. S., & Wigfield, A. (1995). In the mind of the actor: The structure of adolescents' achievement task values and expectancy-related beliefs. *Personality and Social Psychology Bulletin*, *21*(3), 215–225.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology*, *53*(1), 109–132.

Eccles, J. S., Wigfield, A., Harold, R. D., & Blumenfeld, P. (1993). Age and gender differences in children's self-and task perceptions during elementary school. *Child Development*, *64*(3), 830–847.

Eccles, J. S., Wigfield, A., & Schiefele, U. (1998). Motivation to succeed. In N. Eisenberg (Ed.), *Handbook of child psychology* (5th ed., Vol. 3, pp. 1017–1095). New York: Wiley.

Else-Quest, N. M., Hyde, J. S., & Linn, M. C. (2010). Cross-national patterns of gender differences in mathematics: A meta-analysis. *Psychological Bulletin*, *136*(1), 103–127.

European Commission (2009). *She figs 2009. Statistics and indicators on gender equality in science*. <http://ec.europa.eu/research/science-society/document_library/pdf_06/she_figures_2009_en.pdf> Accessed 14.07.17.

Fredricks, J. A., & Eccles, J. S. (2002). Children's competence and value beliefs from childhood through adolescence: Growth trajectories in two male-sex-typed domains. *Developmental Psychology*, *38*(4), 519–533.

Frenzel, A. C., Goetz, T., Lüdtke, O., Pekrun, R., & Sutton, R. E. (2009). Emotional transmission in the classroom: Exploring the relationship between teacher and student enjoyment. *Journal of Educational Psychology*, *101*(3), 705–716.

Frenzel, A. C., Goetz, T., Pekrun, R., & Watt, H. M. G. (2010). Development of mathematics interest in adolescence: Influences of gender, family, and school context. *Journal of Research on Adolescence*, *20*(2), 507–537.

Friedel, J. M., Cortina, K. S., Turner, J. C., & Midgley, C. (2010). Changes in efficacy beliefs in mathematics across the transition to middle school: Examining the effects of perceived teacher and parent goal emphases. *Journal of Educational Psychology*, *102*(1), 102–114.

Good, T. L. (1987). Two decades of research on teacher expectations: Findings and future directions. *Journal of Teacher Education*, *38*(4), 32–47.

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

Hox, J. J. (2002). *Multilevel analysis: Techniques and applications*. Mahwah, NJ: Lawrence Erlbaum Association.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55.

Hyde, J. S. (2005). The gender similarities hypothesis. *American Psychologist*, *60*(6), 581–592.

Hyde, J. S., Lindberg, S. M., Linn, M. C., Ellis, A. B., & Williams, C. C. (2008). Gender similarities characterize math performance. *Science*, *321*(5888), 494–495.

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

Jacobs, J. E., Lanza, S., Osgood, D. W., Eccles, J. S., & Wigfield, A. (2002). Changes in children's self-competence and values: Gender and domain differences across grades one through twelve. *Child Development*, *73*(2), 509–527.

Jacobs, J. E., & Simpkins, S. D. (2005). Mapping leaks in the math, science, and technology pipeline. *New Directions for Child and Adolescent Development*, *110*, 3–6.

Jodl, K. M., Michael, A., Malanchuk, O., Eccles, J. S., & Sameroff, A. (2001). Parents' roles in shaping early adolescents' occupational aspirations. *Child Development*, *72*(4), 1247–1266.

Jussim, L., & Eccles, J. S. (1992). Teacher expectations II: Construction and reflection of student achievement. *Journal of Personality and Social Psychology*, *63*(6), 947–961.

Jussim, L., Robustelli, S., & Cain, T. R. (2009). Teacher expectations and self-fulfilling prophecies. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 349–380). New York: Routledge.

Kaplan, A., & Maehr, M. L. (2002). Adolescents' achievement goals: Situating motivation in sociocultural contexts. In T. Urdan & F. Pajaers (Eds.), *Adolescence and education: Vol. 2, Academic motivation of adolescents* (pp. 125–167). Greenwich, CT: Information Age.

Karabenick, S. A. (2004). Perceived achievement goal structure and college student help seeking. *Journal of Educational Psychology*, *96*(3), 569–581.

Kish, L. (1965). *Survey sampling*. New York: John Wiley.

Köller, O., Daniels, Z., Schnabel, K. U., & Baumert, J. (2001). Kurswahlen von mädchen und jungen im fach mathematik: Zur rolle von fachspezifischem selbstkonzept und interesse [Course selections of girls and boys in mathematics: The role of academic self-concept and interest]. *Zeitschrift für Pädagogische Psychologie*, *14*(1), 26–37.

Kunter, M., Baumert, J., & Köller, O. (2007). Effective classroom management and the development of subject-related interest. *Learning and Instruction*, *17*(5), 494–509.

Kunter, M., Tsai, Y.-M., Klusmann, U., Brunner, M., Krauss, S., & Baumert, J. (2008). Students' and mathematics teachers' perceptions of teacher enthusiasm and instruction. *Learning and Instruction*, *18*(5), 468–482.

Lau, S., & Nie, Y. (2008). Interplay between personal goals and classroom goal structures in predicting student outcomes: A multilevel analysis of person-context interactions. *Journal of Educational Psychology*, *100*(1), 15–29.

LeBreton, J. M., & Senter, J. L. (2008). Answers to 20 questions about interrater reliability and interrater agreement. *Organizational Research Methods*, *11*(4), 815–852.

Lüdtke, O., Robitzsch, A., Trautwein, U., & Kunter, M. (2009). Assessing the impact of learning environments: How to use student ratings of classroom or school characteristics in multilevel modeling. *Contemporary Educational Psychology*, *34*(2), 120–131.

Lüdtke, O., Trautwein, U., Kunter, M., & Baumert, J. (2006). Reliability and agreement of student ratings of the classroom environment: A reanalysis of TIMSS data. *Learning Environments Research*, *9*(3), 215–230.

Maas, C. M. J., & Hox, J. J. (2004). Robustness issues in multilevel regression analysis. *Statistica Nederlandica*, *58*(2), 127–137.

Madon, S., Smith, A., Jussim, L., Russell, D. W., Eccles, J. S., Palumbo, P., et al. (2001). Am I as you see me or do you see me as I am? Self-fulfilling prophecies and self-verification. *Personality and Social Psychology Bulletin*, *27*(9), 1214–1224.

Marginson, S., Tytler, R., Freeman, B., & Roberts, K. (2013). *STEM: Country comparisons international comparisons of science, technology, engineering and mathematics (STEM) education*. Final Report. <http://www.acola.org.au/index.php/projects/securing-australia-s-future/project-2> Accessed 14.07.17.

Marsh, H. W. (1994). Weighting for the right criteria in the Instructional Development and Effectiveness Assessment (IDEA) system: Global and specific ratings of teaching effectiveness and their relation to course objectives. *Journal of Educational Psychology*, *86*(4), 631–648.

Marsh, H. W., Lüdtke, O., Nagengast, B., Trautwein, U., Morin, A. J., Abduljabbar, A. S., et al. (2012). Classroom climate and contextual effects: Conceptual and methodological issues in the evaluation of group-level effects. *Educational Psychologist*, *47*(2), 106–124.

Martin, A., & Marsh, H. (2005). Motivating boys and motivating girls: Does teacher gender really make a difference? *Australian Journal of Education*, *49*(3), 320–334.

Meece, J. L., Anderman, E. M., & Anderman, L. H. (2006). Classroom goal structure, student motivation, and academic achievement. *Annual Review of Psychology*, *57*, 487–503.

Meece, J. L., Glienke, B. B., & Burg, S. (2006). Gender and motivation. *Journal of School Psychology*, *44*(5), 351–373.

Meece, J. L., Herman, P., & McCombs, B. L. (2003). Relations of learner-centered teaching practices to adolescents' achievement goals. *International Journal of Educational Research*, *39*(4), 457–475.

Middleton, J. A., & Spanias, P. A. (1999). Motivation for achievement in mathematics: Findings, generalizations, and criticisms of the research. *Journal for Research in Mathematics Education*, *30*, 65–88.

Midgley, C. (2002). *Goals, goal structures, and patterns of adaptive learning*. Hillsdale, NJ: Erlbaum.

Midgley, C., Maehr, M. L., Hruda, L. Z., Anderman, E., Anderman, L. H., Freeman, K. E., et al. (2000). *Manual for the patterns of adaptive learning scales*. Ann Arbor, Michigan: University of Michigan.

Murayama, K., & Elliot, A. J. (2009). The joint influence of personal achievement goals and classroom goal structures on achievement-relevant outcomes. *Journal of Educational Psychology*, *101*(2), 432–447.

Muthén, L., & Muthén, B. (1998–2010). *Mplus user's guide*. Los Angeles, CA: Muthen & Muthen.

Muthén, L., & Muthén, B. (2009). *Multilevel modeling with latent variables using Mplus: Cross-sectional analysis*. <http://www.statmodel.com> Accessed 14.07.17.

Nagy, G., Garrett, J., Trautwein, U., Cortina, K. S., Baumert, J., & Eccles, J. S. (2008). Gendered high school course selection as a precursor of gendered careers: The mediating role of self-concept and intrinsic value. In H. M. G. Watt & J. S. Eccles (Eds.), *Gender and occupational outcomes: Longitudinal assessments of individual, social, and cultural influences* (pp. 115–143). Washington, DC: American Psychological Association.

Nagy, G., Trautwein, U., Baumert, J., Köller, O., & Garrett, J. (2006). Gender and course selection in upper secondary education: Effects of academic self-concept and intrinsic value. *Educational Research and Evaluation*, *12*(4), 323–345.

Nagy, G., Watt, H. M., Eccles, J. S., Trautwein, U., Lüdtke, O., & Baumert, J. (2010). The development of students' mathematics self-concept in relation to gender: Different countries, different trajectories? *Journal of Research on Adolescence*, *20*(2), 482–506.

National Center for O*NET Development (2014). *O*NET OnLine*. <http://www.onetonline.org/> Accessed 14.07.17.

National Science Board (2014). *Science & engineering indicators*. <http://www.nsf.gov/statistics/seind14/content/digest/nsb1402.pdf> Accessed 14.07.17.

Noack, P. (2004). The family context of preadolescents' orientations toward education: Effects of maternal orientations and behavior. *Journal of Educational Psychology*, *96*(4), 714–722.
Nolen, S. B. (2007). Young children's motivation to read and write: Development in social contexts. *Cognition and Instruction*, *25*(2–3), 219–270.
OECD (2013). *Education at a glance 2013 OECD indicators*. <http://dx.doi.org/10.1787/eag-2013-en: OECD Publishing> Accessed 14.07.17.
Patrick, H., Anderman, L. H., Ryan, A. M., Edelin, K. C., & Midgley, C. (2001). Teachers' communication of goal orientations in four fifth-grade classrooms. *The Elementary School Journal*, *102*(1), 35–58.
Peng, S.-L., Cherng, B.-L., Chen, H.-C., & Lin, Y.-Y. (2013). A model of contextual and personal motivations in creativity: How do the classroom goal structures influence creativity via self-determination motivations? *Thinking Skills and Creativity*, *10*, 50–67.
Plante, I., O'Keefe, P. A., & Théorêt, M. (2013). The relation between achievement goal and expectancy-value theories in predicting achievement-related outcomes: A test of four theoretical conceptions. *Motivation and Emotion*, *37*(1), 65–78.
Pulkka, A.-T., & Niemivirta, M. (2013). In the eye of the beholder: Do adult students' achievement goal orientation profiles predict their perceptions of instruction and studying? *Studies in Educational Evaluation*, *39*(3), 133–143.
Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear modeling. Applications and data analysis methods* (2nd ed.). Thousand Oaks: Sage.
Reyes, M. R., Brackett, M. A., Rivers, S. E., White, M., & Salovey, P. (2012). Classroom emotional climate, student engagement, and academic achievement. *Journal of Educational Psychology*, *104*(3), 700–712.
Roeder, P. M., & Gruehn, S. (1996). Kurswahlen in der gymnasialen oberstufe [Course choice in senior high school]. *Zeitschrift für Pädagogik*, *42*(4), 497–518.
Roeser, R. W., Blumenfeld, P., Eccles, J., Harold, R. D., & Wigfield, A. (1993). Classroom experience and change in upper elementary students' self and task beliefs in reading and math. *Child Development*, *64*(3), 830–847.
Ryan, A. M., & Patrick, H. (2001). The classroom social environment and changes in adolescents' motivation and engagement during middle school. *American Educational Research Journal*, *38*(2), 437–460.
Schwinger, M., & Stiensmeier-Pelster, J. (2011). Performance-approach and performance-avoidance classroom goals and the adoption of personal achievement goals. *British Journal of Educational Psychology*, *81*(4), 680–699.
Simpkins, S. D., Davis-Kean, P. E., & Eccles, J. S. (2006). Math and science motivation: A longitudinal examination of the links between choices and beliefs. *Developmental Psychology*, *42*(1), 70–83.
Simpkins, S. D., Fredricks, J. A., & Eccles, J. S. (2012). Charting the Eccles' expectancy-value model from mothers' beliefs in childhood to youths' activities in adolescence. *Developmental Psychology*, *48*(4), 1019–1032.
Skinner, E. A., & Belmont, M. J. (1993). Motivation in the classroom: Reciprocal effects of teacher behavior and student engagement across the school year. *Journal of Educational Psychology*, *85*(4), 571–581.
Spearman, J., & Watt, H. M. G. (2013). Perception shapes experience: The influence of actual and perceived classroom environment dimensions on girls' motivations for science. *Learning Environments Research*, *16*(2), 217–238.
Tanaka, J. S. (1993). Multifaceted conceptions of fit in structural equation models. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 10–39). Newbury Park, CA: Sage.
Trautwein, U., Lüdtke, O., Marsh, H. W., & Nagy, G. (2009). Within-school social comparison: How students perceive the standing of their class predicts academic self-concept. *Journal of Educational Psychology*, *101*(4), 853–866.
Turner, J. C. (2001). Using context to enrich and challenge our understanding of motivational theory. In S. Volet & S. Järvelä (Eds.), *Motivation in learning contexts: Theoretical advances and methodological implications. Advances in learning and instruction series* (pp. 85–104). Elmsford, NY: Pergamon Press.
Turner, J. C., Midgley, C., Meyer, D. K., Gheen, M., Anderman, E. M., Kang, Y., et al. (2002). The classroom environment and students' reports of avoidance strategies in mathematics: A multimethod study. *Journal of Educational Psychology*, *94*(1), 88–106.
Turner, J. C., & Patrick, H. (2008). How does motivation develop and why does it change? Reframing motivation research. *Educational Psychologist*, *43*(3), 119–131.
Urdan, T. (2004). Using multiple methods to assess students' perceptions of classroom goal structures. *European Psychologist*, *9*(4), 222.
Urdan, T., & Midgley, C. (2003). Changes in the perceived classroom goal structure and pattern of adaptive learning during early adolescence. *Contemporary Educational Psychology*, *28*(4), 524–551.
Urdan, T., Midgley, C., & Anderman, E. M. (1998). The role of classroom goal structure in students' use of self-handicapping strategies. *American Educational Research Journal*, *35*(1), 101–122.
Vekiri, I. (2010). Boys' and girls' ICT beliefs: Do teachers matter? *Computers & Education*, *55*(1), 16–23.
Wang, M.-T. (2012). Educational and career interests in math: A longitudinal examination of the links between classroom environment, motivational beliefs, and interests. *Developmental Psychology*, *48*(6), 1643–1657.
Watson, J., McEwen, A., & Dawson, S. (1994). Sixth form A level students' perceptions of the difficulty, intellectual freedom, social benefit and interest of science and arts subjects. *Research in Science & Technological Education*, *12*(1), 43–52.
Watt, H. M. G. (2002). *Gender achievement-related choices and behaviors in mathematics and English: The nature and influence of self-, tasks-, and value perceptions* (unpublished Ph.D.). University of Sydney.
Watt, H. M. G. (2004). Development of adolescents' self-perceptions, values, and task perceptions according to gender and domain in 7th-through 11th-grade Australian students. *Child Development*, *75*(5), 1556–1574.
Watt, H. M. G. (2005). Explaining gendered math enrollments for NSW Australian secondary school students. *New Directions for Child and Adolescent Development*, *110*, 15–29.
Watt, H. M. G. (2006). The role of motivation in gendered educational and occupational trajectories related to maths. *Educational Research and Evaluation*, *12*(4), 305–322.
Watt, H. M. G., Shapka, J. D., Morris, Z. A., Durik, A. M., Keating, D. P., & Eccles, J. S. (2012). Gendered motivational processes affecting high school mathematics participation, educational aspirations, and career plans: A comparison of samples from Australia, Canada, and the United States. *Developmental Psychology*, *48*(6), 1594–1611.
Weinstein, R. S., Marshall, H. H., Brattesani, K. A., & Middlestadt, S. E. (1982). Student perceptions of differential teacher treatment in open and traditional classrooms. *Journal of Educational Psychology*, *74*(5), 678–692.
Wentzel, K. R. (2002). Are effective teachers like good parents? Teaching styles and student adjustment in early adolescence. *Child Development*, *73*(1), 287–301.
Wentzel, K. R., Battle, A., Russell, S. L., & Looney, L. B. (2010). Social supports from teachers and peers as predictors of academic and social motivation. *Contemporary Educational Psychology*, *35*(3), 193–202.
Wigfield, A., & Eccles, J. S. (2000). Expectancy–value theory of achievement motivation. *Contemporary Educational Psychology*, *25*(1), 68–81.
Wigfield, A., Tonks, S., & Eccles, J. S. (2004). Expectancy value theory in cross-cultural perspective. In D. M. McInerney & S. Van Etten (Eds.), *Big theories revisited* (Vol. 4, pp. 165–198). Greenwich, CT: Information Age Publishing.
Wolters, C. A. (2004). Advancing achievement goal theory: Using goal structures and goal orientations to predict students' motivation, cognition, and achievement. *Journal of Educational Psychology*, *96*(2), 236–250.
Wolters, C. A., & Daugherty, S. G. (2007). Goal structures and teachers' sense of efficacy: Their relation and association to teaching experience and academic level. *Journal of Educational Psychology*, *99*(1), 181.