
Title	Self-efficacy, value, and achievement emotions as mediators between parenting practice and homework behavior: A control-value theory perspective
Author(s)	Wenshu Luo, Pak Tee Ng, Kerry Lee and Khin Maung Aye
Source	<i>Learning and Individual Differences</i> , 50, 275–282. http://dx.doi.org/10.1016/j.lindif.2016.07.017
Published by	Elsevier

© 2016, Elsevier. Licensed under the Creative Commons Attribution-Non-Commercial-No Derivatives 4.0 International <http://creativecommons.org/licenses/by-nc-nd/4.0/>

This is the author's accepted manuscript (post-print) of a work that was accepted for publication in the following source:

Luo, W., Ng, P. T., Lee, K., & Aye, K. M. (2016). Self-efficacy, value, and achievement emotions as mediators between parenting practice and homework behavior: A control-value theory perspective. *Learning and Individual Differences*, 50, 275–282. <http://dx.doi.org/10.1016/j.lindif.2016.07.017>

Notice: Changes introduced as a result of publishing processes such as copy-editing and formatting may not be reflected in this document. For a definitive version of this work, please refer to the published source.

Running head: ACHIEVEMENT EMOTIONS

**Self-efficacy, value, and achievement emotions as mediators between
parenting practice and homework behavior: A control-value theory
perspective**

Wenshu Luo*, Pak Tee Ng, Kerry Lee, and Khin Maung Aye
Nanyang Technological University

*Correspondence should be addressed to Dr. Wenshu Luo, Policy and Leadership Studies
Academic Group, National Institute of Education, 1 Nanyang Walk, Singapore 637616; Email:
wenshu.luo@nie.edu.sg; Tel: (65) 6790-3235; Fax: (65) 6896-9151.

Self-efficacy, value, and achievement emotions as mediators between parenting practice and homework behavior: A control-value theory perspective

From the control-value theory perspective, this study investigated the mediational role of students' math self-efficacy, value, and achievement emotions between parenting practices and homework behaviors. A large sample of 2648 Singapore Secondary 2 students first took measures of parental expectancy and involvement, and then measures of math self-efficacy, value, achievement emotions (enjoyment, pride, boredom, and anxiety), and homework behaviors about 3 months later. The results of multiple-group structural equation modeling largely supported the hypothesized mediation model across gender groups. Math self-efficacy was associated with math enjoyment and pride positively, and math boredom and anxiety negatively; math value was associated with math enjoyment and anxiety positively, and math boredom negatively. The four emotions in turn showed distinct relations to homework behaviors. Partly through math self-efficacy, value, and achievement emotions, both parental expectancy and involvement predicted homework effort positively and homework distraction negatively. Theoretical and practical implications of the findings are discussed.

Keywords: achievement emotion, self-efficacy, value, parenting practice, homework behavior

1 Introduction

The role of affect in student learning receives increasing attention in recent years. Rather than focusing on general positive and negative affect or the most researched emotion—test anxiety, researchers now turn to discrete achievement emotions. Based on attribution and expectancy-value approaches to the study of academic emotions, Pekrun (2006) proposed the control-value theory for analyzing the role of achievement emotions in student learning. Central to this theory is that achievement emotions are primarily aroused by two types of cognitive appraisals: subjective control and subjective value pertaining to achievement activities and outcomes. However, most studies simply reported zero-order correlations between these two types of appraisals and one or more achievement emotions, and there is little empirical evidence on their joint relations to various achievement emotions. In addition, the control-value theory (Pekrun, 2006) assumes that “features of environments delivering information related to controllability and academic values are of critical importance for students’ emotions” (p. 325), which in turn affect the cognitive, motivational and regulatory processes of learning. However, the contextual antecedents of various achievement emotions and their distinct influences on learning have not been thoroughly examined. From the lens of the control-value theory of achievement emotions, this study aims to investigate 1) how math self-efficacy and value are jointly related to achievement emotions (enjoyment, pride, boredom, and anxiety), and 2) the mediational role of math self-efficacy, value and achievement emotions in the predictive relationship between parenting practices and student homework behaviors.

1.1 The control-value theory of achievement emotions

The control-value theory posits that the two types of cognitive appraisals—subjective control and subjective value are the main sources of achievement emotions (Pekrun, 2006;

Pekrun, Goetz, Titz, & Perry, 2002). Subjective control refers to an individual's perceived causal influence of the self over achievement activities and outcomes. It can take the forms of retrospective causal attribution and prospective expectancy of success or failure, often operationalized as self-efficacy, academic self-concept, or academic control (e.g., Goetz, Pekrun, Hall, & Haag, 2006; Pekrun, Goetz, Frenzel, Barchfeld, & Perry, 2011). There are two types of subjective values. Intrinsic values come from academic studying per se, such as a sense of pleasure or satisfaction from doing academic tasks or achieving academic success. Extrinsic values refer to an individual's perceived instrumental usefulness of academic actions or outcomes for achieving other goals.

These two types of appraisals combine to evoke various achievement emotions. In this study, we focused on four achievement emotions in learning mathematics, enjoyment, pride, anxiety and boredom, which are highly salient in academic context (Pekrun, et al., 2002). According to the control-value theory, students experience enjoyment in their learning activity when they feel it is interesting and they have high confidence in doing it well. Students experience pride when they value the outcome of success and have a high sense of control towards achieving success. Boredom as an activity-focused emotion can be experienced when students do not value the learning activity. It may also occur when there is too much or too little challenge in learning activities (Pekrun, Goetz, Daniels, Stupnisky, & Perry, 2010; Pekrun, Hall, Goetz, & Perry, 2014). Students tend to experience anxiety in their study when they perceive the outcome of success/failure to be very important (e.g., in high-stakes examinations), but also think they do not have enough control to avoid failure. Through simply calculating zero-order correlations, many studies found both appraisals correlated positively with positive emotions and negatively with negative emotions (e.g., Goetz, Cronjaeger, Frenzel, Ludtke, & Hall, 2010;

Pekrun, et al., 2010; Pekrun, et al., 2011). This is not fully consistent with the theoretical predictions of the relations. Thus, it is important to examine the two types of appraisals jointly to understand their unique role in predicting various achievement emotions.

Various achievement emotions play distinct roles in student learning (Pekrun, 2006; Pekrun, et al., 2010; Pekrun, et al., 2002). For example, it is assumed that enjoyment and pride as positive activating emotions will lead to the use of adaptive learning strategies and self-regulation. Boredom as a negative deactivating emotion will lead to lowered motivation to learn, lack of concentration, and superficial processing of information. Anxiety as a negative activating emotion will be associated with a more complex learning profile: it may promote individuals to exert more effort in order to avoid failure, but may also lead to irrelevant thinking that distracts attention from the task. In general, recent research reported that compared with negative emotions, positive emotions were related to higher achievement (e.g., Goetz et al., 2012; Luo, Lee, Ng, & Ong, 2014; Pekrun, et al., 2011; Pekrun, et al., 2014). However, very few studies have examined the relationships between various achievement emotions and students' learning strategies and self-regulation (e.g., Luo, Lee, et al., 2014; Pekrun, et al., 2011).

1.2 Homework motivation and behaviors

Defined as tasks assigned by school teachers for students to carry out during non-school hours (Cooper, 1989), homework is often regarded as an extension of in-school academic activities to reinforce what students have learned in school. However, more homework is not always beneficial to academic achievement. For example, it was reported that it is the proportion of homework completed and homework effort that positively predicted student achievement, rather than simply the amount of time spent doing homework (Cooper, Lindsay, & Nye, 1998; Trautwein, 2007; Trautwein, Ludtke, Schnyder, & Niggli, 2006).

Current models of homework practice emphasizes the important role of motivation in student homework behaviors and effectiveness (Cooper, Robinson, & Patall, 2006; Trautwein, Ludtke, Schnyder, et al., 2006). In particular, adopting the expectancy-value approach to homework motivation, Trautwein and colleagues propose that when students perceive high control and attach high value in doing homework, they will exert more effort and concentration in doing homework (Trautwein, Ludtke, Kastens, & Koller, 2006; Trautwein, Ludtke, Schnyder, et al., 2006). For example, students' homework interest has been associated negatively with self-reported distraction in doing homework (Xu, 2010). Extending the control-value theory of achievement emotions to homework context, a recent study reported that homework motivation (control and value beliefs) negatively predicted general unpleasant emotions experienced in doing homework and the latter in turn predicted homework effort negatively (Dettmers et al., 2011). However, more research is needed to examine the role of various discrete achievement emotions in student homework behaviors.

1.3 Parenting practices and student learning

The control-value theory posits that social environments (e.g., induction of values and achievement-related expectancies of significant others) affect students' emotional experiences through the two cognitive appraisals (Pekrun, 2006; Pekrun, et al., 2002). Parenting practices play an important role in student learning. Research has shown that parenting practices may influence students' learning through affecting their control and value beliefs. The expectancy beliefs that parents hold and communicate to children for their academic performance can shape children's own success beliefs (Eccles, Adler, & Kaczala, 1982). Many studies have reported that parental expectancy beliefs for their children's schooling are related to students' motivation and academic outcomes. For example, parental expectancy beliefs for their children's current or

future academic attainment were associated positively with students' self-concept of ability, academic expectations and attainment values, which in turn were associated with students' achievement (Benner & Mistry, 2007; Bois, Sarrazin, Brustad, Trouilloud, & Cury, 2002; Neuenschwander, Vida, Garrett, & Eccles, 2007).

Parental involvement has been conceptualized as the degree to which parents are responsive and involved in children's life or school-related activities (Grolnick & Ryan, 1989; Steinberg, Lamborn, Darling, Mounts, & Dornbusch, 1994). Parental involvement has been associated with student motivation, emotion, and learning. For example, parental involvement in student learning was found to be positively associated with students' expectancy and value beliefs in doing homework (Trautwein, Ludtke, Kastens, et al., 2006). In a mediation model, Goetz et al. (2006) reported that, family valuing and reinforcement of Latin achievement predicted positively Latin self-concept and attainment value; Latin self-concept then predicted Latin enjoyment positively and anxiety negatively, while Latin attainment value predicted both enjoyment and anxiety positively. In another study, parental involvement (warmth and supervision) was correlated positively with self-efficacy and mastery goals and negatively with self-handicapping of Grade 8-10 Australian students, and these three variables mediated the relationship between parental involvement and achievement (Boon, 2007).

Parental involvement has also been linked to students' homework behaviors. For example, in a meta-analysis of 14 studies, Patall, Cooper, and Robinson (2008) found that training parents on homework involvement led to higher rates of homework completion and less homework problems (e.g., denying or complaining about homework). Xu and colleagues reported that family help was related positively to homework management, and negatively to homework distraction (Xu, 2010; Xu & Wu, 2013). A more recent study reported that parental

responsiveness and structure during homework involvement in Grade 5 predicted lower homework procrastination and higher effort and achievement in Grade 7 (Dumont, Trautwein, Nagy, & Nagengast, 2014). To our knowledge, however, no research has been conducted to examine the mediational role of both cognitive appraisals and achievement emotions between parenting practices and students' homework behaviors.

2 Hypotheses of the present study

From the control-value theory perspective (Pekrun, 2006; Pekrun, et al., 2002), this study aimed to examine a hypothesized mediation model (Figure 1), in which cognitive appraisals and achievement emotions are mediators between parenting practices and homework behaviors. More specifically, we predicted that math self-efficacy would be related positively to math enjoyment and pride and negatively to math boredom and anxiety, and math value would be related positively to math enjoyment, pride and anxiety, and negatively to math boredom. Based on the theoretical assumptions of the control-value theory, we hypothesized that achievement emotions would be further associated with homework behaviors: math enjoyment and pride as positive activating emotions would be associated positively with homework effort and negatively with homework distraction, math boredom as a negative deactivating emotion would be associated negatively with homework effort and positively with homework distraction, and math anxiety as a negative activating emotion would be associated positively with both homework effort and distraction.

The control-value theory of achievement emotions assumes that cognitive appraisals and achievement emotions mediate the influences of environmental factors on student learning. Informed by research findings on parenting practices and student motivation, emotions and homework behaviors discussed above (e.g., Boon, 2007; Dettmers, et al., 2011; Dumont, et al.,

2014; Goetz, et al., 2006; Patall, et al., 2008; Trautwein, Ludtke, Kastens, et al., 2006; Xu, 2010; Xu & Wu, 2013), we hypothesized that parental expectancy and involvement would predict math self-efficacy and value positively, and through the mediation of math self-efficacy and value, these two parental variables would predict math enjoyment and pride positively, and math anxiety and boredom negatively. In addition, we hypothesized that through math self-efficacy, value, and achievement emotions, parental expectancy and involvement would further predict homework effort positively, and homework distraction negatively. Since gender differences that generally favor boys have been reported in math-related competency and value beliefs and achievement emotions (A. Frenzel, R. Pekrun, & T. Goetz, 2007a; Luo, Lee, et al., 2014), we would do multiple-group analysis to test whether gender difference exists in both variables' means and their relationships.

3 Method

3.1 Participants and procedure

On a voluntary basis, 2648 Secondary 2 (8th grade) students from 102 classes (16 schools) in Singapore participated in this study. The participants were 13.78 ($SD = 0.49$) years old on average, including 966 boys (36.5%). They were composed of 1790 Chinese (67.6%), 480 Malay (18.1%), 187 Indian (7.1%), and 191 others (7.2%). As part of a larger project on student motivation and self-regulated learning, participants took measures of this study in two online surveys. Perceived parental expectancy and involvement were measured at the beginning of the school year, and math self-efficacy, value, achievement emotions, and homework behaviors were measured about 3 months later. All the items were rated on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree).

3.2 Measures

Parental expectancy and involvement. Parental expectancy referred to students' perceived parental confidence in their ability to do well in school. Three items were designed to measure parental expectancy (Cronbach's $\alpha = .74$), such as, "My parents think I can do well in school," and "My parents tell me that I can do better than now." Parental involvement referred to the extent to which students perceive their parents as responsive, supportive, and involved in their learning. Based on existing measures (Gonzalez, Doan Holbein, & Quilter, 2002; Steinberg, Lamborn, Dornbusch, & Darling, 1992), four items were designed to measure parental involvement (Cronbach's $\alpha = .73$), such as, "My parents often discuss with me how well I am doing at school," and "My parents always help me if I have difficulty with my homework."

Math self-efficacy and value. Four items adapted from Midgley et al. (2000) were used to measure math self-efficacy (Cronbach's $\alpha = .84$), such as "I can do almost all the work in my math class." Math value was measured as perceived utility value of math, the extent to which students perceive learning mathematics will be helpful in their daily life, future education, and career (Eccles & Wigfield, 2002). Four items adapted from PISA 2003 and TIMSS 2007 were used to measure math value (Cronbach's $\alpha = .86$), such as, "I think learning math will help me in my daily life."

Achievement emotions. We adapted items from the Achievement Emotions Questionnaire – Mathematics (Pekrun, Goetz, & Perry, 2007) to measure math enjoyment, pride, boredom, and anxiety. Pekrun et al. (2007) used 6-15 items to measure each achievement emotion across 2 or 3 situations: class, learning, and test, and reported high internal consistency across situations. In this study, we measured achievement emotions in students' math study in general, each by 4 items. Sample items are given below: math enjoyment ("I enjoy being in my math lessons"); math pride ("I feel proud of what I know about math"); math boredom ("I get bored in my math

class”); and math anxiety (“I get very nervous when answering math questions”). Cronbach’s α was .87, .86, .87, and .82, respectively, for math enjoyment, pride, boredom, and anxiety.

Homework behaviors. Homework effort and distraction were measured by adapting items from the literature (Trautwein, Ludtke, Schnyder, et al., 2006). Three items were used to measure homework effort (Cronbach’s $\alpha = .84$), such as “Even when my math homework is difficult, I try to complete it.” Four items were employed to measure homework distraction (Cronbach’s $\alpha = .79$), such as “I often get distracted when doing my math homework”.

3.3 Statistical analysis

We first conducted preliminary analyses with raw composite scores to explore the data, including zero-order correlations, gender difference tests, and intra-class correlations (ICCs) to decompose the variance of each variable at class and student levels. We then conducted multiple-group confirmatory factor analysis (CFA) to examine the measurement model and measurement equivalence across genders. With measurement equivalence supported, we moved on to run multiple-group structural equation modeling (SEM) to test the hypothesized mediation model.

4 Results

The results of preliminary analyses are shown in Table 1. Boys reported higher math self-efficacy, value, enjoyment, pride, boredom, and homework distraction than girls. Math efficacy and value were correlated positively with math enjoyment, pride, and homework effort, and negatively with math boredom, anxiety, and homework distraction. Math enjoyment and pride were correlated positively with homework effort and negatively with homework distraction, and the opposite for math boredom and anxiety. Parental expectancy and involvement were correlated positively with math self-efficacy, value, enjoyment, pride, and homework effort, and negatively with math boredom, anxiety, and homework distraction. The values of ICCs indicated that relatively little variance (2-9%) existed at class level across all variables. Thus, in

consideration that 1) the variances at class level were trivial compared to those at individual level (Lee, 2000), and 2) the complex models to be tested (the number of free parameters was much larger than the number of classes) required large sample size, we did multiple-group CFA and SEM at individual level.

Measurement invariance across groups is a prerequisite for making substantive cross-group comparisons (e.g., tests of group mean differences and invariance of structural parameter estimates) (Vandenberg & Lance, 2000). We tested three nested measurement models to examine measurement equivalence between boys and girls: Model 1 with configural invariance (same factor pattern), Model 2 with metric equivalence (same factor pattern and loadings), and Model 3 with both metric and scalar equivalence (same factor pattern and loadings and intercepts of indicators). As shown in Table 2, all the 3 measurement models had good fit. As suggested by Cheung and Rensvold (2002), because the change of Comparative Fit Index (ΔCFI) is not affected by model complexity, sample size, and the overall goodness-of-fit in comparison with other goodness-of-fit indexes (e.g., chi-square), it was used to compare the nested models. A value no larger than .01 in ΔCFI would support the invariance hypothesis as defined in the more restricted model (Cheung & Rensvold, 2002). Comparing the three models, the most parsimonious Model 3 was supported, indicating measurement equivalence (both metric and scalar invariance) between gender groups. By testing gender differences in latent means in Model 3, we found boys were higher on perceived parental involvement ($p < .05$), math self-efficacy, value, enjoyment, pride, boredom, and homework distraction ($ps < .01$).

To test mediational relationships, it is important to examine whether the mediators were not only related to predictors, but also significantly related to outcomes after controlling for the remote direct effects from predictor to outcome variables (Baron & Kenny, 1986; Preacher &

Hayes, 2008). Therefore, we first tested a more complex mediation model (Model 4) with 16 remote direct effects from predictors to outcomes, including 12 paths from parental expectancy and involvement to the four achievement emotions and the two homework behaviors, and 4 paths from math self-efficacy and value to the two homework behaviors. In Model 4, all structural parameters (path coefficients, residual variances, and covariances of latent factors) were set to be equal across gender groups. As shown in Table 2, compared with Model 3, the more restricted Model 4 was accepted. However, 13 of the 16 remote direct paths were non-significant, and thus they were removed (set to be 0) in Model 5. In comparison with Model 4, the more restricted Model 5 was accepted. The three remote direct paths remained in Model 5 were from parental involvement, math self-efficacy, and math value to homework effort. In Model 5, we also identified that two paths related to math pride in the hypothesized mediation model (from math value to math pride and from math pride to homework distraction) were not significant, and they were removed in Model 6. Compared with Model 5, the more parsimonious Model 6 was accepted as the final model.

The gender-consistent standardized path coefficients are shown in Figure 2. Parental expectancy and involvement predicted positively both math self-efficacy and value. Math self-efficacy was in turn associated positively with enjoyment and pride and negatively with boredom and anxiety; math value was in turn associated positively with enjoyment and anxiety, and negatively with boredom. Math enjoyment, pride and anxiety were then positively and math boredom negatively related to homework effort; math enjoyment, boredom and anxiety were all positively related to homework distraction. In addition, we found that parental involvement, math self-efficacy, and math value were directly and positively related to homework effort.

The indirect and total effects are shown in Table 3. Through achievement emotions, math self-efficacy was associated positively with homework effort and negatively with homework distraction; math value was associated positively with both homework effort and distraction. Through math self-efficacy and value, parental expectancy and involvement predicted positively math enjoyment and pride, and negatively math boredom and anxiety. Through the mediation of math self-efficacy, value, and achievement emotions, parental expectancy and involvement predicted positively homework effort, and negatively homework distraction.

5 Discussion

In general, the findings of this study largely supported the hypothesized mediation model. The two cognitive appraisals were jointly related to achievement emotions, which in turn showed distinct associations with homework behaviors. Through the mediation of cognitive appraisals and emotions, perceived parental expectancy and involvement predicted students' homework behaviors. Although some gender differences existed in math-related achievement motivation, emotions, and homework behaviors, the structural relationships among the variables were consistent across genders (e.g., Frenzel, et al., 2007a). In the following sections, we discuss theoretical and practical implications of the findings.

5.1 Math self-efficacy, value, and achievement emotions

Consistent with the control-value theory of achievement emotions and findings in previous studies (Frenzel, et al., 2007a; Pekrun, et al., 2011; Perry, Hladkyj, Pekrun, & Pelletier, 2001), we found that high math self-efficacy was associated with high positive emotions and low negative emotions. In particular, the negative relationship between math self-efficacy and boredom supports the previous finding that boredom is typically experienced in high demanding/low control situations (Pekrun, et al., 2010; Pekrun, et al., 2014).

Compared with self-efficacy, math value showed a different pattern of relationships with achievement emotions. Consistent with the control-value theory, after controlling for math self-efficacy, math value was associated positively with math enjoyment and anxiety, and negatively with math boredom. As found in a previous study (Goetz, et al., 2006), the unique positive association between math value and anxiety after controlling for self-efficacy is in contrast with the negative zero-order correlation between these two variables found in both the present and previous studies (e.g., Luo, Paris, Hogan, & Luo, 2011; Pekrun, et al., 2011), suggesting the importance of examining the two cognitive appraisals simultaneously. After controlling for math self-efficacy, however, we did not find that math value was significantly associated with math pride. One possible explanation is that math value was operationalized as perceived utility value in this study. Compared with utility value, both intrinsic and attainment values (the latter refers to the relevance of a task for confirming/disconfirming important aspects of one's self-worth) (Eccles & Wigfield, 2002) might activate sense of pride. Future studies need to distinguish different types of values and examine their roles in students' emotional experiences.

Consistent with gender stereotypes, boys reported higher math efficacy and value beliefs, more positive emotions, and more distraction in doing homework (Frenzel, et al., 2007a; Luo, Lee, et al., 2014; Meece, Glienke, & Burg, 2006). Gender difference in negative emotions was more complex. There was no gender difference in math anxiety, but boys reported more math boredom. Although many studies found higher math anxiety in girls, others reported no gender difference, including those measuring general math anxiety with adolescents (for reviews, see Devine, Fawcett, Szucs, & Dowker, 2012; Hill et al., 2015). It is possible that gender difference in math anxiety is related to other personal/contextual factors. For example, our recent analysis suggests that gender difference in math anxiety is moderated by students' academic tracks. Very

few studies have examined gender difference in math boredom and the result is inconsistent. Some found no gender difference (A. Frenzel, R. Pekrun, & T. Goetz, 2007b; Luo, Lee, et al., 2014), while others found that gender difference varied across types of boredom (e.g., under-challenged and over-challenged boredom) (Daschmann, Goetz, & Stupnisky, 2011). Thus, further research is needed to examine gender differences in negative emotions in math study.

5.2 Cognitive appraisals, achievement emotions, and homework behaviors

The findings in this study suggest that when students experience high enjoyment, high pride, low boredom, or high anxiety in their math study, they are more likely to make effort in doing math homework. In addition, when students experience high enjoyment, high boredom, or high anxiety in their math study, they are more likely to get distracted when doing math homework. Consistent with the control-value theory and previous studies (Pekrun, et al., 2010; Pekrun, et al., 2011; Pekrun, et al., 2002), these findings imply that pride as a positive activating emotion may enhance students' motivation to make more effort in their study, while boredom as a negative deactivating emotion is generally detrimental to learning. Anxiety as a negative activating emotion, however, has more complex influences on student learning. On one hand, it may induce extrinsic motivation to work hard so as to avoid failure; on the other hand, it may also distract students' attention from doing the tasks and self-regulation. For example, anxiety has been found to be correlated positively with extrinsic motivation and external regulation, but negatively with self-regulation (Luo, Aye, Hogan, Kaur, & Chan, 2013; Pekrun, et al., 2011). It is interesting that math enjoyment showed slight positive relationship with both homework effort and distraction. This might be because students who enjoy learning math tend to be more self-regulated in terms of both learning content and process (Helle, Laakkonen, TuiJula, & Vermunt, 2013). Thus they may not limit their attention and effort only to the homework given by teachers,

especially when homework tasks are not well selected and meant only for students to drill and practice. Altogether, these distinct relations between achievement emotions and homework behaviors suggest that rather than focusing on general positive or negative emotions, it is important to distinguish various discrete emotions and examine their different roles in learning.

Math self-efficacy and value were associated positively with homework effort directly and also indirectly through achievement emotions, suggesting that these two cognitive appraisals are important predictors of homework effort (e.g., Trautwein, Ludtke, Schnyder, et al., 2006). However, the two appraisals had opposite association with homework distraction through achievement emotions. Particularly through math anxiety, math value was associated positively with homework distraction. This might be related to the extrinsic nature of utility value measured in this study, suggesting that future studies need to examine the roles of various types of values in students' emotional experiences.

5.3 Parental practices and homework behavior: appraisals and emotions as mediators

We found that students' math efficacy and value fully mediated the relationship between perceived parental expectancy and involvement and student achievement emotions. The positive relationships between parental expectancy and involvement and math self-efficacy and value are in line with previous studies that found that both parental expectancy (e.g., Bois, et al., 2002; Neuenschwander, et al., 2007; Simpkins, Fredricks, & Eccles, 2012) and involvement (e.g., Hong & Ho, 2005; Luo, et al., 2013; Trautwein, Ludtke, Kastens, et al., 2006) were associated with students' own control-related and value-related beliefs. Consistent with previous studies (e.g., Duchesne & Ratelle, 2010; Goetz, et al., 2006), the findings in this study suggest that higher parental expectancy and involvement predict more positive and less negative achievement emotions of students.

Through the mediation of math self-efficacy, value, and achievement emotions, both parental expectancy and involvement predicted positively homework effort and negatively homework distraction. The adaptive prediction of homework behaviors by parental involvement is congruent with previous studies (Patall, et al., 2008; Trautwein, Ludtke, Kastens, et al., 2006; Xu, 2010; Xu & Wu, 2013). In addition, the direct effect from parental involvement to homework effort suggests that parental involvement in student learning can directly lead to more effort of students in doing homework.

5.4 Practical implications

This study extended research on achievement emotions to an East Asian country, Singapore. Rooted in the Confucian culture, academic effort and achievement are highly valued in Singapore (Luo, Hogan, Yeung, Sheng, & Aye, 2014). Students in Singapore have done well in international assessments (e.g., the Program for International Student Assessment). However, many researchers and educators are concerned that students are driven externally by an excessive focus on national examinations (e.g., at Primary 6 and Secondary 4) and may not be adequately engaged in their learning process. Although the current educational policy initiatives aim to transform student learning from quantity to quality (Ng, 2008), classroom instruction is still much driven by preparation for examinations (Hogan et al., 2013). Moreover, extra tuition is not just a source of help to support weak or failing students, but rather an increasingly popular means by which parents try to give their children a sharper competitive edge (Hio, 2014; Tan, 2014).

Achievement emotions not only play an important role in student learning and self-regulation, but also are important learning outcomes in their own right (Goetz, et al., 2006). The findings of this study suggest that parents can enhance their children's achievement motivation and positive emotions by showing high expectancy belief and being involved in children's

learning. Rather than simply sending children for extra tuition, parents should hold and convey their confidence in their children's ability to do well in school. It is also important for parents to show personal interest in children's learning and provide them with necessary support (e.g., learning resources at home and assistance with difficult homework). These recommendations can also be implemented in school parent-involvement programs.

5.5 Limitations and future directions

Despite large sample size and systematic data analysis in this study, there are some limitations to be addressed in future studies. First, the design of this study is correlational in nature despite a time interval between measures of parenting practices and student cognitive appraisals, emotions and homework behaviors. Thus, longitudinal studies with multiple waves of data collection are recommended to better examine the causation between achievement emotions and their theoretical antecedents and effects. Second, in this study, the control- and value-related beliefs were measured as self-efficacy and utility value. Future studies can employ other ways to operationalize these two types of appraisals. For example, it might be important to distinguish intrinsic and various types of extrinsic value appraisals when examining their relations to achievement emotions. Third, general parenting practices were measured in this study. It is possible that future research that assesses math-specific parenting practices will find stronger relationships between parenting practices and math-related learning. In addition, although the final model was equivalent between boys and girls, it is important to cross-validate it in another sample. Furthermore, there could be a common method factor in this study due to the use of only self-report measures and the findings could also be specific to math. Future research should examine whether the findings in this study can be replicated with multiple methods of data collection or in other subject domains.

References

- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*, 1173-1182.
- Benner, A. D., & Mistry, R. S. (2007). Congruence of mother and teacher educational expectations and low-income youth's academic competence. *Journal of Educational Psychology, 99*(1), 140-153.
- Bois, J., Sarrazin, P., Brustad, R. J., Trouilloud, D., & Cury, F. (2002). Mothers' expectancies and young adolescents' perceived physical competence: A year long study. *Journal of Early Adolescence, 22*(4), 384-406.
- Boon, H. J. (2007). Low- and high-achieving Australian secondary school students: Their parenting, motivations, and academic achievement. *Australian Psychologist, 42*, 212-225.
- Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9*(2), 233-255.
- Cooper, H. (1989). *Homework*. White Plains, N. Y.: Longman.
- Cooper, H., Lindsay, J. J., & Nye, B. (1998). Relationships among attitudes about homework, amount of homework assigned and completed, and student achievement. *Journal of Educational Psychology, 90*(1), 70-83.
- Cooper, H., Robinson, J. C., & Patall, E. A. (2006). Does homework improve academic achievement? A synthesis of research, 1987-2003. *Review of Educational Research, 76*(1), 1-62.

- Daschmann, E. C., Goetz, T., & Stupnisky, R. H. (2011). Testing predictors of boredom at school: Development and validation of the precursors to boredom scales. *British Journal of Educational Psychology, 81*, 421-440.
- Dettmers, S., Trautwein, U., Ludtke, O., Goetz, T., Frenzel, A., & Pekrun, R. (2011). Students' emotions during homework in mathematics: Testing a theoretical model of antecedents and achievement outcomes. *Contemporary Educational Psychology, 36*, 25-35.
- Devine, A., Fawcett, K., Szucs, D., & Dowker, A. (2012). Gender differences in mathematics anxiety in relation to mathematics performance when controlling for test anxiety. *Behavioral and Brain Functions, 8*:33.
- Duchesne, S., & Ratelle, C. F. (2010). Parental behaviors and adolescents' achievement goals at the beginning of middle school: Emotional problems as potential mediators. *Journal of Educational Psychology, 102*(2), 497-507.
- Dumont, H., Trautwein, U., Nagy, G., & Nagengast, B. (2014). Quality of parental homework involvement: Predictors and reciprocal relations with academic functioning in the reading domain. *Journal of Educational Psychology, 106*(1), 144-161.
- Eccles, J. S., Adler, T. F., & Kaczala, C. M. (1982). Socialization of achievement attitudes and beliefs: Parental influences. *Child Development, 53*, 310-321.
- Eccles, J. S., & Wigfield, A. (2002). Motivation beliefs, values and goals. *Annual Review of Psychology, 53*, 109-132.
- Frenzel, A., Pekrun, R., & Goetz, T. (2007a). Girls and mathematics – a “hopeless” issue? A control-value approach to gender differences in emotions towards mathematics. *European Journal of Psychology of Education, 22*(4), 497-514.

- Frenzel, A., Pekrun, R., & Goetz, T. (2007b). Perceived learning environment and students' emotional experiences: A multilevel analysis of mathematics classrooms. *Learning and Instruction, 17*, 478-493.
- Goetz, T., Cronjaeger, H., Frenzel, A., Ludtke, O., & Hall, N. C. (2010). Academic self-concept and emotion relations: Domain specificity and age effects. *Contemporary Educational Psychology, 35*, 44-58.
- Goetz, T., Nett, U. E., Martiny, S. E., Hall, N. C., Pekrun, R., Dettmers, S., & Trautwein, U. (2012). Students' emotions during homework: Structures, self-concept antecedents, and achievement outcomes. *Learning and Individual Differences, 22*, 225-234.
- Goetz, T., Pekrun, R., Hall, N., & Haag, L. (2006). Academic emotions from a social-cognitive perspective: Antecedents and domain specificity of students' affect in the context of Latin instruction. *British Journal of Educational Psychology, 76*, 289-308.
- Gonzalez, A. R., Doan Holbein, M. F., & Quilter, S. (2002). High school students' goal orientations and their relationship to perceived parenting styles. *Contemporary Educational Psychology, 27*, 450-470.
- Grolnick, W. S., & Ryan, R. M. (1989). Parent styles associated with children's self-regulation and competence in school. *Journal of Educational Psychology, 81*, 143-154.
- Helle, L., Laakkonen, E., Tuijula, T., & Vermunt, J. D. (2013). The developmental trajectory of perceived self-regulation, personal interest and general achievement throughout high school: A longitudinal study. *British Journal of Educational Psychology, 83*, 252-266.
- Hill, F., Mammarella, I. C., Devine, A., Caviola, S., Passolunghi, M. C., & Szucs, D. (2015). Maths anxiety in primary and secondary school students: Gender differences,

- development changes and anxiety specificity. *Learning and Individual Differences*, <http://dx.doi.org/10.1016/j.lindif.2016.1002.1006>.
- Hio, L. (2014). Tuition seen as 'necessity' for students to do well, *The Straits Times*, September 2. Retrieved from <http://www.straitstimes.com/st/print/2791844#>
- Hogan, D., Chan, M., Rahim, R., Kwek, D., Aye, K. M., Loo, S. C., . . . Luo, W. (2013). Assessment and the logic of instructional practice in Secondary 3 English and mathematics classrooms in Singapore. *Review of Education*, 1(1), 57-106.
- Hong, S., & Ho, H. (2005). Direct and indirect longitudinal effects of parental involvement on student achievement: Second-order latent growth modeling across ethnic groups. *Journal of Educational Psychology*, 97(1), 32-42.
- Lee, V. (2000). Using hierarchical linear modeling to study social context: The case of school effects. *Educational Psychologist*, 35, 125-141.
- Luo, W., Aye, K. M., Hogan, D., Kaur, B., & Chan, M. C. Y. (2013). Parental behaviors and learning of Singapore students: The mediational role of achievement goals. *Motivation and Emotion*, 37(2), 274-285.
- Luo, W., Hogan, D., Yeung, A. S., Sheng, Y. Z., & Aye, K. M. (2014). Attributional beliefs of Singapore students: Relations to self-construal, competence, and achievement goals. *Educational Psychology*, 34(2), 154-170.
- Luo, W., Lee, K., Ng, P. T., & Ong, J. X. W. (2014). Incremental beliefs of ability, achievement emotions, and learning of Singapore students. *Educational Psychology*, 34(5), 619-634.
- Luo, W., Paris, S. G., Hogan, D., & Luo, Z. (2011). Do performance goals promote learning? A pattern analysis of Singapore students' achievement goals. *Contemporary Educational Psychology*, 36, 165-176.

- Meece, J. L., Glienke, B. B., & Burg, S. (2006). Gender and motivation. *Journal of School Psychology, 44*, 351-373.
- Midgley, C., Maehr, M. L., Hruda, L. Z., Anderman, E., Anderman, L., & Freeman, K. E. (2000). *Manual for the Patterns of Adaptive Learning Scales (PALS)*. Ann Arbor: University of Michigan.
- Neuenschwander, M. P., Vida, M., Garrett, L., & Eccles, J. S. (2007). Parents' expectations and students' achievement in two Western nations. *International Journal of Behavioral Development, 31*(6), 594-602.
- Ng, P. T. (2008). Educational reform in Singapore: From quantity to quality. *Educational Research for Policy and Practice, 7*, 5-15.
- Patall, E. A., Cooper, H., & Robinson, J. C. (2008). Parent involvement in homework: A research synthesis. *Review of Educational Research, 78*(4), 1039-1101.
- Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational Psychology Review, 18*, 315-341.
- Pekrun, R., Goetz, T., Daniels, D., Stupnisky, R. H., & Perry, R. P. (2010). Boredom in achievement settings: Exploring control-value antecedents and performance outcomes of a neglected emotion. *Journal of Educational Psychology, 102*(3), 531-549.
- Pekrun, R., Goetz, T., Frenzel, A., Barchfeld, P., & Perry, R. P. (2011). Measuring emotions in students' learning and performance: The Achievement Emotions Questionnaire (AEQ). *Contemporary Educational Psychology, 36*, 36-48.

- Pekrun, R., Goetz, T., & Perry, R. P. (2007). *Achievement emotions questionnaire (AEQ-M) - Mathematics: Users' manual*. Munich, Germany: Department of Psychology, University of Munich.
- Pekrun, R., Goetz, T., Titz, W., & Perry, R. P. (2002). Academic emotions in students' self-regulated learning and achievement: A program of qualitative and quantitative research. *Educational Psychologist, 37*, 91-105.
- Pekrun, R., Hall, N. C., Goetz, T., & Perry, R. P. (2014). Boredom and academic achievement: Testing a model of reciprocal causation. *Journal of Educational Psychology, 106*(3), 696-710.
- Perry, R. P., Hladkyj, S., Pekrun, R., & Pelletier, S. T. (2001). Academic control and action control in the achievement of college students: A longitudinal field study. *Journal of Educational Psychology, 93*, 776-789.
- Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40*(3), 879-891.
- 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.
- Steinberg, L., Lamborn, S. D., Darling, N., Mounts, N. S., & Dornbusch, S. M. (1994). Over-time changes in adjustment and competence among adolescents from authoritative, authoritarian, indulgent and neglectful families. *Child Development, 65*, 754-770.

- Steinberg, L., Lamborn, S. D., Dornbusch, S. M., & Darling, N. (1992). Impact of parenting practices on adolescent achievement: Authoritative parenting, school involvement, and encouragement to succeed. *Child Development, 63*, 1266-1281.
- Tan, T. (2014). \$1 billion spent on tuition in one year, *The Straits Times*, 9 Nov. Retrieved from <http://news.asiaone.com/news/education/1-billion-spent-tuition-one-year>
- Trautwein, U. (2007). The homework-achievement relation reconsidered: Differentiating homework time, homework frequency, and homework effort. *Learning and Instruction, 17*, 372-388.
- Trautwein, U., Ludtke, O., Kastens, C., & Koller, O. (2006). Effort on homework in grades 5 through 9: Development, motivational antecedents, and the association with effort on classwork. *Child Development, 77*, 1094-1111.
- Trautwein, U., Ludtke, O., Schnyder, I., & Niggli, A. (2006). Predicting homework effort: Support for a domain-specific, multilevel homework model. *Journal of Educational Psychology, 98*, 438-456.
- Vandenberg, R. J., & Lance, C. E. (2000). A review and synthesis of the measurement invariance literature: Suggestions, practices and recommendations for organizational research. *Organizational Research Methods, 3*(1), 4-70.
- Xu, J. (2010). Predicting homework distraction at the secondary school level: A multilevel analysis. *Teacher College Record, 112*(7), 1937-1970.
- Xu, J., & Wu, H. (2013). Self-regulation of homework behavior: Homework management at the secondary school level. *The Journal of Educational Research, 106*, 1-13.

Table 1

Descriptive Statistics, Gender Differences, Correlations, and Intra-class Correlations (ICCs)

	<i>Total</i>	<i>Boys</i>	<i>Girls</i>	2)	3)	4)	5)	6)	7)	8)	9)	10)	ICC
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>										
1) Parental expectancy	4.04 (0.72)	4.07 (0.70)	4.02 (0.73)	.50	.27	.24	.20	.23	-.12	-.07	.24	-.06	.02
2) Parental involvement	3.45 (0.79)	3.49 (0.78)	3.43 (0.80)	--	.26	.24	.22	.23	-.14	-.06	.25	-.07	.02
3) Math efficacy	3.49 (0.82)	3.60 (0.81)	3.43 (0.82) ^a		--	.63	.62	.67	-.31	-.26	.50	-.15	.03
4) Math value	3.79 (0.81)	3.88 (0.81)	3.74 (0.81) ^a			--	.56	.52	-.30	-.06	.47	-.09	.03
5) Math enjoyment	3.20 (0.93)	3.34 (0.93)	3.12 (0.93) ^a				--	.66	-.47	-.12	.49	-.13	.09
6) Math pride	3.37 (0.89)	3.52 (0.88)	3.28 (0.88) ^a					--	-.26	-.15	.47	-.09	.03
7) Math boredom	2.74 (1.01)	2.83 (1.03)	2.69 (0.99) ^a						--	.49	-.33	.47	.09
8) Math anxiety	2.91 (0.93)	2.95 (0.93)	2.89 (0.93)							--	-.10	.46	.07
9) Homework effort	3.65 (0.79)	3.63 (0.79)	3.65 (0.79)								--	-.10	.05
10) Homework distraction	3.03 (0.83)	3.16 (0.81)	2.95 (0.83) ^a									--	.07

Note. ^a indicates significant gender difference; all correlations are significant ($p < .01$).

Table 2

Goodness-of-Fit Indexes of Measurement and Structural Models

	χ^2 (df)	CFI	TLI	RMSEA	SRMR
Measurement Model 1 (configural invariance)	3287.86 (1240)	0.959	0.953	0.035	0.036
Measurement Model 2 (metric invariance)	3321.24 (1268)	0.959	0.954	0.035	0.036
Measurement Model 3 (metric and scalar invariance)	3451.00 (1296)	0.957	0.953	0.035	0.037
Mediation Model 4 (with all 16 remote direct effects from predictors to outcomes)	3630.09 (1351)	0.954	0.952	0.036	0.048
Mediation Model 5 (with 13 non-significant remote direct effects removed)	3647.13 (1364)	0.954	0.953	0.036	0.048
Mediation Model 6 (with 2 non-significant paths related to math pride removed)	3648.36 (1366)	0.954	0.953	0.036	0.048

Note. CFI = Comparative Fit Index; TLI = Tucker Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual.

Table 3

Total Indirect Effects and Total Effects as found in Model 6

	Total indirect effects	Total effects
From math self-efficacy		
Homework effort	.13 (.04)**	.42 (.03)**
Homework distraction	-.26 (.03)**	-.26 (.03)**
From math value		
Homework effort	.10 (.01)**	.21 (.03)**
Homework distraction	.08 (.03)**	.08 (.03)**
From parental expectancy		
Math enjoyment	.17 (.02)**	.17 (.02)**
Math pride	.19 (.03)**	.19 (.03)**
Math boredom	-.09 (.01)**	-.09 (.01)**
Math anxiety	-.07 (.02)**	-.07 (.02)**
Homework effort	.13 (.02)**	.13 (.02)**
Homework distraction	-.05 (.01)**	-.05 (.01)**
From parental involvement		
Math enjoyment	.13 (.02)**	.13 (.02)**
Math pride	.14 (.03)**	.14 (.03)**
Math boredom	-.07 (.01)**	-.07 (.01)**
Math anxiety	-.04 (.02)*	-.04 (.02)*
Homework effort	.11 (.02)**	.22 (.03)**
Homework distraction	-.03 (.01)**	-.03 (.01)**

Note. * $p < .05$, ** $p < .01$.

Figure captions

Figure 1. The hypothesized mediation model.

Figure 2. The final mediation model.

Note. Standardized path coefficients are shown, with standard errors in following parentheses. $p < .01$ for all path coefficients except for the one from math enjoyment to homework effort ($p < .05$). In the parentheses under each mediator and outcome variable are percentage explained variances.



