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Students' emotions during homework in mathematics: Testing a theoretical model of antecedents and achievement outcomes

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ABSTRACT

The experience of pleasant and unpleasant emotions in academic situations is known to affect students' learning. The aim of the present study was to extend previous research by examining the antecedents and consequences of student emotions in the homework context. Multilevel analyses of a longitudinal dataset containing 3483 grade 9 and grade 10 students in 155 classes showed that the perceived quality of the homework tasks assigned by the teacher affected students' experience of unpleasant homework-related emotions. Moreover, the experience of unpleasant emotions during homework sessions was negatively related to homework effort and negatively predicted later achievement in mathematics.

1. Unpleasant homework-related emotions in mathematics: testing a theoretical model of antecedents and achievement outcomes

The advantages and disadvantages of homework remain a hotly debated issue in educational psychology. There is growing evidence that homework can be an effective supplement to in-school learning (e.g., Trautwein, 2007). At the same time, it may overburden students, causing unpleasant emotions in both students and their parents, with negative implications for family life (Corno & Xu, 2004; Leone & Richards, 1989). As students' emotions are not only "side-effects of learning," but "an integral part of learning in close interaction with conative and cognitive processes" (Op't Eynde & Turner, 2006, p. 362), homework-related emotions can also be expected to have implications for students' academic learning. Yet despite a growing volume of research showing that achievement emotions significantly influence students' learning, and despite the obvious relevance of emotions to homework practice, there have been few attempts to systematically analyze the antecedents and consequences of students' emotions in the homework context. This study strives to fill this gap in homework research.

2. Achievement emotions in the homework context

Several studies have shown that homework is often an emotionally charged activity (e.g., Pekrun, Goetz, Titz, & Perry, 2002; Warton, 2001). Although some students enjoy it, most report unpleasant emotions during homework sessions (Chen & Stevenson, 1989). According to Warton (2001), the costs of homework include decreasing motivation and increasing anxiety or boredom. Some students become so frustrated by their homework that they stop working on their assignments altogether (Corno & Xu, 2004). In the experience sampling studies by Leone and Richards (1989) and Verma, Sharma, and Larson (2002), students reported more unpleasant emotions during homework than during other activities, including classwork.

How do these emotions influence students' homework behavior and achievement? Leone and Richards (1989, p. 532) pointed out that a student in a negative mood is likely to have a very different learning experience than a student in a positive mood. Similarly, Trautwein, Niggli, Schnyder, and Lüdtke (2009) argued that homework is likely to be most effective if students do not typically experience unpleasant emotions such as anger while doing their assignments. Trautwein, Schnyder, Niggli, Neumann, and Lüdtke (2009) found a reciprocal relationship between achievement and homework-related emotions, with low achievement predicting higher levels of unpleasant homework-related emotions, and higher levels of unpleasant homework-related emotions predicting low

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achievement. In sum, the few studies available to date indicate that homework elicits various emotions that may impact student learning and achievement. However, little is known about the antecedents and consequences of homework-related emotions, and a general theoretical model for these emotions is lacking.

3. Theoretical framework

There are two main possibilities for integrating emotions into a homework model. First, existing models of emotions in achievement contexts can be adapted to the homework situation. Second, existing homework models that do not specifically include emotions can be extended. In the present research, we integrated elements of the control-value theory of achievement emotions (Pekrun, 2006; Pekrun, Frenzel, Goetz, & Perry, 2007) into a homework model (Trautwein, Lüdtke, Schnyder, & Niggli, 2006).

The control-value theory of achievement emotions provides a theoretical framework for analyzing emotions in achievement-related contexts. The theory combines elements from expectancy-value approaches to the study of emotions (Turner & Schallert, 2001) with attributional theories of achievement motivation and emotions (Weiner, 1985). It proposes the learning environment to influence two components of cognitive appraisal that are central to the development of achievement emotions. The first component, subjective control, covers control-related cognitions such as self-efficacy expectancies, achievement-related expectancies, and causal attributions of outcomes. The second component, subjective value, reflects the perceived valence of actions and outcomes. Emotions are a product of the two components. For instance, if the valence of homework is positive and perceived control is high, students are likely to enjoy doing their homework. The theory further predicts subjective control and subjective value to mediate the relationship between characteristics of the learning environment (e.g., quality of instruction) and emotional experience. Finally, it postulates achievement emotions to affect learning and achievement (for a more detailed description of the theory, see Pekrun, 2006; Pekrun et al., 2007). Several studies have demonstrated the relevance of achievement emotions for students' motivation, learning, and achievement. For instance, enjoyment of mathematics has been found to be positively correlated with mathematics grades (Goetz, Frenzel, Pekrun, Hall, & Lüdtke, 2007). Summarizing several studies, Pekrun et al. (2002) found pleasant emotions such as enjoyment to predict high achievement and unpleasant emotions such as test anxiety and boredom to predict low achievement.

Trautwein et al. (2006) have proposed a domain-specific, multilevel homework model for the analysis of homework effects in the school context. The model predicts that the effort students put into their homework is positively related to achievement gains. It further includes elements of expectancy-value theory (Eccles & Wigfield, 2002) and proposes that homework effort is influenced by students' homework expectancy beliefs in terms of their confidence in being able to complete a given homework task successfully ("Can I succeed on this task or activity?"; Wigfield & Wagner, 2005, p. 224) and by homework value beliefs in terms of their beliefs that the tasks assigned are important for succeeding in a given domain, their expectancy of the activity's long-term benefits, the costs associated with doing homework, and its intrinsic value ("Why do I want to do this activity?"; Wigfield & Wagner, 2005, p. 224). Moreover, the model predicts that homework characteristics (e.g., homework quality in terms of the perceived quality of the tasks selected and the assignment of challenging but not overly difficult tasks) and student characteristics (e.g., cognitive abilities, gender) affect homework expectancy and value beliefs and homework effort. Empirical findings support the central predictions of the model (e.g., Dettmers, Trautwein, Lüdtke, Kunter, & Baumert, 2010; Trautwein, 2007; Trautwein & Lüdtke, 2007; Trautwein, Lüdtke, Kastens, & Köller, 2006; Trautwein, Lüdtke, Roberts, Schnyder, & Niggli, 2009).

3.1. Learning environments, achievement emotions, homework effort, and achievement

Both control-value theory and current models of homework assignment and completion include characteristics of the learning environment. The control-value theory of achievement emotions postulates that characteristics of the learning environment (e.g., instructional quality and task characteristics, autonomy support, goal structures, and achievement feedback received) are crucial for the development of achievement emotions. Moreover, it predicts that control and value beliefs mediate the effects of these instructional characteristics on achievement emotions (Pekrun, 2006). High-quality instruction that stimulates and supports students' learning (e.g., through suitable learning material) may enhance the intrinsic value of achievement activities and thus contribute to the development of pleasant activity-related emotions such as enjoyment. Challenging, but solvable, tasks are thought to elicit positive emotions, whereas overly difficult/overly easy tasks may result in very low/very high control beliefs and thus lead to boredom (Else-Quest, Hyde, & Hejmadi, 2008; Pekrun, Goetz, Daniels, Stupnisky, & Perry, 2010). Frenzel, Pekrun, and Goetz (2007) analyzed the effects of the perceived learning environment (e.g., instructional quality, including aspects of clarity and structure) on emotional experience. They found that quality of instruction positively predicted enjoyment and negatively predicted anxiety, anger, and boredom at the student level and negatively predicted anger at the class level.

Similarly, recent homework research has shown that aspects of the learning environment affect students' homework-related emotions (Trautwein, Niggli, et al., 2009) as well as the effort they put into their homework and, ultimately, their achievement (e.g., Dettmers et al., 2010; Trautwein & Lüdtke, 2007; Trautwein & Lüdtke, 2009). For instance, Trautwein, Niggli, et al. (2009) found a controlling homework style on the part of the teacher to be associated with less homework effort and more unpleasant homework-related emotions on the part of students in French as a second language classes. In contrast, students whose teachers considered homework to be particularly helpful when done independently, and who supported students' homework autonomy by encouraging them to complete homework assignments on their own, reported lower levels of unpleasant homework-related emotions. Likewise, quality of mathematics homework has been found to positively predict homework effort and mathematics achievement (Dettmers et al., 2010).

3.2. A theoretical model of homework-related emotions

The present investigation in the domain of mathematics attempts to combine the approaches of homework research and research on achievement emotions by analyzing the effects of homework quality and expectancy-value components on homework-related emotions, homework effort, and achievement and examining the mediating role of homework-related emotions. Specifically, we seek to integrate basic propositions of Pekrun's (2006) and Pekrun et al. (2007) control-value theory of achievement emotions into the homework model proposed by Trautwein, Lüdtke, Schnyder, et al. (2006). Fig. 1 presents the model analyzed in the present study. In accordance with the predictions of both theories and the results of previous studies, homework quality is proposed to predict homework expectancy and value beliefs, homework-related emotions, homework behavior, and achievement. Two indicators of homework quality in mathematics were analyzed in the