

Measuring emotions in students' learning and performance: The Achievement Emotions Questionnaire (AEQ)

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ABSTRACT

Aside from test anxiety scales, measurement instruments assessing students' achievement emotions are largely lacking. This article reports on the construction, reliability, internal validity, and external validity of the Achievement Emotions Questionnaire (AEQ) which is designed to assess various achievement emotions experienced by students in academic settings. The instrument contains 24 scales measuring enjoyment, hope, pride, relief, anger, anxiety, shame, hopelessness, and boredom during class, while studying, and when taking tests and exams. Scale construction used a rational–empirical strategy based on Pekrun's (2006) control-value theory of achievement emotions and prior exploratory research. The instrument was tested in a study using a sample of university students ($N = 389$). Findings indicate that the scales are reliable, internally valid as demonstrated by confirmatory factor analysis, and externally valid in terms of relationships with students' control-value appraisals, learning, and academic performance. The results provide further support for the control-value theory and help to elucidate the structure and role of emotions in educational settings. Directions for future research and implications for educational practice are discussed.

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1. Introduction

Academic settings abound with achievement emotions such as enjoyment of learning, hope, pride, anger, anxiety, shame, hopelessness, or boredom. These emotions are critically important for students' motivation, learning, performance, identity development, and health (Schutz & Pekrun, 2007). Accordingly, theoretically-grounded measurement instruments are needed to analyze their functions and origins, and to assess these emotions in educational practice. To date, there is a lack of such instruments, with the single exception of test anxiety questionnaires. In response to this deficit, we developed a self-report instrument measuring various achievement emotions that students commonly experience in academic settings (Achievement Emotions Questionnaire, AEQ). Previous publications referring to this instrument have reported data using preliminary versions or selected scales only (Acee et al., 2010; Daniels et al., 2009; Mouratidis, Vansteenkiste, Lens, & Auweele, 2009; Pekrun, Elliot, & Maier, 2006, 2009; Pekrun, Goetz, Daniels, Stupnisky, & Perry, 2010; Pekrun, Goetz, Perry, Kramer, &

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Hochstadt, 2004). The present research involves the first comprehensive investigation of the AEQ, including all scales of the instrument within one analysis. This investigation makes it possible to examine the psychometric quality of the instrument, to analyze the overall structure and role of achievement emotions as experienced by students in academic settings, and to further test hypotheses of the control-value theory of achievement emotions (Pekrun, 2006; Pekrun, Frenzel, Goetz, & Perry, 2007).

Construction of the AEQ was informed by the models for assessing achievement emotions that are provided by the measurement of test anxiety. Specifically, whereas early instruments such as the Test Anxiety Questionnaire (TAQ; Mandler & Sarason, 1952) deemed test anxiety to be a unidimensional construct, conceptions developed since then make it possible to differentiate various components of the construct, with affective, cognitive, and physiological components being central to contemporary measures (Zeidner, 2007). The advances in the measurement of test anxiety enabled researchers to successfully uncover the structures, functions, and origins of this emotion (for overviews, see Hembree, 1988; Zeidner, 1998, 2007).

In line with current test anxiety measurement and conceptions of emotion more generally, the AEQ is based on a multi-component definition of achievement emotion. In contrast to test anxiety

measures, however, the AEQ assesses a broader range of major achievement emotions. The 24 scales of the instrument tap into nine different emotions occurring in three different academic achievement settings. In the following sections, we first outline the theoretical conception underlying the AEQ and its validation. Next, we describe the construction of the instrument. We then report an empirical analysis targeting item and scale statistics, reliability, internal validity, and external validity of the instrument.

1.1. Conceptual framework: the control-value theory of achievement emotions

As a framework for defining emotions, constructing scales, and validating the instrument, the control-value theory of achievement emotions was used (Pekrun, 2006; Pekrun et al., 2007). The control-value theory provides an integrative approach for analyzing various emotions experienced in achievement contexts, including academic settings as well as achievement situations in other life domains (e.g., sports, professional activities). The theory builds on assumptions from expectancy-value theories of emotions (Pekrun, 1992a; Turner & Schallert, 2001), transactional approaches (Lazarus & Folkman, 1984), attributional theories (Weiner, 1985), and models of the performance effects of emotions (Fredrickson, 2001; Pekrun, 1992b; Pekrun, Goetz, Titz, & Perry, 2002; Zeidner, 1998, 2007). It expands these views by integrating propositions from different theories and by focusing on both outcome-related and activity-related achievement emotions.

1.1.1. Definition and component structures of emotion

In line with contemporary component process models of emotions (Scherer, 2009), the control-value theory views emotions as sets of interrelated psychological processes, whereby affective, cognitive, motivational, and physiological components are of primary importance. For example, anxiety can comprise uneasy and tense feelings (affective), worries (cognitive), impulses to escape from the situation (motivational), and peripheral activation (physiological). This view is consistent with leading-edge conceptions of test anxiety, but extends these conceptions in an important way. Although most current test anxiety instruments assess affective, physiological, and cognitive components of anxiety, they neglect the motivational component. Items pertaining to this component were originally part of Mandler and Sarason's (1952) TAQ, but later motivational components were omitted. These components are included in the current conception.

From a measurement perspective, the multi-component conception of emotions adopted in the control-value theory implies that emotions are best modeled as hierarchically organized structures, with the components comprising an emotion being first-order factors and the emotion itself being represented by a second-order factor. For example, test anxiety would be conceived as being represented by one second-order factor for the emotion test anxiety, and four primary factors for the affective, cognitive, motivational, and physiological components of test anxiety that are nested within the second-order factor (Fig. 1; see Hodapp & Benson (1997) for a similar approach). Empirically, such hierarchical factor models should prove superior to single-factor models postulating just one factor representing the emotion.

1.1.2. Definition of achievement emotion

Achievement emotions are defined as emotions that are directly linked to achievement activities or achievement outcomes. In past research, studies on achievement emotions focused on emotions related to achievement outcomes, including both *prospective outcome emotions*, such as hope and anxiety linked to possible success and failure, respectively, and *retrospective outcome emotions* like pride and shame linked to prior success and failure, respectively

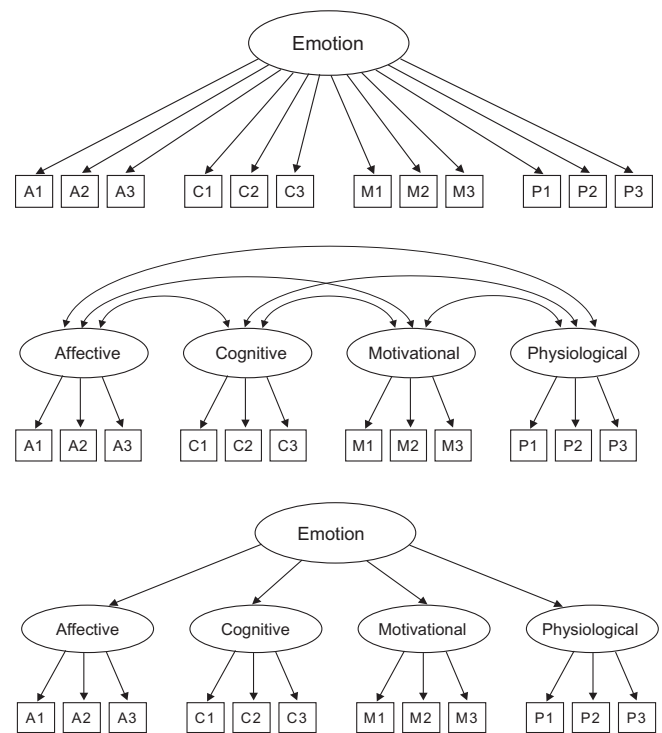


Fig. 1. Models for component structures of achievement emotions. Upper part: Model 1A (one-factor model). Middle part: Model 1B (four component factors model). Lower part: Model 1C (hierarchical model). A1–A3, C1–C3, M1–M3, P1–P3 denote affective, cognitive, motivational, and physiological items, respectively.

(Weiner, 1985; Zeidner, 1998). The definition proposed by the control-value theory implies that *activity emotions* pertaining to current achievement-related activities are also considered as achievement emotions. Examples are students' enjoyment of learning, boredom experienced during classroom instruction, or anger at the task demands of academic learning (Pekrun, 2006; Pekrun et al., 2010).

In Pekrun's (2006; Pekrun et al., 2002) three-dimensional taxonomy of achievement emotions, the differentiation of activity versus outcome emotions pertains to the *object focus* of these emotions. In addition, as with emotions more generally, achievement emotions can be grouped according to their *valence* and to the degree of *activation* implied. In terms of valence, positive emotions can be distinguished from negative emotions, such as pleasant enjoyment versus unpleasant anxiety. In terms of activation, physiologically activating emotions can be differentiated from deactivating emotions, such as activating hope versus deactivating hopelessness. By using the dimensions valence and activation, the taxonomy is consistent with circumplex models of affect that arrange affective states in a two-dimensional (valence \times activation) space (Feldman Barrett & Russell, 1998; Linnenbrink, 2007).

1.1.3. Situational context and temporal specificity

Achievement emotions occur in different academic settings, such as attending class, studying, and taking tests and exams. These settings differ in relation to their functions and social structures. By implication, emotions can vary across these settings as well. For example, enjoyment of classroom instruction may be different from enjoying the challenge of an exam—some students may be excited when going to class, others when writing exams. Therefore, measures of achievement emotions should distinguish between emotions experienced in these different settings.

In addition, in keeping with emotions more generally, achievement emotions can be conceptualized in trait-like or state-like ways. The defining characteristic of the trait versus state distinction is the temporal generality of the emotion under consideration. For example, habitual test anxiety as measured by test anxiety scales is regarded as a trait emotion (Zeidner, 1998); anxiety experienced an hour before a specific exam would be viewed as a state emotion (Spielberger, Anton, & Bedell, 1976); and emotions typically experienced by a student in a specific semester-long course over a lengthy period of time would be located in between trait and state emotions on a conceptual continuum representing emotional traits versus states.

1.1.4. Antecedents of achievement emotions

The control-value theory posits that achievement emotions are induced when the individual feels in control of, or out of control of, activities and outcomes that are subjectively important—implying that appraisals of control and value are the proximal determinants of these emotions. Control appraisals pertain to the perceived controllability of achievement-related actions and outcomes. As such, two important types of control appraisals are action-control expectancies and action-outcome expectancies (see Skinner's (1996) taxonomy of constructs of control). Action-control expectancies are expectancies that an action can be initiated and performed by the individual (Pekrun, 2006), with “self-efficacy expectation” (Bandura, 1977) being the modal term used most often today to denote these expectancies. Action-outcome expectancies imply that one's actions (e.g., academic effort) will produce desired outcomes (e.g., good grades); in the educational literature, these expectancies have been called “academic control” (e.g., Perry, Hladkyj, Pekrun, & Pelletier, 2001). Value appraisals relate to the subjective importance of achievement-related activities and outcomes.

The theory proposes that enjoyment of achievement activities is instigated when these activities are experienced as both controllable and valuable. For example, a student is expected to enjoy studying when she feels competent to master the learning material and perceives the material as interesting. Conversely, boredom is induced when the activity lacks any incentive value. The anticipatory outcome emotions hope and anxiety, related to potential success and failure, respectively, are thought to arise when there is some lack of control, implying uncertainty about these achievement outcomes, paired with subjective importance of these outcomes. For example, a student would feel anxious before an exam if he expects that he could fail and perceives the exam as important. If he is sure to succeed or does not care, there is no need to be anxious. Hopelessness is thought to be triggered when achievement seems not controllable at all, implying subjective certainty about failure. Finally, retrospective outcome emotions such as pride and shame are induced when success and failure, respectively, are perceived to be caused by internal factors implying control, or lack of control, about these outcomes (for further details, see Pekrun, 2006).

1.1.5. Outcomes of achievement emotions

According to the control-value theory, achievement emotions can profoundly affect students' learning and performance. Several mediating mechanisms are posited to be responsible for these effects, including students' motivation, strategy use, and regulation of learning (Pekrun, 1992b, 2006). Emotions are thought to influence students' intrinsic motivation to learn which is based on interest and curiosity in learning, as well as their extrinsic motivation related to the attainment of positive outcomes (e.g., good grades) or to the prevention of negative outcomes (e.g., poor grades). Furthermore, emotions are expected to facilitate use of different learning strategies, including flexible strategies such as elab-

oration of learning material as well as rigid strategies such as simple rehearsal. In addition, emotions can promote different styles of regulation including students' self-regulation versus external regulation of learning.

Positive activating emotions such as enjoyment, hope, and pride are thought to promote both intrinsic and extrinsic motivation, facilitate use of flexible learning strategies, and support self-regulation, thus positively affecting academic performance under most conditions. Conversely, negative deactivating emotions, such as hopelessness and boredom, are posited to uniformly reduce motivation and the effortful processing of information, implying negative effects on performance. For positive deactivating and negative activating emotions, such as relief, anger, anxiety, and shame, the relationships are presumed to be more complex. Specifically, anger, anxiety, and shame can undermine intrinsic motivation, but can induce strong extrinsic motivation to invest effort to avoid failure, implying that the effects on students' overall motivation to learn and invest effort need not be negative. Furthermore, these emotions are expected to promote use of more rigid learning strategies like rehearsal. As a consequence, negative activating emotions can have variable effects on students' learning (also see Lane, Whyte, Terry, & Nevill, 2005; Turner & Schallert, 2001), although negative effects on overall academic performance likely outweigh any beneficial consequences for most students (Boekaerts, 1993; Hembree, 1988; Pekrun, 2006).

1.2. Construction of the AEQ

1.2.1. Rational-empirical strategy of test construction

Construction of the AEQ was based on the theoretical considerations outlined earlier and on a series of preliminary empirical studies. These studies included exploratory investigations analyzing the occurrence and structures of various achievement emotions (Pekrun, 1992c; Pekrun et al., 2002; Spangler, Pekrun, Kramer, & Hofmann, 2002) and four quantitative studies focusing on scale development (Pekrun, Goetz, Perry, Kramer, & Hochstadt, 2004; Titz, 2001). The studies were guided by theory and were used to inform further development of theory-based emotion taxonomies which, in turn, were employed to construct the final AEQ scales. Thus, the strategy used involved theory-evidence loops integrating both rational and empirical perspectives (for more information, see Pekrun et al., 2004; Titz, 2001).

1.2.2. Emotions assessed by the AEQ

The decision to include scales for nine different emotions (enjoyment, hope, pride, relief, anger, anxiety, hopelessness, shame, and boredom) was based on two criteria. First, we selected emotions that occur frequently in students, as documented in our exploratory studies (Pekrun, 1992c; Pekrun et al., 2002; Titz, 2001). Second, we chose emotions to represent major emotion categories as defined by the three-dimensional taxonomy outlined earlier. Accordingly, the AEQ addresses *activity emotions* (enjoyment, boredom, and anger), *prospective outcome emotions* (hope, anxiety, and hopelessness), and *retrospective outcome emotions* (pride, relief, and shame). In terms of valence, the instrument measures both positive and negative emotions, and in terms of activation, it assesses both activating and deactivating emotions. As such, the AEQ makes up the four emotion categories comprising the valence and activation dimensions: *positive activating* (enjoyment, hope, pride); *positive deactivating* (relief); *negative activating* (anger, anxiety, shame); and *negative deactivating* (hopelessness, boredom).

1.2.3. Defining situational context and temporal specificity

In line with the contextual specificity of achievement emotions, we constructed separate scales for class-related, learning-

related, and test-related emotions. Regarding temporal specificity, the original version of the AEQ is intended to measure students' habitual, trait-like achievement emotions. However, the instrument can be used to assess all three types of emotions mentioned earlier (trait, course-specific, state) by adapting the instructions accordingly (see Pekrun, Goetz, Frenzel, & Perry, 2011).

1.2.4. Item and scale development

Initial item development for the AEQ was based on student reports obtained from our exploratory studies (Pekrun, 1992c; Titz, 2001). Concerning test-related anxiety, scale construction also included items adapted from Sarason's (1984) Reactions-to-Tests Questionnaire and Hodapp and Benson's (1997) integrative test anxiety questionnaire. Conceptual considerations and the exploratory data were used to construct taxonomies for components of achievement emotions, and items assessing these components were formulated. The components considered in these taxonomies, and in the scales, pertain to affective, cognitive, motivational, and physiological facets for each of the emotions measured. An effort was made to construct items that ensure discriminant validity of scales measuring different emotions, including neighboring emotions (i.e., like-valenced emotions having similar antecedents and components; Kuppens, van Mechelen, Smits, & de Boeck, 2004) that are difficult to separate empirically, such as anxiety and hopelessness.

The initial item pool consisted of more than 1500 items (Titz, 2001). From this pool, items were selected for preliminary versions of the scales by using expert judgment and criteria of semantic redundancy. Selection of items for the final scales was based on item and scale statistics for the preliminary versions (Pekrun et al., 2004; Titz, 2001). Again, in selecting items, we made an effort to attend to both convergent and divergent scale validity. Items were selected according to convergent item validity (i.e., high factor loadings on the relevant scale) as well as divergent item validity (i.e., low factor loadings on other emotion scales). The original German AEQ scales were translated into the English language by a team of three experts, two of them bilingual. A backtranslation procedure was used to ensure content-related item equivalence.

The final instrument consists of 24 scales that are organized in three sections assessing class-related, learning-related, and test-related emotions (see Appendix for sample items and Pekrun et al. (2011), for the complete instrument). Each of these scales contains items measuring the affective, cognitive, motivational, and physiological components of the respective emotion. A 5-point Likert scale (1 = *completely disagree*, 5 = *completely agree*) is used to record item responses. The class-related emotion scales include 80 items and instruct students to report how they feel with regard to class-related enjoyment, pride, anger, anxiety, shame, hopelessness, and boredom. The learning-related emotion scales include 75 items and instruct students to report how they feel with regard to studying in terms of the same eight emotions. Finally, the test emotion scales include 77 items and instruct students to indicate how they feel with regard to test-related enjoyment, hope, pride, relief, anger, anxiety, shame, and hopelessness. Within each section, the items are ordered in three blocks assessing emotional experiences before, during, and after an encounter with the specified academic context. These blocks focus on activity emotions (during), prospective outcome emotions (before), and retrospective outcome emotions (after) related to the setting addressed. Sequencing items this way is in line with principles of situation-reaction inventories and is intended to help respondents access their emotional memories (Endler & Okada, 1975).

1.3. Prior research using the AEQ

Selected scales of the AEQ have successfully been used to assess relationships between achievement emotions and students' learning and academic performance. Scales of the AEQ served to examine the linkages between students' achievement goals and their class-related and learning-related emotions (Daniels et al., 2009; Mouratidis et al., 2009; Pekrun, Elliot, & Maier, 2006, 2009). In line with the control-value approach to goals and emotions proposed by Pekrun et al. (2006, 2009), mastery goals predicted activity emotions, and performance-approach goals and performance-avoidance goals predicted positive and negative outcome emotions, respectively. Furthermore, these emotions were documented as mediators of the effects of achievement goals on students' academic performance (Daniels et al., 2009; Pekrun et al., 2009). In research on test emotions (Pekrun et al., 2004), the test-related emotion scales were also found to relate to students' learning and performance, with enjoyment, hope, and pride showing positive relations with most indicators of learning, and anger, anxiety, shame, and hopelessness showing negative relations. In addition, students' boredom has been analyzed using the learning-related boredom scale of the AEQ (Acee et al., 2010; Pekrun et al., 2010). The findings suggest that boredom relates negatively to students' academic control, motivation to learn, use of flexible learning strategies, self-regulation of learning, and academic performance. Finally, a domain-specific variant of the instrument measuring students' emotions in mathematics (Achievement Emotions Questionnaire-Mathematics, AEQ-M) was employed to analyze differences in students' mathematics emotions across genders, classrooms, and cultures (e.g., Frenzel, Pekrun, & Goetz, 2007; Frenzel, Thrash, Pekrun, & Goetz, 2007).

The findings of these studies suggest that the AEQ scales can be used to analyze various achievement emotions. However, since none of studies included more than a subset of scales, they did not provide a systematic account of the psychometric quality of the instrument and of the full range of emotions addressed by the AEQ. Therefore, we lack knowledge about the overall reliability and validity of the instrument. In particular, there is a research deficit regarding the internal component structures and interrelations of diverse achievement emotions as assessed by the AEQ, and about the relationships of the full set of emotions with important antecedents and outcomes such as students' control-value appraisals, learning, and academic performance.

1.4. Aims of the present study

Because a comprehensive analysis of the AEQ is lacking to date, the present research sought to analyze item and scale statistics, reliability, internal test validity, and external test validity for the complete instrument (see Slaney and Maraun (2008) for the distinction of internal versus external test validity). In doing so, we aimed to analyze the internal structures and external linkages of the various achievement emotions measured by the AEQ. Regarding external linkages, the study examined the relationships between achievement emotions and their presumed antecedents and outcomes, as addressed by Pekrun's (2006) control-value theory of achievement emotions. We used a dataset involving a North American student sample previously employed by Pekrun et al. (2004) to analyze select aspects of the AEQ test emotions scales, but made use of the entire dataset in analyzing all 24 scales of the instrument. The original version of the AEQ measuring students' habitual achievement emotions experienced across academic achievement situations was used, implying that these emotions were measured as domain-general, trait-like variables. By assessing habitual, trait-like achievement emotions, the present research analyzed emotions at the same level of generality as test

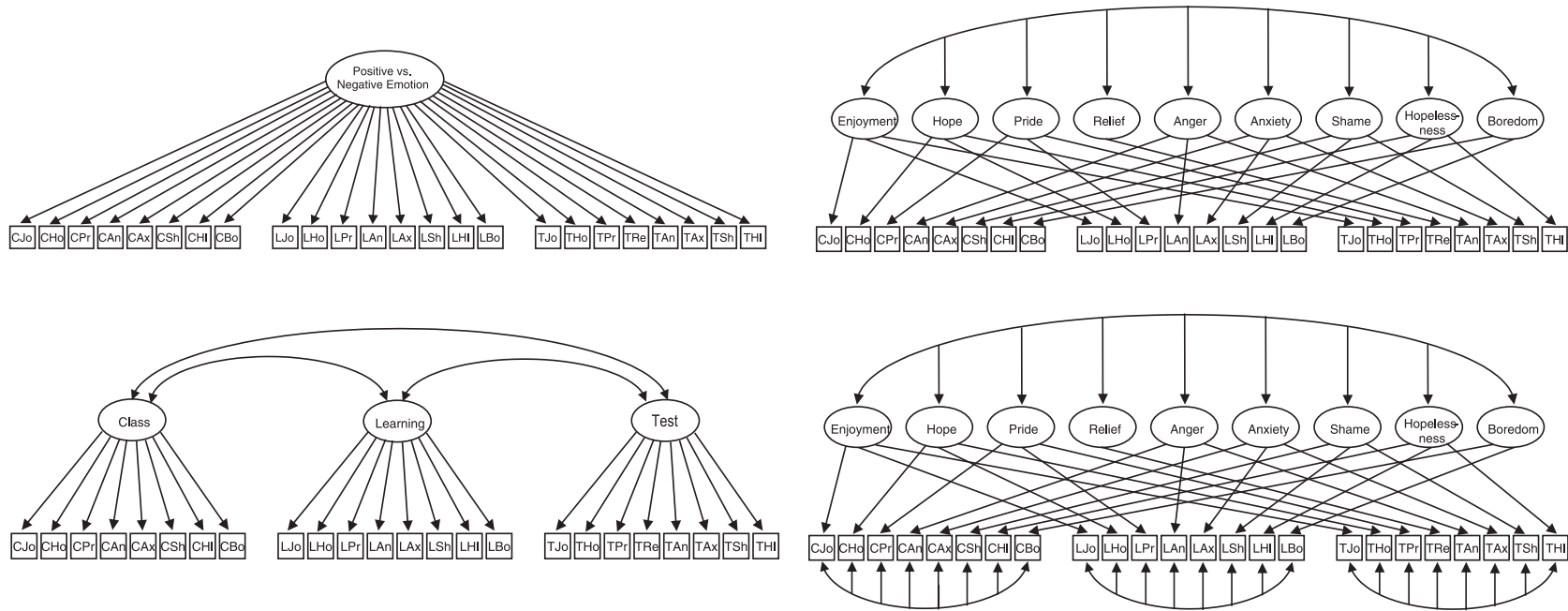


Fig. 2. SEM models for relationships between emotions. Upper left part: Model 2A (one emotion-factor model). Upper right part: Model 2B (eight emotion-factors model). Lower left part: Model 2C (three setting-factors model). Lower right part: Model 2C (emotion x setting-factors model). C, L, and T denote class-related, learning-related, and test-related emotions, respectively. Jo = enjoyment, Ho = hope, Pr = pride, Re = relief, An = anger, Ax = anxiety, HI = hopelessness, Bo = boredom.

anxiety scales (Zeidner, 1998). Specifically, we focused on the following issues: (1) item and scale statistics, including reliabilities; (2) gender differences; (3) internal test validity of the scales with regard to the internal component structures of emotions; (4) internal test validity in terms of the relationships between emotions; and (5) external test validity in terms of relationships with students' appraisals, learning, and performance.

With regard to gender, we sought to document the validity of the instrument in terms of replicating the gender differences in students' test anxiety that have consistently been found in prior research (Hembree, 1988; Zeidner, 1998). With regard to the internal component structures of scales, we used confirmatory factor analysis (CFA) to examine if these structures are best captured by hierarchical component factor models as described earlier, and compared these models to one-factor models as well as component factor models involving independent components (Fig. 1).

Concerning the relations between emotions, correlational analysis and CFA were used to document the distinctness of the emotion constructs assessed by the AEQ. We expected that a CFA model representing the two-facet structure of the instrument (i.e., nine different emotions nested within three different achievement settings) would best fit the data, as compared with alternative models. The alternative models included a one-factor model representing positive versus negative emotions as one bipolar factor, as well as two models differentiating between emotions only, or between different settings only (Fig. 2).

With respect to relations with learning and achievement, we examined the linkages of emotions with all of the primary antecedents and outcome variables addressed by the control-value theory as described earlier, including control-value appraisals (self-efficacy, academic control, academic value), intrinsic and extrinsic motivation, overall academic effort, use of flexible and rigid learning strategies (elaboration and rehearsal), self- and external regulation of learning, and academic performance.

2. Method

2.1. Participants and procedure

The sample consisted of 389 students (234 female; age: $M = 20.63$ years; $SD = 3.48$) in several undergraduate psychology courses at a large, Midwestern Canadian university who participated in return for extra course credit. Students were enrolled in study programs at different faculties including the faculties of arts (42.7%), management (15.4%), science (12.6%), and nursing (8.1%). The distribution of students across genders and faculties is typical for students participating in undergraduate psychology courses at Canadian universities (Perry, Stupnisky, Hall, Chipperfield, & Weiner, 2010). Participants completed the measures in one session.

2.2. Measures

2.2.1. Achievement emotions

To assess students' achievement emotions, the complete AEQ as described earlier was used (see Appendix for sample items). Students were instructed to report how they felt, typically, when attending class, studying, or taking test and exams in their university courses.

2.2.2. Perceived control and value

A 10-item version of Perry's (Perry et al., 2001) Perceived Academic Control Scale and the Self-Efficacy for Learning and Performance Scale of the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1991) were used to measure achievement-related subjective con-

trol. The items of the Perceived Academic Control Scale relate to influencing academic performance (e.g., "I have a great deal of control over my academic performance in my courses"; "The more effort I put in my courses, the better I do in them"). The Self-Efficacy for Learning and Performance Scale consists of five items assessing students' confidence about being able to master academic tasks and get good grades (e.g., "I'm confident I can do an excellent job on the assignments and tests in courses at university"). Participants responded by using 1 (*strongly disagree*) to 5 (*strongly agree*) scales, and the scores were summed to form the two control indexes ($\alpha = .83$ and $.82$ for academic control and self-efficacy, respectively). Perceived academic value was assessed with a short four-item version of the Task Value Scale of the MSLQ (Pintrich et al., 1991; e.g., "Understanding the subject matter of courses at university is very important to me"; "I am very interested in the content areas of courses at university"; 1 = *strongly disagree*, 5 = *strongly agree*; $\alpha = .69$).

2.2.3. Motivation

The Intrinsic Goal Orientation, Extrinsic Goal Orientation, and Effort Regulation scales of the MSLQ (Pintrich et al., 1991) were included in the study. The Intrinsic Goal Orientation and Extrinsic Goal Orientation scales are measures of intrinsic motivation based on interest and curiosity and of extrinsic motivation related to getting good grades, respectively, with each scale comprised of four items (e.g., "In classes at university, I prefer course material that arouses my curiosity, even if it is difficult to learn"; "Getting good grades in classes at university is the most satisfying thing for me right now"). The Effort Regulation scale is a measure of students' overall effort and motivation to learn (four items; e.g., "I work hard to do well in my classes even if I don't like what we are doing"). Participants responded by using 1 (*strongly disagree*) to 5 (*strongly agree*) scales, and the scores were summed to form the intrinsic motivation, extrinsic motivation, and effort indexes ($\alpha s = .51$, $.68$, and $.61$ for intrinsic motivation, extrinsic motivation, and effort, respectively).

2.2.4. Learning strategies

As indicators of flexible versus rigid learning strategies, students' use of elaboration and rehearsal strategies was assessed. Both strategies were measured with the respective scales of the MSLQ (Pintrich et al., 1991). The elaboration and rehearsal scales consisted of six and four items, respectively (e.g., "When reading for my classes, I try to relate the material to what I already know"; "When studying for my classes, I practice saying the material to myself over and over"). Participants responded by using 1 (*strongly disagree*) to 5 (*strongly agree*) scales, and the scores were summed to form the elaboration and rehearsal indexes ($\alpha s = .73$ and $.59$ for elaboration and rehearsal, respectively).

2.2.5. Self-regulation versus external regulation of learning

A four-item version of Goetz' (2004) Perceived Self-regulation of Learning Scale was used to measure students' self-regulation of learning goals, use of strategies, and monitoring of learning outcomes (e.g., "When studying, I set my own goals that I want to attain"; "When studying difficult material, I decide for myself which strategy to use"; "I am able to evaluate for myself how I make progress at learning"). A four-item version of Goetz' (2004) Perceived External Regulation of Learning Scale was used to measure external regulation (e.g., "The way I study largely depends on the professor's recommendations"; "When studying, I entirely rely on the readings I am given"). Participants responded by using 1 (*strongly disagree*) to 5 (*strongly agree*) scales, and the scores were summed to form the self-regulation and external regulation indexes ($\alpha s = .72$ and $.57$, respectively).

2.2.6. Academic performance

Students' performance was measured by assessing their grade point average attained over the academic year prior to the study.

3. Results and discussion

3.1. Item and scale statistics

Table 1 shows response distributions, item-total correlations, and reliabilities of the AEQ scales. The findings indicate that there was sufficient variation of scores on all scales. Most of the distributions were relatively symmetrical, the exception being the hopelessness scales which were positively skewed. Given the extreme nature and relatively rare occurrence of this emotion in achievement settings (Pekrun, 1992c; Titz, 2001), such skewness seems adequate and should not be reduced by normalizing distributions. Furthermore, the findings show that scale items had excellent part-whole corrected item-total correlations for all scales, with none of the correlations falling short of the .30 threshold. In line with item characteristics, reliabilities were above $\alpha = .75$ for all scales and above $\alpha = 0.85$ for 15 of the 24 scales. In sum, these findings indicate that the AEQ scales show sufficient variation, and that reliabilities range from good to excellent.

3.2. Gender differences

In analyzing the scale statistics separately by gender, we found that means were significantly different for five emotions. As compared with male students, female students reported more class-related enjoyment ($M_s = 32.76$ and 30.95 , $SD_s = 6.49$ and 6.35 , for female and male students, respectively; $t[387] = 2.68$, $p < .01$) and less class-related anger ($M_s = 16.67$ and 18.34 , $SD_s = 6.00$ and 6.39 ; $t[387] = -2.58$, $p < .05$). Furthermore, female students reported more learning-related anxiety ($M_s = 31.57$ and 29.28 , $SD_s = 7.90$ and 7.48 ; $t[387] = 2.82$, $p < .01$), more test anxiety

($M_s = 37.60$ and 34.08 , $SD_s = 10.09$ and 9.53 ; $t[387] = 3.39$, $p < .01$), and less test-related hope ($M_s = 25.50$ and 26.59 , $SD_s = 4.74$ and 5.15 ; $t[387] = -2.12$, $p < .05$). There were no significant mean differences for any of the other emotions.

In interpreting these gender differences, it should be noted that the effect sizes of the differences were relatively small (all $d_s < .40$), and that none of the differences generalized across settings, with the single exception of anxiety which differed significantly for settings of both learning and taking tests. The differences in self-reported anxiety are consistent with a vast literature showing that, on an average, female students report higher achievement anxiety than male students (Hembree, 1988; Zeidner, 1998). Given the consistency of this finding reported in the literature, the present findings attest to the convergent validity of the AEQ anxiety scales in terms of replicating these differences.

3.3. Internal validity: component structures of emotions

As noted, the AEQ scales were designed to represent the affective, cognitive, motivational, and physiological components of emotion within each scale. Following our earlier reasoning, we adopted the approach proposed by Hodapp and Benson (1997) to examine the validity of the scales in terms of their presumed internal structures. Three different structural models were competitively tested for each scale (Fig. 1). Model 1A was a general factor model assuming one latent emotion factor, with all scale items being manifest indicators of this factor. Model 1B was a four component factors model consisting of four separate latent factors representing the four emotion components, with the scale items being indicators for these factors. Model 1C was constructed as a hierarchical model that integrated the perspectives of the first two models by consisting of four latent primary component factors and one latent secondary emotion factor.

Given our component structuring of achievement emotions, we expected the component factors and hierarchical models to show

Table 1
Item and scale statistics.

| | No. of items | Possible range | Observed range | <i>M</i> | <i>SD</i> | Skewness | Mean $r_{i(t-t)}$ ^a | Alpha |
|----------------------------------|--------------|----------------|----------------|----------|-----------|----------|--------------------------------|-------|
| <i>Class-related emotions</i> | | | | | | | | |
| Enjoyment | 10 | 10–50 | 15–49 | 31.99 | 6.47 | –.10 | .55 | .85 |
| Hope | 8 | 8–40 | 13–40 | 27.39 | 4.67 | –.20 | .51 | .79 |
| Pride | 9 | 9–45 | 11–45 | 31.20 | 5.50 | –.30 | .52 | .82 |
| Anger | 9 | 9–45 | 9–42 | 17.39 | 6.24 | .75 | .58 | .86 |
| Anxiety | 12 | 12–60 | 12–56 | 27.68 | 8.30 | .28 | .55 | .86 |
| Shame | 11 | 11–55 | 11–52 | 25.22 | 8.80 | .38 | .63 | .89 |
| Hopelessness | 10 | 10–50 | 10–42 | 17.56 | 6.68 | 1.04 | .67 | .90 |
| Boredom | 11 | 11–55 | 11–54 | 30.84 | 9.88 | .06 | .74 | .93 |
| <i>Learning-related emotions</i> | | | | | | | | |
| Enjoyment | 10 | 10–50 | 14–49 | 33.09 | 5.78 | –.24 | .44 | .78 |
| Hope | 6 | 6–30 | 10–30 | 20.27 | 3.70 | –.11 | .52 | .77 |
| Pride | 6 | 6–30 | 9–30 | 21.59 | 4.00 | –.38 | .45 | .75 |
| Anger | 9 | 9–45 | 9–42 | 22.00 | 7.04 | .18 | .56 | .86 |
| Anxiety | 11 | 11–55 | 11–47 | 30.69 | 7.76 | –.24 | .53 | .84 |
| Shame | 11 | 11–55 | 11–51 | 27.00 | 8.32 | .29 | .57 | .86 |
| Hopelessness | 11 | 11–55 | 11–48 | 23.06 | 8.09 | .58 | .62 | .90 |
| Boredom | 11 | 11–55 | 11–50 | 30.69 | 9.29 | –.09 | .70 | .92 |
| <i>Test Emotions</i> | | | | | | | | |
| Enjoyment | 10 | 10–50 | 10–46 | 28.33 | 6.00 | .01 | .45 | .78 |
| Hope | 8 | 8–40 | 13–39 | 25.91 | 4.93 | .09 | .52 | .80 |
| Pride | 10 | 10–50 | 14–48 | 31.32 | 6.48 | –.16 | .58 | .86 |
| Relief | 6 | 6–30 | 6–30 | 21.51 | 4.26 | –.39 | .52 | .77 |
| Anger | 10 | 10–50 | 10–43 | 23.36 | 7.28 | .26 | .57 | .86 |
| Anxiety | 12 | 12–60 | 14–60 | 36.19 | 9.97 | –.01 | .62 | .90 |
| Shame | 10 | 10–50 | 10–44 | 21.92 | 7.52 | .43 | .60 | .87 |
| Hopelessness | 11 | 11–55 | 11–47 | 22.12 | 8.42 | .65 | .69 | .92 |

^a Median of part-whole corrected item-total correlations.

Table 2
Emotion component structures of AEQ scales: confirmatory factor analysis.

| Emotion | Model | Class-related emotions | | | | | Learning-related emotions | | | | | Test emotions | | | | |
|--------------|-------|------------------------|----|-----|-----|-------|---------------------------|----|------|------|-------|---------------|-----|-----|------|-------|
| | | χ^2 | df | GFI | CFI | RMSEA | χ^2 | df | GFI | CFI | RMSEA | χ^2 | df | GFI | CFI | RMSEA |
| Enjoyment | 1 | 117 | 32 | .94 | .97 | .083 | 164 | 33 | .92 | .91 | .102 | 119 | 34 | .94 | .89 | .081 |
| | 2 | 80 | 27 | .96 | .98 | .072 | 83 | 27 | .96 | .96 | .073 | 64 | 28 | .97 | .95 | .058 |
| | 3 | 89 | 29 | .96 | .98 | .073 | 85 | 29 | .96 | .96 | .071 | 71 | 30 | .96 | .94 | .060 |
| Hope | 1 | 43 | 20 | .97 | .98 | .045 | 46 | 9 | .96 | .95 | .103 | 75 | 20 | .95 | .94 | .085 |
| | 2 | 32 | 17 | .98 | .99 | .048 | 18 | 6 | .98 | .98 | .073 | 43 | 17 | .97 | .97 | .063 |
| | 3 | 32 | 17 | .98 | .99 | .048 | 18 | 6 | .98 | .98 | .073 | 43 | 17 | .97 | .97 | .063 |
| Pride | 1 | 61 | 27 | .97 | .98 | .057 | 93 | 8 | .93 | .88 | .166 | 113 | 32 | .94 | .94 | .082 |
| | 2 | 45 | 23 | .97 | .99 | .049 | 5 | 4 | 1.00 | 1.00 | .022 | 64 | 26 | .97 | .97 | .062 |
| | 3 | 60 | 25 | .97 | .98 | .061 | 18 | 6 | .98 | .98 | .074 | 86 | 28 | .96 | .96 | .074 |
| Relief | 1 | | | | | | | | | | 39 | 13 | .97 | .96 | .072 | |
| | 2 | | | | | | | | | | 26 | 12 | .98 | .98 | .056 | |
| | 3 | | | | | | | | | | 26 | 12 | .98 | .98 | .056 | |
| Anger | 1 | 128 | 27 | .93 | .97 | .099 | 196 | 27 | .90 | .94 | .127 | 97 | 33 | .95 | .95 | .071 |
| | 2 | 43 | 21 | .98 | .99 | .053 | 57 | 18 | .97 | .99 | .075 | 45 | 27 | .98 | .98 | .042 |
| | 3 | 46 | 23 | .97 | .99 | .052 | 72 | 20 | .96 | .98 | .082 | 52 | 29 | .97 | .98 | .046 |
| Anxiety | 1 | 475 | 51 | .83 | .91 | .147 | 172 | 44 | .93 | .95 | .087 | 228 | 53 | .91 | .92 | .093 |
| | 2 | 138 | 45 | .94 | .97 | .073 | 133 | 38 | .94 | .96 | .080 | 95 | 47 | .96 | .98 | .052 |
| | 3 | 144 | 47 | .94 | .97 | .073 | 134 | 40 | .94 | .96 | .078 | 110 | 49 | .95 | .97 | .057 |
| Shame | 1 | 363 | 38 | .94 | .98 | .080 | 123 | 44 | .95 | .97 | .068 | 107 | 33 | .95 | .95 | .076 |
| | 2 | 301 | 32 | .95 | .98 | .079 | 98 | 39 | .96 | .98 | .063 | 100 | 27 | .95 | .95 | .084 |
| | 3 | 304 | 34 | .95 | .98 | .078 | 105 | 41 | .95 | .98 | .064 | 104 | 29 | .95 | .95 | .082 |
| Hopelessness | 1 | 97 | 34 | .95 | .98 | .069 | 92 | 44 | .96 | .99 | .053 | 92 | 44 | .96 | .98 | .054 |
| | 2 | 80 | 28 | .95 | .98 | .069 | 56 | 38 | .97 | 1.00 | .035 | 82 | 38 | .96 | .98 | .055 |
| | 3 | 89 | 30 | .96 | .99 | .071 | 56 | 40 | .97 | 1.00 | .033 | 83 | 40 | .96 | .98 | .053 |
| Boredom | 1 | 141 | 44 | .94 | .99 | .075 | 238 | 44 | .90 | .97 | .107 | | | | | |
| | 2 | 114 | 38 | .95 | .99 | .072 | 127 | 37 | .94 | .98 | .080 | | | | | |
| | 3 | 127 | 40 | .94 | .99 | .075 | 130 | 39 | .94 | .98 | .078 | | | | | |

superior fit, as compared with the one-factor models. We expected the fit of the hierarchical models to be similar to the fit of the component factors models, indicating that combining the four factors under the umbrella of one second-order emotion factor is supported empirically. Although the hierarchical models represented our theoretical conception, we did not expect them to show better fit than the component factors models, since they involved estimation of one more latent factor.

Structural equation modeling (LISREL 8.80; Jöreskog & Sörbom, 2006) was used to test the fit of the three models for each of the 24 scales (Table 2). Following Hoyle and Panter's (1995) recommendations, we used both absolute and incremental fit indexes to evaluate the models, including the χ^2/df ratio, the goodness-of-fit index (GFI), the comparative fit Index (CFI), and the root mean square error of approximation (RMSEA). CFIs above .95 and RMSEAs below .05 are thought to indicate good fit, RMSEAs between .05 and .08 reasonable fit, and RMSEAs between .08 and .10 mediocre fit. We adopted Cheung and Rensvold's (2002) cut-off criteria for evaluating differences of fit between models, with a loss of fit of $\Delta CFI > .01$ being regarded as substantial.

Using these criteria, model fit of the component factors and hierarchical models was at least reasonable for all of the scales and good for the vast majority of the scales (Table 2). In contrast, the one-factor models showed a poor fit for 10 of the scales in terms of CFI being below .95, and for 14 scales in terms of RMSEA being above .08. Furthermore, a direct comparison shows that the fit for the component factors and hierarchical models was clearly superior for most of the scales, as compared with the fit for the one-factor models.

These findings indicate that scale construction was successful in terms of internal, structural validity. As such, the findings show that test anxiety is not the only emotion for which internal component structures should be taken into account. For most of the

scales, the component factors and hierarchical models which differentiated between emotion components fit better than one-factor models, thus corroborating our propositions on the internal structures of achievement emotions.

3.4. Internal validity: relationships between emotions

3.4.1. Correlational analysis

Our theoretical conception posits that it is useful to distinguish (a) between the different discrete emotions that occur within a given achievement setting (class-related, learning-related, test-related), and (b) between the emotions experienced in different achievement settings. Pearson product-moment correlations were computed to test these propositions. As may be seen from Table 3, the positive emotions enjoyment, hope, and pride correlated positively in all three settings. Similarly, there were positive correlations between the negative emotions anger, anxiety, shame, hopelessness, and boredom. The correlations between these positive emotions, on the one hand, and negative emotions, on the other hand, were moderately negative. However, diverging from the pattern of positive relationships between like-valenced emotions, test-related relief correlated positively with test-related pride and anxiety, thus showing connections to one positive and one negative emotion. The relationship with anxiety is likely due to relief occurring when anxiety-inducing threat is reduced, suggesting that relief is often preceded by anxiety, and that students who habitually experience relief during or after test situations also habitually experience anxiety in these same situations.

Overall, these findings show that the emotion constructs measured by the AEQ are clearly separable. This also is true for emotions that might be presumed to constitute opposite ends of a bipolar continuum, such as enjoyment and boredom, or hope and

Table 3
Manifest intercorrelations of AEQ scales.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|-------------------------------------|------|------|------|-----|-----|-----|-----|-----|-----|
| <i>Correlations within settings</i> | | | | | | | | | |
| 1 Enjoyment | | | | | | | | | |
| 2 Hope | .71 | | | | | | | | |
| | .64 | | | | | | | | |
| | .70 | | | | | | | | |
| 3 Pride | .62 | .68 | | | | | | | |
| | .72 | .64 | | | | | | | |
| | .71 | .68 | | | | | | | |
| 4 Relief | .06 | -.04 | .22 | | | | | | |
| 5 Anger | -.40 | -.35 | -.21 | - | | | | | |
| | -.44 | -.52 | -.33 | - | | | | | |
| | -.24 | -.36 | -.20 | .08 | | | | | |
| 6 Anxiety | -.24 | -.36 | -.15 | - | .64 | | | | |
| | -.12 | -.42 | -.15 | - | .61 | | | | |
| | -.38 | -.48 | -.29 | .36 | .57 | | | | |
| 7 Shame | -.26 | -.34 | -.19 | - | .58 | .79 | | | |
| | -.15 | -.43 | -.23 | - | .56 | .68 | | | |
| | -.29 | -.42 | -.37 | .06 | .63 | .65 | | | |
| 8 Hopelessness | -.34 | -.44 | -.26 | - | .76 | .69 | .62 | | |
| | -.33 | -.58 | -.43 | - | .67 | .68 | .75 | | |
| | -.38 | -.52 | -.40 | .00 | .72 | .67 | .78 | | |
| 9 Boredom | -.57 | -.42 | -.27 | - | .62 | .46 | .40 | .50 | |
| | -.51 | -.48 | -.38 | - | .76 | .49 | .50 | .58 | |
| <i>Correlations across settings</i> | | | | | | | | | |
| Class versus learning | .61 | .52 | .59 | - | .61 | .66 | .71 | .73 | .73 |
| Class versus test | .47 | .57 | .60 | - | .74 | .63 | .71 | .77 | - |
| Learning versus test | .58 | .62 | .60 | - | .69 | .74 | .78 | .81 | - |

Note: Within each block, upper/middle/lower coefficients are for class-, learning-, and test-related emotions, respectively. For relief, test-related relief was assessed only. For boredom, class-related and learning-related boredom were assessed only. $p < .05/.01$ for $|r| > .10/.14$.

hopelessness, which showed no more than moderately negative relationships. Indeed, the strongest relationships were found for neighboring, like-valenced emotions such as enjoyment and hope, or anxiety, shame, and hopelessness. In interpreting these correlations, it is important to note that the present study used the AEQ to assess students' habitual, trait-like emotions. Neighboring trait emotions are known to be strongly correlated (for a conceptual discussion, see Pekrun et al., 2004; also see Watson & Clark, 1992), in contrast to state emotions that show more divergence (e.g., Goetz, 2004; Goetz, Preckel, Pekrun, & Hall, 2007).

Furthermore, as expected, the correlations also indicate that the emotions were separable across the three settings examined (Table 3). Correlations were moderate for the positive emotions, and stronger for some of the negative emotions. The strongest correlations across class, studying, and taking tests were found for students' hopelessness and shame. These emotions showed substantial generalization across situations, thus representing generalized individual dispositions in the achievement domain in the present student sample.

3.4.2. Structural equation modeling of latent relationships

In order to more fully assess the relationships between achievement emotions, structural equation modeling was employed (LISREL 8.80, Jöreskog & Sörbom, 2006). As noted, we constructed four models and tested them competitively, aiming to document the distinctness of the emotion constructs assessed by the AEQ. The 24 scales of the instrument served as manifest indicators in each model (Fig. 2). Model 2A was a one-factor model assuming that the interrelations between achievement emo-

tions can be explained by one general bipolar factor, with positive emotions having positive factor loadings and negative emotions negative loadings on this single factor. Model 2B consisted of nine latent factors made up of the nine discrete emotions assessed by the AEQ (enjoyment, hope, pride, relief, anger, anxiety, shame, hopelessness, and boredom). Indicators for the factors were the emotion scales pertaining to the respective emotion. For example, the class-related, learning-related, and test-related enjoyment scales served as indicators for the enjoyment factor. For relief, there was one manifest indicator only (the test relief scale). The factor loading for this indicator was fixed to the reliability of the scale (.77).

Model 2C was a three-settings model comprised of three latent factors representing emotions experienced in the three settings addressed by the AEQ. The class-related, learning-related, and test-related emotion scales served as indicators for the class-related, learning-related, and test emotions factors, respectively. Model 2D sought to fully represent the two-facet structure of the AEQ by simultaneously taking the nine discrete emotions and the three settings into account. Following recommendations by Marsh, Byrne, and Craven (1993), a correlated uniquenesses approach was used to construct this model. The nine discrete emotions were represented by nine latent factors, and the influences of the three settings were taken into account by letting the uniquenesses of scales correlate within settings.

To test model fit, we used the same set of indicators as described earlier. The one-factor model had a poor fit to the data, with $\chi^2(252) = 5647.78$, $GFI = .42$, $CFI = .81$, and $RMSEA = .250$. The fit for the nine-emotions factor model was substantially better, although not satisfactory either, with $\chi^2(217) = 2349.25$, $GFI = .64$, $CFI = .92$, and $RMSEA = .170$. Similarly, the three-settings factor model had a poor fit, with $\chi^2(249) = 5866.39$, $GFI = .41$, $CFI = .83$, and $RMSEA = .257$. In marked contrast, the two-facet, emotion \times setting model showed a reasonable fit, with $\chi^2(134) = 370.78$, $GFI = .92$, $CFI = .99$, and $RMSEA = .072$. In line with our theoretical perspective, these findings demonstrate that the relationships between different achievement emotions can be best explained by taking into account both the differences between discrete emotions and the differences between emotions that occur in different achievement settings.

Furthermore, the two-facet model provides estimates of the latent relationships between the nine emotions (Table 4). In line with the manifest correlations, these relationships were positive for enjoyment, hope, and pride; positive for anger, anxiety, shame, hopelessness, and boredom; and negative between these positive and negative emotions. Again, relief was an exception from this pattern. Relief correlated positively with two positive emotions (enjoyment and pride) and three negative emotions (anxiety, shame, and boredom). Importantly, although some of the relationships between neighboring emotions, such as enjoyment and hope,

Table 4
Two-facet model: latent correlations between emotions.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|----------------|--------|--------|--------|-------|-------|-------|-------|-------|
| 1 Enjoyment | | | | | | | | |
| 2 Hope | .82** | | | | | | | |
| 3 Pride | .78** | .82** | | | | | | |
| 4 Relief | .21** | .11* | .30** | | | | | |
| 5 Anger | -.43** | -.49** | -.28** | .08 | | | | |
| 6 Anxiety | -.22** | -.48** | -.20** | .30** | .79** | | | |
| 7 Shame | -.22** | -.47** | -.26** | .24** | .72** | .90** | | |
| 8 Hopelessness | -.38** | -.62** | -.42** | .04 | .86** | .84** | .86** | |
| 9 Boredom | -.60** | -.51** | -.36** | .16* | .76** | .58** | .53** | .66** |

* $p < .05$.

** $p < .01$.

Table 5
Correlations of achievement emotions with appraisals, learning, and performance.

| Emotion | Appraisals | | | Motivation | | | Strategies | | | Performance | |
|--------------|------------------|---------------|------------|------------|-----------|--------|-------------|-----------|-----------------|---------------------|-------------------|
| | Academic control | Self-efficacy | Task value | Intrinsic | Extrinsic | Effort | Elaboration | Rehearsal | Self-regulation | External regulation | GPA at University |
| Enjoyment | .32 | .37 | .55 | .45 | .14 | .29 | .40 | .21 | .26 | -.07 | .15 |
| | .32 | .44 | .51 | .49 | .22 | .37 | .42 | .19 | .34 | -.01 | .22 |
| | .20 | .50 | .35 | .37 | .12 | .37 | .38 | .23 | .38 | -.02 | .26 |
| Hope | .40 | .53 | .47 | .41 | .16 | .38 | .44 | .25 | .45 | -.03 | .19 |
| | .43 | .56 | .41 | .43 | .07 | .47 | .40 | .09 | .51 | -.14 | .33 |
| | .35 | .60 | .37 | .40 | .04 | .44 | .40 | .18 | .51 | -.05 | .25 |
| Pride | .37 | .51 | .44 | .35 | .34 | .36 | .42 | .32 | .43 | .12 | .15 |
| | .44 | .49 | .44 | .40 | .26 | .42 | .42 | .28 | .46 | .03 | .29 |
| | .33 | .56 | .32 | .34 | .17 | .42 | .44 | .31 | .49 | .06 | .34 |
| Relief | .17 | .07 | .15 | .05 | .25 | .04 | .21 | .20 | .14 | .23 | .14 |
| Anger | -.60 | -.35 | -.44 | -.22 | -.05 | -.38 | -.30 | -.11 | -.25 | .28 | -.27 |
| | -.41 | -.39 | -.33 | -.27 | .02 | -.43 | -.29 | -.02 | -.31 | .29 | -.25 |
| | -.54 | -.40 | -.32 | -.20 | .08 | -.37 | -.29 | -.03 | -.30 | .34 | -.32 |
| Anxiety | -.47 | -.39 | -.18 | -.10 | .16 | -.33 | -.18 | .02 | -.29 | .32 | -.18 |
| | -.30 | -.35 | -.08 | -.11 | .20 | -.30 | -.13 | .08 | -.30 | .35 | -.14 |
| | -.30 | -.38 | -.13 | -.16 | .27 | -.28 | -.11 | .12 | -.28 | .33 | -.14 |
| Shame | -.48 | -.34 | -.21 | -.10 | .14 | -.31 | -.18 | .02 | -.26 | .23 | -.18 |
| | -.41 | -.35 | -.15 | -.08 | .17 | -.41 | -.19 | .03 | -.35 | .30 | -.27 |
| | -.47 | -.43 | -.19 | -.08 | .18 | -.38 | -.25 | -.01 | -.37 | .23 | -.37 |
| Hopelessness | -.67 | -.45 | -.40 | -.26 | -.02 | -.41 | -.39 | -.11 | -.34 | .23 | -.31 |
| | -.62 | -.51 | -.29 | -.26 | .11 | -.45 | -.36 | -.03 | -.46 | .33 | -.32 |
| | -.60 | -.51 | -.33 | -.23 | .09 | -.45 | -.35 | -.04 | -.41 | .25 | -.34 |
| Boredom | -.29 | -.27 | -.38 | -.23 | .00 | -.42 | -.19 | -.04 | -.16 | .25 | -.15 |
| | -.32 | -.34 | -.38 | -.26 | -.02 | -.48 | -.26 | -.05 | -.28 | .24 | -.24 |

Note: Within each block, upper/middle/lower coefficients are for class-, learning-, and test-related emotions, respectively. For relief, test-related relief was assessed only. For boredom, class-related and learning-related boredom were assessed only.
 $p < .05/.01$ for $|r| > .10/.14$.

were high, they clearly indicate that all of the emotion constructs are separable, given that the latent coefficients were corrected for unreliability and represent the highest possible estimates for these relationships.

3.5. External validity: linkages with students' appraisals, learning, and performance

3.5.1. Relationships with control and value appraisals

Table 5 shows the correlations of students' control-value appraisals and the AEQ achievement emotions. As predicted by Pekrun's (2006) control-value theory described earlier, there were clear linkages between appraisals and emotions. Academic control, self-efficacy, and task value correlated generally positively with the positive emotions and negatively with the negative emotions. Regarding value, it should be noted that this variable was operationalized as positive task value in the present study. The control-value theory proposes that the negative value of failure contributes to students' negative outcome emotions such as anxiety, shame, and hopelessness, but this proposition was not tested in the present study.

3.5.2. Relationships with learning and performance

As expected, there also were clear linkages between the emotions and variables of learning and performance, with different patterns of relations for different groups of emotions (Table 5). Specifically, the positive activating emotions enjoyment, hope and pride related positively to intrinsic motivation, effort, elaboration of learning material, and self-regulation of learning. In contrast, most of the correlations with external regulation were zero for these emotions. In line with the positive relationships with variables of learning, the correlations with students' GPA

were positive as well. Relationships with GPA were stronger for learning-related and test-related positive activating emotions, as compared with the class-related emotions within this category.

The negative deactivating emotions hopelessness and boredom showed the opposite pattern of linkages in terms of uniformly negative correlations with intrinsic motivation, effort, elaboration, self-regulation, and academic performance. Furthermore, these emotions correlated positively with students' perceived external regulation of learning. Overall, the pattern of relationships corroborates that positive activating emotions are likely beneficial for students' engagement and learning, whereas negative deactivating emotions are likely detrimental, as posited by the control-value theory.

As expected, relationships were more complex for the negative activating emotions anger, anxiety, and shame. On the one hand, all three emotions correlated negatively with intrinsic motivation, elaboration, and self-regulation. On the other hand, anxiety and shame correlated positively with students' extrinsic motivation targeting achievement outcomes, and test anxiety correlated positively with rehearsal of learning material. These findings are in line with the control-value theory's proposition that negative activating emotions can exert variable effects on students' learning. Despite these variable effects, however, anger, anxiety, and shame related negatively to students' overall self-reported effort at learning and to their academic performance.

These findings demonstrate the external validity of the AEQ scales and show that students' emotions have substantial linkages with their engagement and performance. Many of these relationships proved to be rather strong, with correlations in the .30–.50 range. Interestingly, these relationships were relatively weak for test anxiety, as compared with other achievement emotions. For

example, whereas the correlation between the AEQ test hopelessness scale and students' GPA was $r = -.34$, the correlation for test anxiety was $r = -.14$ in the present research—a low correlation which is quite typical for the range of correlations produced by test anxiety studies (Hembree, 1988). The findings of the present study thus reinforce the premise that research on students' affect is well advised to move on from test anxiety to include a broader range of emotions experienced in academic settings.

4. Conclusions

From a measurement perspective, the findings of the present research corroborate the reliability and validity of the AEQ. From the perspective of substantive research, they underscore the importance of distinguishing between discrete achievement emotions and show that these emotions relate meaningfully to students' learning and performance. Specifically, the findings indicate that the item statistics and reliabilities of the AEQ scales are good to excellent, and that the scales are well-suited to describe the internal structures of achievement emotions in terms of their affective, cognitive, motivational, and physiological components. Furthermore, the results of structural equation modeling confirmed that students' emotional experiences, and the AEQ scales assessing these experiences, can be organized by distinguishing between various discrete emotions, and between different academic settings in which these emotions are experienced. Generally, these results suggest that measures of students' achievement emotions should consider the component structures of these emotions, the differences between discrete emotions, and the differences between emotional experiences across different academic settings.

Finally, the findings show that students' achievement emotions are linked to their control and value appraisals, motivation, use of learning strategies, self-regulation of learning, and academic performance. In so doing, they corroborate the external validity of the scales as well as propositions of Pekrun's (2006) control-value theory. Whereas the positive activating emotions enjoyment, hope, and pride related positively to most of the variables measured, these relationships were negative for the deactivating emotions hopelessness and boredom. As expected, the pattern of linkages was more complex for the activating negative emotions anger, anxiety, and shame; however, the relationships with students' overall self-reported effort, and with their academic performance, were negative as well.

Although these findings substantiate the psychometric quality of the AEQ and our study hypotheses, there also are clear limitations in the present research. First, the sample consisted of North American undergraduate students only. While studies with German and Chinese student samples using variants of the AEQ have produced similar findings and attest to the cross-cultural useability of the instrument (Frenzel, Thrash, et al., 2007; Pekrun et al., 2010; Titz, 2001), it is open to question whether the findings generalize cross-culturally to other populations as well. Similarly, while first attempts to use variants of the instrument with younger students proved successful (Frenzel, Pekrun, et al., 2007; Frenzel, Thrash, et al., 2007; Lichtenfeld, Pekrun, Stupnisky, Reiss, & Murayama, 2010), more research is needed testing the psychometric quality of the instrument with K-12 students and older adult populations. To make appropriate use of the scales with these populations, cognitive validation of the content validity of items would be useful (Karabenick et al., 2007).

Second, the present research used the original version of the AEQ that assesses students' achievement emotions as domain-general, trait-like constructs, similar to the construct of test anxiety. Recent research has shown that students' emotions are

partially organized in domain-specific ways (Goetz, Frenzel, Pekrun, Hall, & Lüdtke, 2007). Research using domain-specific variants of the AEQ, such as the Achievement Emotions Questionnaire-Mathematics (AEQ-M), corroborates the psychometric quality of these variants. However, instruments such as the AEQ-M do not assess the full range of emotions and settings addressed by the original AEQ. Using the full instrument for assessing domain-specific achievement emotions, and analyzing the generalizability of the current study findings to domain-specific emotions, remains a task for future research. Similarly, future research should more fully examine the utility of the AEQ for measuring state achievement emotions. Similar to trait measures of emotions more generally, some of the intercorrelations between emotions were relatively high in the present research. As noted, it is to be expected that these correlations are lower for state emotions (Goetz, 2004; Goetz et al., 2007), which would further underscore the need to distinguish between discrete achievement emotions.

Furthermore, the findings regarding external validity are limited by the correlational nature of the study design which does not allow to interpret linkages between emotions, appraisals, and learning in causal ways. There are a few studies that included selected scales of the AEQ and used predictive designs. These studies suggest that the AEQ scales have predictive power in explaining students' achievement outcomes, and that the emotions assessed by the AEQ scales are explained by students' goals and appraisals (Daniels et al., 2009; Pekrun et al., 2009, 2010). However, more research is clearly needed to disentangle the causal relationships of achievement emotions with their antecedents and outcomes. Beyond unidirectional, predictive designs, such research should also attend to the reciprocal nature of these linkages. For example, appraisals can induce achievement emotions, but these emotions can reciprocally influence students' appraisals and adoption of achievement goals (Daniels et al., 2009; Linnenbrink & Pintrich, 2002). Similarly, achievement emotions can impact students' success at learning, but success and failure can reciprocally shape students' emotions (Pekrun, 2006).

Finally, the present findings have a number of important implications for educational practice. First, they suggest that the AEQ can be used to assess students' achievement emotions. To date, the instrument has mainly been employed for research purposes, but it also may be well-suited to serve practical purposes for assessment in counseling and evaluation. Given the overall length of the instrument, this may require further research to tailor the scales to the specific purposes within given diagnostic settings. Also, research would be needed to norm the scales for practical application. Second, although caution should be given to not interpreting the findings in causal ways, they are clearly in line with the assumption that a number of different emotions are of critical importance to students' engagement and learning. By implication, educators are well advised to heed students' emotions—including the well-researched emotion test anxiety, but also including a broad variety of emotions beyond anxiety.

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Appendix A

Achievement Emotions Questionnaire (AEQ): scales and sample items.

| Class-related emotions | |
|---------------------------|---|
| 1 Enjoyment | I enjoy being in class (d) |
| 2 Hope | I am confident when I go to class (b) |
| 3 Pride | I am proud of myself (a) |
| 4 Anger | I am angry (a) |
| 5 Anxiety | Thinking about class makes me feel uneasy (b) |
| 6 Shame | I get embarrassed (d) |
| 7 Hopelessness | I feel hopeless (b) |
| 8 Boredom | I get bored (d) |
| Learning-related emotions | |
| 1 Enjoyment | I enjoy acquiring new knowledge (d) |
| 2 Hope | I have an optimistic view toward studying (b) |
| 3 Pride | I'm proud of my capacity (d) |
| 4 Anger | Studying makes me irritated (d) |
| 5 Anxiety | I get tense and nervous while studying (d) |
| 6 Shame | I feel ashamed that I can't absorb the simplest of details (d) |
| 7 Hopelessness | I feel hopeless when I think about studying (b) |
| 8 Boredom | The material bores me to death (d) |
| Test emotions | |
| 1 Enjoyment | For me the test is a challenge that is enjoyable (d) |
| 2 Hope | I have great hope that my abilities will be sufficient (b) |
| 3 Pride | I'm proud of how well I mastered the exam (a) |
| 4 Relief | I feel very relieved (a) |
| 5 Anger | I am fairly annoyed (a) |
| 6 Anxiety | I feel panicky when writing an exam (d) |
| 7 Shame | I feel ashamed (a) |
| 8 Hopelessness | I have lost all hope that I have the ability to do well on the exam (d) |

Note: b/d/a = before/during/after the situation of attending class, studying, or taking tests and exams, respectively.

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