ELSEVIER

Learning and Instruction 16 (2006) 323–338

Learning and Instruction

www.elsevier.com/locate/learninstruc

A hierarchical conceptualization of enjoyment in students☆

Thomas Goetz [a,*], Nathan C. Hall [b], Anne C. Frenzel [a], Reinhard Pekrun [a]

[a] *Department of Psychology, University of Munich, Leopoldstrasse 13, 80802 Munich, Germany*
[b] *Department of Psychology, University of California, Irvine, CA 92697-7085, USA*

Abstract

The focus of the present study is on students' experiences of enjoyment, an emotion largely neglected in educational research. We present a model in which specific levels of generalization of the construct of enjoyment are differentiated. Based on their extent of generalization, these differentiated constructs of enjoyment are located in a hierarchical structure. Enjoyment of life is presented as most generalized and is consequently located at the highest level of the hierarchical structure, followed by students' enjoyment concerning their education, learning, and most specifically, their use of learning strategies. The hypotheses derived from this model were tested on longitudinal data from a sample of 513 German school students in grades 5–10. Results of structural equation modeling provide empirical support for the specific levels of generalization. The pattern of relations between students' experiences of enjoyment comprised a simplex-like (ordered correlation) structure as hypothesized in our theoretical model. Concerning the direction of causal flow between the constructs of enjoyment, longitudinal structural equation modeling indicated top-down effects of adjacent levels when controlling for horizontal effects. The enjoyment scales further showed clear linkages to learning behavior including self-regulated learning and creative problem solving. Methodological implications and directions for future research are discussed.

Keywords: Enjoyment; Learning; Hierarchy

When describing our emotional experiences, we rely on an extensive vocabulary of emotion-related language that allows us to answer a question as simple as "How do you feel?" with a great degree of sophistication (see Shaver, Schwartz, Kirson, & O'Connor, 1986). In order to provide a conceptual framework for understanding the manner in which people describe their emotions as well as the interrelations among specific emotional experiences, researchers have used both quantitative and qualitative means of classifying verbal expressions of emotion. With respect to quantitative research, underlying dimensions such as activation, valence, intensity, and duration have often been used to categorize emotions. For instance, in research by Watson and Tellegen (1985), emotions were categorized based on a "circumplex model" according to their level of activation and valence. In a similar vein, Ricci-Bitti and Scherer (1986) and Wallbott and Scherer (1988) examined emotion-specific intensities and duration, respectively, for emotions such as enjoyment, anger, anxiety, and sadness.

☆ This study was supported by a grant from the "Bildungspakt Bayern Foundation" to the first author and a German Academic Exchange Service (DAAD) scholarship to the second author (A/04/13064).
* Corresponding author. Tel.: +49 89 2180 5086; fax: +49 89 2180 5250.
E-mail address: goetz@edupsy.uni-muenchen.de (T. Goetz).

0959-4752/$ - see front matter © 2006 Elsevier Ltd. All rights reserved.
doi:10.1016/j.learninstruc.2006.07.004

In all of these approaches, emotions are categorized along specific dimensions that have been characterized as either unidimensional or bi-polar in nature. Moreover, other researchers suggest that different types of emotions may be structured in a hierarchical manner. For example, confirmatory analysis conducted by Tellegen, Watson, and Clark (1999) found a ''general bi-polar Happiness-Versus-Unhappiness dimension, relatively independent PA (positive affect) and NA (negative affect) dimensions at the next level, and more circumscribed discrete affects at the base'' (p. 302; concerning the assessment of this positive/negative affect dimension [PANAS], see Watson, Clark & Tellegen, 1988). Thus, previous research on emotional experiences has found it useful to group emotions according to common dimensions, describing general classes of emotions in reference to their common underlying theme (e.g., positive, deactivating, or enduring emotions) or using a prototype approach, by which an exemplary emotion reflects the main elements of a class of emotional experiences (e.g., anxiety as representative of negative activating emotions; see Shaver et al., 1986 for more information on the prototype approach).

These approaches generalize across different emotional experiences by discussing groups of discrete emotions which are similar along specific dimensions. Beyond these categorizations based on specific dimensions, few, if any, models exist which categorize emotional experiences according to their levels of generalization. Such an approach would be particularly important for differentiation *within* a specific emotion. For example, one could differentiate between specific levels of generalization in one's experiences of enjoyment, such as enjoyment of life, school-related enjoyment, or learning-related enjoyment. In contrast, most studies on emotional psychological constructs have examined emotions at a specific level of generalization and fail to qualify their analyses as such. In the case of enjoyment, recent research on subjective well-being (Diener, 2000) and quality of life (Endicott, Nee, Harrison, & Blumenthal, 1993) has identified enjoyment of life, alongside life satisfaction, proving to be a key component underlying these constructs. With respect to experiences of enjoyment specifically in students, recent educational research has also investigated school-related enjoyment (Olechowski, 1995), learning-related enjoyment (Goetz, Pekrun, Hall, & Haag, 2006; Maes & Kals, 2002; Pekrun, Goetz, Titz, & Perry, 2002a, 2002b), test-related enjoyment (Pekrun et al., 2002a), and enjoyment during the completion of an achievement test (Goetz, 2004a, Kleine, Goetz, Pekrun, & Hall, 2005; Pekrun et al., 2004). However, as each study assessed enjoyment at only one level of generalization, relations between the experiences of enjoyment at differing levels of generalization have remained largely unexplored.

One exception to this trend can be found in the context of anxiety research, in which general anxiety and test anxiety are clearly differentiated (Zeidner, 1998) and often assessed in the same study. A meta-analysis conducted by Hembree (1988) found a total of 77 studies that investigated both test anxiety and general anxiety. In this meta-analysis, general anxiety and test anxiety were found to correlate highly for students in grades 1–12 ($r_{ave} = 0.56$) and for college students ($r_{ave} = 0.48$). Nonetheless, beyond the area of anxiety research, we found no further research concerning the relations between different levels of generalization within a specific emotion.

Hierarchical models in self-concept research. While we did not find models on the hierarchical organization of specific discrete emotions, there do exist theoretical models and empirical research in related fields, namely self-concept research, in which hierarchical conceptualizations have been employed (see Marsh & Shavelson, 1985). For instance, in early research in this area by Shavelson, Hubner, and Stanton (1976), a model of self-concept was investigated in which self-concepts of differing levels of generalization were arranged in a hierarchical manner. In their model, the highest position in the hierarchy, and consequently, the most generalized facet of the self-concept, was referred to as ''general self-concept'' or ''general self-esteem''. Academic and non-academic self-concepts were located on hierarchically lower levels; constructs which were further differentiated into even more specific self-concepts such as one's verbal and non-verbal self-concept (i.e., academic) or one's self-concept related to social interactions (i.e., non-academic).

The hierarchical self-concept model of Shavelson et al. (1976) prompted numerous studies that investigated the central components of this model and their interrelations. Many of the theoretical assumptions of this model were also subsequently confirmed. However, one finding not consistent with Shavelson et al.'s (1976) model has frequently arisen: verbal and mathematical self-concepts have proven to be relatively independent. Furthermore, issues concerning the operationalization and the usefulness of the ''global self-concept'' construct are still under debate (for revisions of Shavelson et al.'s model, see Marsh, 1990, 1993). Marsh and Yeung (1998, p. 526), for example, argued that ''researchers should consider multiple dimensions of self-concept particularly relevant to the concerns of their research, supplemented, perhaps, by more general measures''. Similar ideas have been forwarded by Gottfried, Fleming, and Gottfried (2001) as well as Walls and Little (2005) with respect to levels of generality within and across different academic content areas.

A critical issue in hierarchical self-concept models has been the direction of causality within these models. In top-down models, the direction of causal flow is from higher-order factors at the top of the model to lower-order factors at the base. For bottom-up models, the causal flow is from factors at the base of the model to higher-order factors. In reciprocal models, the causal flow goes in both directions. Marsh and Yeung (1998) state that theoretical approaches concerning the direction of causal flow have been ambiguous, involve inadequately operationalized constructs, and have not included methodologically defensible approaches.

Consequently, Marsh and Yeung (1998, p. 511) state that "given these fundamental limitations, it is not surprising that empirical research findings have been inconclusive". Moreover, in an attempt to address the methodological shortcomings mentioned above, these authors suggested a new statistical approach involving a series of structural equation models for analyzing longitudinal data. The results of Marsh and Yeung (1998) using this statistical technique provided clear support for horizontal effects (stability), little support for the top-down effects, and no support for bottom-up and reciprocal effects in the context of hierarchically organized self-concept constructs. An adapted version of this approach was utilized in the present study to examine the hierarchical structure within discrete academic emotions, namely experiences of enjoyment.

A hierarchical conceptualization of enjoyment. We suggest that similar to the differentiation of various self-concepts based on their levels of generalization (Shavelson et al., 1976), emotional experiences can also be differentiated according to levels of generalization. In conceptualizing our hierarchical model of experiences of enjoyment (see Fig. 1), we adapted the hierarchical approach found in self-concept research as the basis for our theoretical model. We concentrated specifically on the emotional experience of enjoyment based on the recent focus on this emotion in positive psychology research, mainly in studies investigating the correlates and dimensions underlying quality of life and subjective well-being (see a special issue on Positive Psychology in the American Psychologist, Seligman & Csikszentmihalyi, 2000). Although the model concentrates on students' affect in the context of learning and achievement, contexts outside school settings are also discussed.

In our conceptualization of different levels of generalization of enjoyment, we refer exclusively to trait emotional experiences (see Cattell & Scheier, 1961; Spielberger, 1972). When people talk about trait emotions, they refer to "typical" emotional experiences, that is to individual dispositions to react with a specific pattern of emotions to specific situations (e.g., "I generally enjoy classes"). However, when they describe actual, real-time emotional experiences, they refer to state emotions (e.g., "I am enjoying class at this moment"). An emotional trait can be conceptualized as a long-enduring disposition to experience a particular emotional state (cf. Epstein, 1977). As such, trait emotions may be conceptualized as cumulative state emotional experiences.

Trait emotions (and also state emotions) can be differentiated according to the generality of the situation they refer to. For example, students can react habitually with a specific pattern of emotions to very specific life domains (e.g., working on an arithmetic task within a math achievement test) or to more general situations (e.g., school). An example

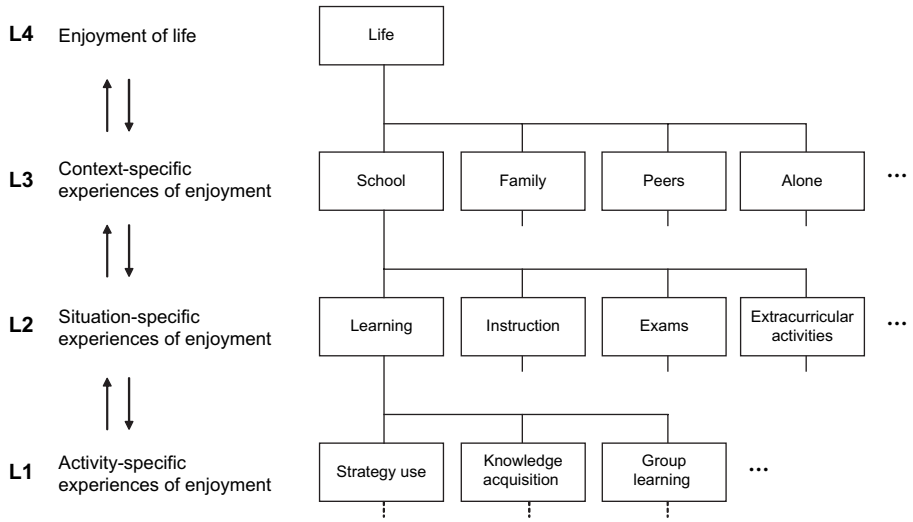

Fig. 1. Hierarchical model of the experience of enjoyment. L1, L2, L3, and L4: levels of generalization; L1 represents lowest level.

of a highly generalized trait emotional experience would be the habitual level of enjoyment a student experiences while thinking about school in general.

Concerning the direction of causality in this model, bidirectional effects between constructs located on the different levels of hierarchy might be assumed (i.e., bottom-up and top-down effects). That is, higher-level constructs are assumed to be both consequences and antecedents of constructs located on lower levels. Different mechanisms might also underlie each process. For instance, the mechanism underlying bottom-up processes may involve generalization, in which the perceived sum of emotional experiences at lower levels (e.g., enjoying the use of learning strategies, enjoying group learning) result in more general emotional schemas (e.g., enjoyment of learning in general; cf. Harter, 1999 for this approach in self-concept research). On the other hand, the processes underpinning top-down effects might involve these emotional schemas predisposing individuals to respond to specific learning situations with a specific emotional pattern (cf. Brown, 1993 for this approach in self-concept research). Because both these directional assumptions are without empirical evidence within the context of emotion research, the present study examined the relative strength of both bottom-up and top-down processes in school-aged students. As outlined above, within self-concept research, empirical findings on the direction of causality in multidimensional, hierarchical self-concept models are contradictory.

As the most highly generalized level of enjoyment, enjoyment of life is located at the top of the hierarchical model (level of generalization L4). Enjoyment of life is the individual generalized disposition to enjoy life (e.g., ''On the whole I enjoy my life''; cf. highly generalized self-esteem items like ''On the whole I am satisfied with myself'', Rosenberg, 1965). Assuming reciprocal causality, our model suggests that life enjoyment may be both a cause and a consequence of context-specific experiences of enjoyment (level of generalization L3). Context-specific experiences of enjoyment are individual dispositions to react with a specific level of enjoyment to specific contexts like school, family, and peers. In addition to these social contexts, experiences of enjoyment associated with independent academic activities were also integrated into our model. As such, in addition to other related feelings of enjoyment experienced in social domains involving family, peers, and school personnel, action- and self-related experiences of enjoyment that occur during independent academic activities are also represented (e.g., reading a book). Statements like ''I enjoy going to school'' or ''I enjoy being with my family'' or ''I enjoy being among my peers'' or ''I enjoy being alone'' reflect context-specific enjoyment. We assume that context-specific experiences of enjoyment are again both a cause and a consequence of experiencing enjoyment in specific situations encountered in that general context (level of generalization L2).

Situation-specific experiences of enjoyment are defined as individual dispositions to react with a specific level of enjoyment to specific situations within an academic context. In Fig. 1, for example, enjoyment-related situations found in a school context are categorized in terms of learning, instruction, exams, and events outside the classroom setting (e.g., school outing, sports competition). Statements like ''I look forward to learning'' or ''I enjoy classes'' reflect such situational experiences of enjoyment. Finally, our model also proposes that students may experience the emotion of enjoyment related to engaging in situation-specific activities (level of generalization L1). Thus, activity-specific experiences of enjoyment can be defined as individual dispositions to react with a specific level of enjoyment to specific academic activities. Examples of learning-related, situation-specific activities are depicted on the lowest level of the hierarchy in Fig. 1. As such, students' experiences of enjoyment related to using different learning strategies, competence acquisition, and group learning may all act as both a cause and a consequence of the more generalized construct of learning-related enjoyment. A statement reflecting enjoyment at level L1 would be ''I enjoy using different strategies when I am learning.''

Similar to Shavelson et al.'s (1976) hierarchical self-concept model, there may be additional levels of generalization below level L1 which represent increasingly specific groups of activities. However, for the sake of parsimony, our study examined students' emotional experiences at only the four levels of academic activities described in Fig. 1 and did not integrate levels below level L1 into our model. In sum, although the model depicted does not serve to provide an exhaustive account of students' experiences of enjoyment, it does allow us to examine the proposed theoretical relations between different levels of enjoyment based on their degree of generalization.

1. Research questions and hypotheses

In this study we examine one vertical branch of the model depicted in Fig. 1. Thus, we do not investigate the entire hierarchical structure but rather relations between the constructs located on one vertical branch, that is, enjoyment of

life, school-related enjoyment, learning-related enjoyment, and enjoyment of strategy use. The research questions are as follows:

(1) Can experiences of enjoyment at different levels of generalization be differentiated empirically? This question refers to the structural validity of the enjoyment scales. Our model suggests that a factor structure in which enjoyment items of a specific level of generalization are indicators of their latent level of generalization should be superior to a structure in which all items are defined as indicators of one single factor of enjoyment.
(2) Do the relations between the constructs of enjoyment at different levels of generalization conform to a simplex-like structure? Based on our model (see Fig. 1), ordered correlations between constructs located on vertical branches should be observed, with the strongest relations between the various levels of enjoyment found between neighboring hierarchical levels. Following Ryan and Connell (1989), we refer to our assumed structure as a ''simplex-like'' one, because according to Guttman (1954), a true simplex should contain at least five variables. The simplex concept is derived from Guttman's Radex Theory, which specifically concerns ordered relations between correlated variables. In a simplex model, variables are ordered with respect to their complexity or conceptual similarity, in that those constructs considered to be more similar correlate more highly than those proposed to be more discrepant.
(3) Are top-down or bottom-up effects predominant in our hierarchical model of the experience of enjoyment? This question refers to the direction of causality in our model. We found no empirical studies dealing with this question within the context of emotion research and findings on the direction of causality in multidimensional, hierarchical self-concept models are still unclear (see above). However, in the study by Marsh and Yeung (1998), whose methodological approach was adopted for the present study, horizontal effects were predominant and weak top-down and no bottom-up or reciprocal effects were found. Following our theoretical model (see Fig. 1), we expected both bottom-up and top-down effects when controlling for horizontal effects (stability) of the emotion scales of different levels of generalization.
(4) Are there links between constructs of enjoyment and actual learning behavior? According to Pekrun (2000, in press), Pekrun et al.'s (2002a) control-value theory on the antecedents and consequences of academic emotions, students' emotional experiences should both influence and be influenced by their learning behavior (see also Goetz, Zirngibl, Pekrun, & Hall, 2003). Based on this theory, high levels of enjoyment should coincide with flexible learning styles (e.g., high levels of self-regulated learning and flexible problem solving; for empirical results see Goetz, 2004a; Pekrun et al., 2002a, 2002b). Following from mood research (e.g., mood-dependent learning; Hettena & Ballif, 1981), enjoyment can be assumed to correspond with the use of metacognitive strategies (see Sperling, Howard, Staley, & DuBois, 2004 for metacognitive strategies). However, the strength of the relation between enjoyment and learning behavior should differ according to the level of generalization of the enjoyment constructs. More specifically, concrete learning behavior (e.g., use of a specific strategy) should show the strongest relation with enjoyment of strategy use whereas more comprehensive strategies, namely strategies including different methods and principles of learning (e.g., self-regulated learning), should show stronger relations to more generalized levels of academic enjoyment.

2. Method

2.1. Sample and data assessment

Data for this study was obtained from two waves of a longitudinal project assessing the development of self-regulatory competencies in German students (Goetz, 2004b). Altogether $N = 649$ students participated at the two points of assessment, 64 students participated at Time 1 but not at Time 2 (and 6 students vice versa). Thus, the number of students who took part in our study in both phases was 579, reflecting a drop out rate of 9.95%. From these 579 students, 513 complete sets of responses were obtained. That is, 11.40% of our data sets could not be included in our analysis due to missing item responses. Altogether, we obtained complete data sets from both phases for 79.78% of the students who participated at Time 1. Multivariate analysis of variance showed that the 64 students who participated exclusively at Time 1 did not differ significantly in their experiences of enjoyment at Time 1 from the other 579 students who participated twice. This finding allows us to be confident that students who participated twice did not represent a positively selected sample.

The effective sample of 513 students consisted of 326 female and 187 male students from grades 5 to 10 enrolled in the middle track of the German three-track education system (31 classes; age: $M = 13.82$, SD = 1.89). The number of students from grades 5 through 10 was 89, 111, 70, 61, 99, and 83. Student data was collected in the middle (January 2003) and at the end of the school year (July 2003) by school staff through the use of a standardized questionnaire which each lasted approximately 45 min.

2.2. Enjoyment at different levels of generalization

Based on the hierarchical model depicted in Fig. 1, enjoyment was assessed by items addressing specific levels of generalization in students' experiences of enjoyment. Two items were used to assess each of four levels of enjoyment which differed in their respective degrees of generalization. Specifically, the four hierarchically organized levels of enjoyment assessed in this study concerned students' experiences of enjoyment with respect to the use of specific learning strategies (''enjoyment of strategy use''; L1), learning in general (''enjoyment of learning''; L2), overall enjoyment of school activities (''enjoyment of school''; L3), and an overarching enjoyment of life (''enjoyment of life''; L4). Sample items are ''I enjoy using different strategies when I am learning'' (L1), ''I enjoy gaining knowledge'' (L2), ''I enjoy going to school'' (L3), and finally ''I enjoy life'' (L4). With one exception, namely ''enjoyment of learning,'' all scales were constructed specifically for this study. The scale for assessing ''enjoyment of learning'' is a modified version of that found in Pekrun et al.'s (2002a) Academic Emotions Questionnaire (AEQ). Response format consisted of a 5-point Likert scale ranging from (1) *strongly disagree*, to (5) *strongly agree*. In the Appendix, the means, standard deviations and intercorrelations for the enjoyment items at Times 1 and 2 are depicted.

2.3. Measures of learning quality

To examine the link between enjoyment and learning behavior, four scales were included in our study that assessed students' strategy use. A 5-point Likert scale identical to that used for the enjoyment measures was employed. In order to examine whether these four scales in fact corresponded to different learning behaviors, correlations between these measures were calculated. Results showed one relatively strong correlation between self-regulated learning and flexible-creative problem solving ($r = 0.57/0.63$ for Time 1/2). All other correlations ranged from 0.26/0.28 to 0.39/0.47 (Time 1/2) with a median correlation of 0.31/0.41.

2.3.1. Self-regulated learning

We used a 7-item scale from Pekrun et al. (2002a; see also Pekrun et al., 2004) for the assessment of self-regulated learning. This scale assesses central aspects of self-regulated learning including one's planning of the learning process (e.g., ''Before I start with my homework I think about the best way of doing it''), elaboration of goals (e.g., ''When I study I set personal goals that I want to attain''), and activation of goal-oriented control processes (e.g., ''I notice when I am proceeding too slowly in a subject''). For Times 1/2 the scale means were 24.86/23.95 with a standard deviation of 4.82/5.35. The alphas of the scale were 0.73/0.79 (Cronbach's α).

2.3.2. Flexible-creative problem solving

We used a 4-item scale from Pekrun et al. (2002a) that had initially been developed for university students. Using this scale, the extent to which students solve academic problems in a flexible and creative way was assessed (e.g., ''When I am learning, I am inventive in solving problems''). For Times 1/2 the means of the scale were 12.78/12.19 with a standard deviation of 3.35/3.63. The alphas of the scale were 0.68/0.76 (Cronbach's α).

2.3.3. Learning from mistakes

We used a 2-item scale developed by Schmitz (2000) as part of our assessment of learning strategies which assessed the extent to which students take advantage from previous mistakes by reflecting and consequently learning from them. Because an integral part of learning from one's mistakes involves reflecting on one's own work, this learning strategy could also be more accurately considered a *metacognitive* learning strategy due its focus on benefiting from previous mistakes by first thinking carefully about why they occurred. A sample item is ''After a test I have an accurate look at my mistakes in order to learn from them.'' For Times 1/2 the means of the scale were 6.81/6.51 with a standard deviation of 2.20/2.23. The alphas of the scale were 0.73/0.74 (Cronbach's α).

2.3.4. Frequency of learning with index cards

Also assessed was the frequency of a specific, concrete learning behavior, namely learning with index cards in different subject areas (Mathematics, Science, German, English, Geography). This scale was developed for this study and consisted of five items worded as follows: ''I often make use of index cards in [specific subject]''. For Times 1/2 the means of the scale were 8.62/10.39 with a standard deviation of 4.07/5.67. The alphas of the scale were 0.76/0.88 (Cronbach's α).

3. Results

3.1. Structural validity of emotion scales

In order to examine the structural validity of the emotion scales (see Hypothesis 1), we adapted a procedure outlined in Hodapp and Benson (1997). By means of confirmatory factor analysis (LISREL 8.53; Jöreskog & Sörbom, 2002), two nested models were competitively tested. This was done for each of the two points of assessment. In the two models examined (see Fig. 2), enjoyment items (manifest variables) were defined as indicators of latent levels corresponding to the general construct of enjoyment (Model 1) and their respective generalization of enjoyment (Model 2). The intercorrelations for the manifest variables are presented in the Appendix. In Model 1 (one-factor model), all items are defined as indicators of a single latent factor of enjoyment. In Model 2 (four-factor model), four independent latent factors for enjoyment are defined, representing enjoyment corresponding to the levels of generalization depicted in Fig. 1 (i.e., enjoyment related to life, school, learning, and strategy use). In order to test for the existence of an acceptable two- or three-factor model, we also calculated all three- and four-factor models that could be constructed from all combinations of the four enjoyment scales. That is, we also tested a total of six three-factor and seven two-factor models.

Competitive testing was based on comparing selected fit indices (Comparative Fit Index – CFI, Bentler, 1990; Non-Normed Fit Index – NNFI [Tucker–Lewis Index – TLI], Tucker & Lewis, 1973; Root Mean Square Error of Approximation – RMSEA, Steiger, 1990). The fit of a model is typically concluded to be good if CFI > 0.95, NNFI > 0.95, and RMSEA < 0.05 (Byrne, 1998). The three indices of fit differ in that the NNFI and RMSEA control for model parsimony, whereas the CFI does not.

Table 1 shows the results of competitive testing. The results are similar for both points of assessment. The fits of the one-factor and four-factor model were substantially different (Chi-squared statistics, $p < 0.001$), with the four-factor model showing a substantially better fit (CFI = 0.99/0.99, NNFI = 0.98/0.99, RMSEA = 0.043/0.041 for Times 1/2). The fit of the one-factor model can be described as very poor (CFI = 0.70/0.58, NNFI = 0.58/0.41, RMSEA = 0.215/248 for Times 1/2). Consequently, it is not meaningful to define all enjoyment items as indicators of one single factor of enjoyment. Rather the enjoyment items should be defined as indicators of different latent levels of generalization of enjoyment (enjoyment of life, school, learning, and strategy use). The fit indices for all possible two- and three-factor models were unacceptable as well, with RMSEA values ranging from 0.107 to 0.244.

3.2. Simplex-like structure of the emotion scales

In order to examine the interrelations among the constructs of enjoyment at different levels of generalization (see Hypothesis 2), the correlations between the factors of the four-factor model (see Fig. 2) were first calculated. The factor correlations are presented in Table 2. Most important for our research question is that correlations became weaker with increasing distance between the hierarchical levels. According to Guttman (1954), a ''perfect'' simplex model evidences its largest correlations among a main diagonal – correlations that increasingly taper off as one moves away from that diagonal. This pattern of correlation is found in our correlation matrix. As for neighboring levels, the relation between school- and life-related enjoyment ($r = 0.37/38$ for Time 1/2) was weaker than the relations between school- and learning-related enjoyment ($r = 0.76/0.70$) and between learning- and strategy-related enjoyment ($r = 0.59/0.53$). Thus, the relations between enjoyment constructs related to the academic domain were found to be stronger than the relations between school- and life-related enjoyment located at the top of the proposed hierarchy.

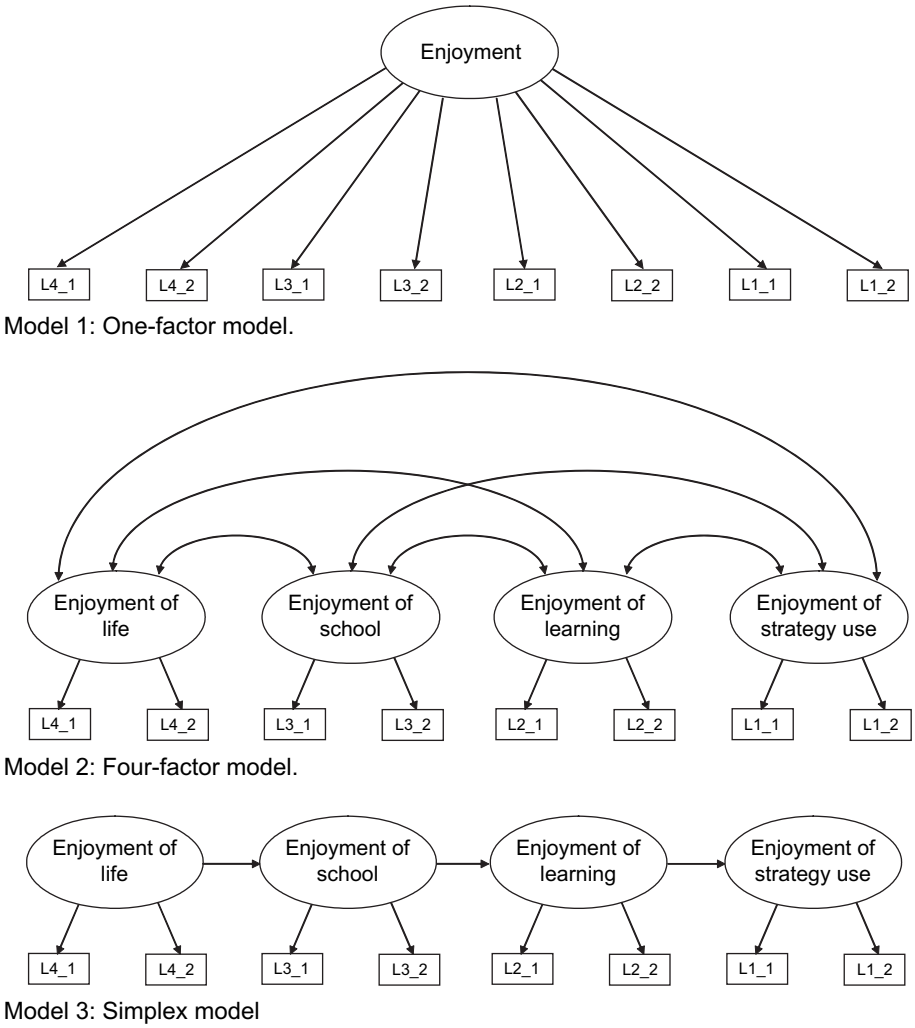

Fig. 2. Structural models. L1, L2, L3, and L4: levels of generalization; L1 represents lowest level; _1, scale item 1; _2, scale item 2.

Furthermore, we tested the simplex-like structure by use of SEM (see Jöreskog, 1970; Jöreskog & Sörbom, 1996). To this end, we compared the fit of the four-factor model with that of a simplex model (Model 3, see Fig. 2), in which only relations between adjacent constructs were assumed. It is important to note that the direction of the paths of the simplex model were not relevant for this analysis as reverse directions of arrows would lead to an identical fit of the model. The main point is that path-coefficients between non-adjacent constructs are set to zero in the simplex model. In Table 1, the fit indices for the four-factor model and the simplex model are

Table 1
Characteristics of the structural equation models

Models	Time point	χ^2	df	χ^2/df	CFI	NNFI	RMSEA
One-factor model	1	492.11	20	24.61	0.70	0.58	0.215
	2	649.30	20	32.47	0.58	0.41	0.248
Four-factor model	1	27.08	14	1.93	0.99	0.98	0.043
	2	25.80	14	1.84	0.99	0.99	0.041
Simplex model	1	32.68	17	1.92	0.99	0.98	0.042
	2	32.47	17	1.91	0.99	0.99	0.042

CFI, comparative fit index; NNFI, non-normed fit index; RMSEA, root mean square error of approximation. $N = 513$.

Table 2
Simplex-like pattern of correlations among the factors of the four-factor models (T1 and T2)

	Enjoyment – time point 1		
	L4 Enjoyment of life	L3 Enjoyment of school	L2 Enjoyment of learning
Enjoyment – time point 1			
L4 Enjoyment of life	–		
L3 Enjoyment of school	0.37	–	
L2 Enjoyment of learning	0.31	0.76	–
L1 Enjoyment of strategy use	0.16	0.33	0.59
	Enjoyment – time point 2		
	L4 Enjoyment of life	L3 Enjoyment of school	L2 Enjoyment of learning
Enjoyment – time point 2			
L4 Enjoyment of life	–		
L3 Enjoyment of school	0.38	–	
L2 Enjoyment of learning	0.29	0.70	–
L1 Enjoyment of strategy use	0.17	0.28	0.53

L1, L2, L3, and L4: levels of generalization; L1 representing the lowest level. Depicted are correlations of the latent factors. All correlations are significant for $p < 0.01$. $N = 513$.

presented for both time points. Both for Time 1 and Time 2, the four-factor and the simplex models each had a good fit to the data. Because the two models are nested, the fit of the models can be directly compared. For each time point, there was no significant difference between the four-factor and the simplex model ($\Delta\chi^2 = 5.60$, Δ df $= 3$; $p = 0.133$ for Time 1; $\Delta\chi^2 = 6.67$, Δ df $= 3$; $p = 0.083$ for Time 2). The RMSEA of the simplex model (0.042 for Times 1, 2) was within the 90% confidence interval of the RMSEA for the four-factor model ([0.017; 0.067] for Time 1 and [0.013; 0.065] for Time 2). Thus, the insignificant loss of fit when setting paths between non-adjacent relations to zero shows that those paths are negligible. In sum, the comparison of the four-factor and the simplex model clearly indicates a simplex-structure underlying the relations between the enjoyment constructs. Both factor correlations and SEM indicated the simplex-like structure initially proposed, and more specifically, provide empirical support for Hypothesis 2 as outlined above.

3.3. Direction of causality in the hierarchical model of enjoyment

In order to examine the direction of causality in our hierarchical model of enjoyment (Hypothesis 3), we adapted a procedure outlined in Marsh and Yeung (1998). However, while Marsh and Yeung tested a model in which two levels of generalization were differentiated, that is, one higher-level construct (global self-concept) and several other constructs at a equal hierarchical level (specific self-concepts), our model is based on a simplex-like structure such that there were four instead of two levels of generalization. Consequently, we had to modify Marsh and Yeung's (1998) procedure for testing our hypothesis. By means of SEM (LISREL 8.53, Jöreskog & Sörbom, 2002), five nested models were competitively tested (four of these models are depicted in Fig. 3).

In model A (see Fig. 3), horizontal effects were specified exclusively, with each level at Time 2 (T2) modeled as a consequence of the corresponding level at Time 1 (T1). Horizontal effects reflect the stability of the construct over time. We retained these horizontal effects in all subsequent models in order to control for the stability of the constructs in all models. In addition, bottom-up effects, top-down effects, and both bottom-up and top-down effects (reciprocal effects) involving adjacent hierarchical levels were specified in models B, C, and D. As relations between non-adjacent levels were conceivable, we also tested a model E (not included in Fig. 3) which included paths from all constructs at Time 1 (T1) to all constructs at Time 2 (T2). That is, in contrast to models A–D, transdimensional paths (paths from T1-constructs to non-adjacent constructs at Time 2) were also assessed in addition to the horizontal, bottom-up, and top-down paths. Thus, model E consists of a total of 16 paths. In all of the five models examined, each set of two enjoyment items (manifest variables) were defined as indicators of one of four latent levels corresponding to the constructs of enjoyment at different levels of generalization. Intercorrelations between all manifest variables are presented in Appendix.

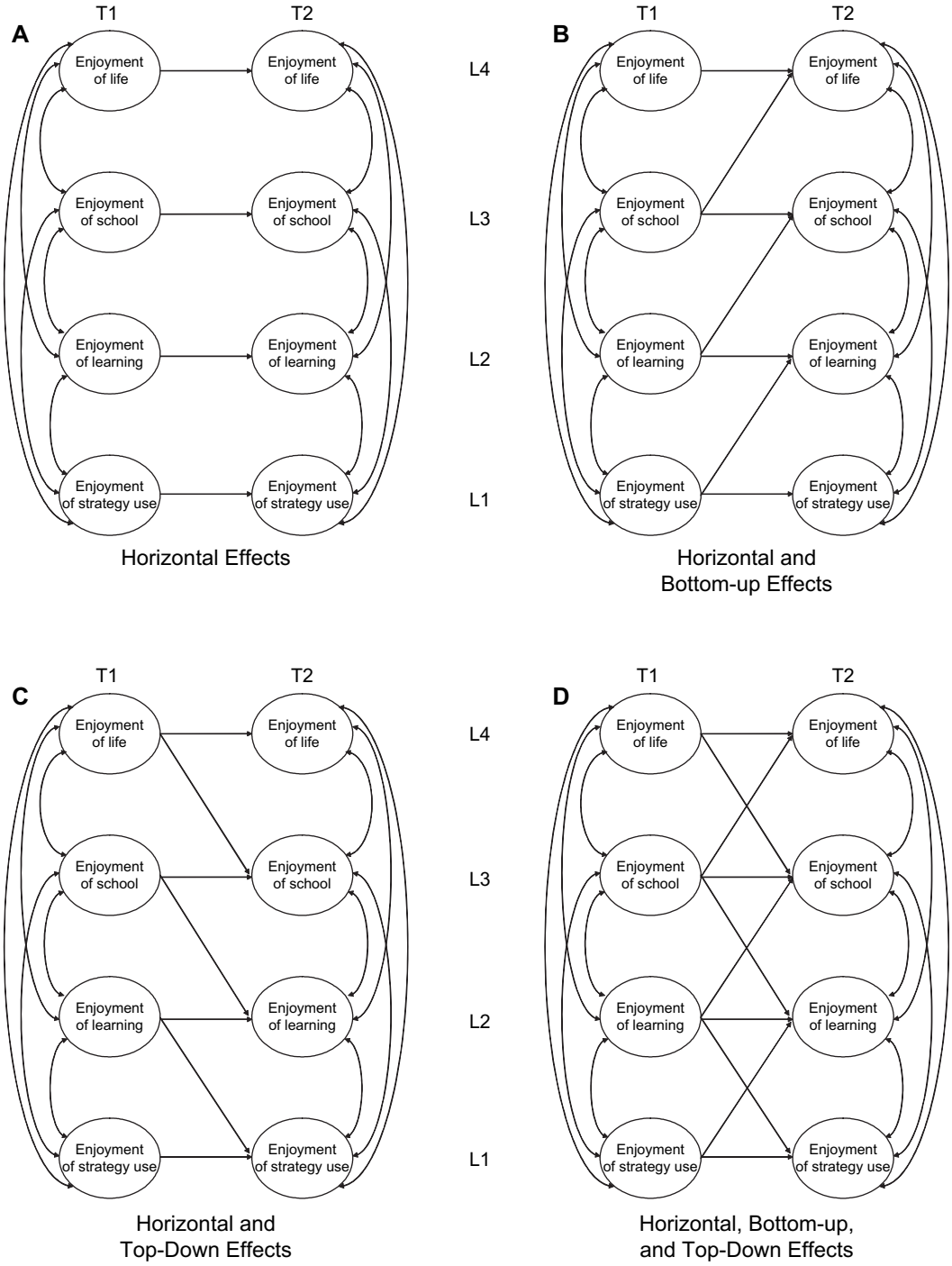

Fig. 3. Horizontal, bottom-up, and top-down models. L1, L2, L3, and L4: levels of generalization; L1 represents lowest level; T1, Time 1; T2, Time 2.

In line with Marsh and Yeung (1998), we present the results of the SEM models with correlated residual variances between items which were assessed identically in both Times 1 and 2. Because we used each of the eight items (2 items × 4 levels) at both points of assessment, eight correlated residual variances were specified in models A through E. Table 3 shows the fit indices for the five models. The horizontal model (A) shows an acceptable fit to

the data with path-coefficients (stability) of 0.56 for enjoyment of life (L4), 0.73 for enjoyment of school (L3), 0.72 for enjoyment of learning (L2), and 0.56 for enjoyment of strategy use (L1). The fact that enjoyment of life (L4), as the most generalized yet context unspecific construct, was not the most stable construct is consistent with findings from self-concept research in which global components are not found to be more stable than more specific components of self-concept (Marsh, 1990, 1993; Marsh & Yeung, 1998).

Adding bottom-up paths to the horizontal paths (B) resulted in an insignificant gain of fit ($\Delta\chi^2 = 5.99$, Δ df $= 3$; $p = 0.112$; see Table 3) and none of the bottom-up effects reached significance ($p > 0.05$). However, model C, in which horizontal and top-down effects were specified, showed a significantly better fit than model A ($\Delta\chi^2 = 16.23$, Δ df $= 3$; $p = 0.001$) and model B ($\Delta\chi^2 = 10.24$, Δ df $= 3$; $p = 0.016$). Integrating bottom-up paths to the horizontal and top-down effects (reciprocal model D) did not significantly increase model fit ($\Delta\chi^2 = 3.52$, Δ df $= 3$; $p = 0.318$). Furthermore, model E (horizontal, bottom-up, top-down, and transdimensional paths) showed no significant increase of fit compared to model C (horizontal and top-down paths; $\Delta\chi^2 = 14.29$, Δ df $= 9$; $p = 0.112$) or model D (reciprocal model; $\Delta\chi^2 = 10.77$, Δ df $= 6$; $p = 0.10$). This result indicates that in addition to the horizontal effects, relations between adjacent levels of generalization were most prevalent.

In sum, the top-down model (C) is the preferable model as its fit was significantly better than those of model A (horizontal effects exclusively) or model B (bottom-up effects). Furthermore, transdimensional effects (model D) can be considered negligible. As for the path-coefficients of the top-down model (C), the horizontal effects (stability) were 0.56 for level L4 (enjoyment of life), 0.73 for level L3 (enjoyment of school), 0.54 for level L2 (enjoyment of learning), and 0.34 for level L1 (enjoyment of strategy use). The top-down effects of model C were 0.02 (ns) from level L4 to level L3, 0.22 ($p < 0.05$) from level L3 to level L2, and 0.25 ($p < 0.01$) from level L2 to level L1. Thus, while the effects between experiences of enjoyment within the academic domain were significant, namely between enjoyment of school (L3) and enjoyment of learning (L2), and between enjoyment of learning (L2) and enjoyment of strategy use (L1), there was no significant top-down effect from enjoyment of life to enjoyment of school.

3.4. Links between enjoyment constructs and learning behavior

By means of correlational analysis, we examined links between the emotion constructs and learning behavior (Hypothesis 4). We correlated the enjoyment scales with measures of self-regulated learning, flexible-creative problem solving, learning from mistakes, and frequency of learning with index cards. Altogether and in line with our theory, the results indicated clear relations between enjoyment and learning behavior (see Table 4) with high intensities of enjoyment coinciding with more sophisticated learning methods. Whereas the frequency of learning with index cards as a concrete learning strategy was most strongly correlated with enjoyment of strategy use (L1), the three more general learning behaviors (self-regulated learning, flexible-creative problem solving, learning from mistakes) showed the strongest relations with enjoyment of learning (L2). The pattern of correlations (Table 4) also indicated a simplex-like structure of the enjoyment scales. For example, frequency of learning with index cards correlated strongest with enjoyment of strategy use (L1; $r = 0.41/0.48$ for Time 1/2), followed by enjoyment of learning (L2; $r = 0.31/0.35$), enjoyment of school (L3; $r = 0.29/0.26$), and enjoyment of life (L1; $r = 0.09/0.13$).

Table 3
Results of competitive model testing

Models	χ^2	df	χ^2/df	CFI	NNFI	RMSEA
(A) Horizontal	133.76	80	1.67	0.99	0.98	0.036
(B) Horizontal + bottom-up	127.77	77	1.66	0.99	0.98	0.036
(C) Horizontal + top-down	117.53	77	1.53	0.99	0.98	0.032
(D) Horizontal + bottom-up + top-down	114.01	74	1.54	0.99	0.98	0.032
(E) Horizontal + bottom-up + top-down + transdimensional	103.24	68	1.52	0.99	0.98	0.032

CFI, comparative fit index; NNFI, non-normed fit index; RMSEA, root mean square error of approximation. $N = 513$.

Table 4
Emotion scales and learning behavior (Time 1/2)

Levels of enjoyment	Self-regulated learning	Flexible-creative problem solving	Learning from mistakes	Learning with index cards
L4 Enjoyment of life	0.29/0.29	0.21/0.29	0.17/0.24	0.09/0.13
L3 Enjoyment of school	0.36/0.38	0.37/0.39	0.32/0.32	0.29/0.26
L2 Enjoyment of learning	0.45/0.47	0.44/0.50	0.44/0.46	0.31/0.35
L1 Enjoyment of strategy use	0.31/0.32	0.40/0.48	0.34/0.37	0.41/0.48

Depicted are Pearson's correlation coefficients. L1, L2, L3, and L4: levels of generalization; L1 represents the lowest level. $N = 513$. $r \geq 0.9$, $p < 0.05$; $r \geq 0.11$, $p < 0.01$; $r \geq 0.14$, $p < 0.001$.

4. Discussion and implications

4.1. Structure of emotion measures

Previous studies on the structure of emotions have primarily categorized various discrete emotions on the basis of common underlying dimensions (i.e., horizontal generalization across different emotions). The results of this study indicate that beyond this dimensional approach it is also empirically possible to differentiate between different levels of specificity within a single discrete emotion in a hierarchical manner (i.e., vertical levels of generalization within one emotion). SEM analysis showed a strong structural validity of the four enjoyment scales indicating that it is meaningful to define the eight items (manifest variables) as indicators of their respective generalization of enjoyment, namely enjoyment of life (L4), enjoyment of school (L3), enjoyment of learning (L2), and enjoyment of strategy use (L1). Both the pattern of correlations between the four enjoyment factors and SEM analysis confirmed the assumed simplex-like structure. Adjacent relations between levels L1, L2, and L3 were stronger than those between L3 and L4. This might be due to the fact that L1, L2, and L3 are all related to the academic domain while enjoyment of life (L4) is a very broad construct. Based on our findings, it may be important both in planning a study on emotions and in interpreting its results to take into account the generalization level of the emotion construct under investigation. For instance, when generating emotion scales, it may be helpful to pay attention to the degree of generalization in the survey items.

4.2. Direction of causality in the hierarchical model of enjoyment

Concerning the direction of causality in our hierarchical model of enjoyment, we assumed bidirectional relationships between the enjoyment constructs, that is, both bottom-up and top-down effects. Within self-concept research, Marsh and Yeung (1998) found strong horizontal and weak top-down effects, whereas bottom-up or reciprocal effects were negligible. However, our study is conceptually dissimilar from this research in that their study had no hierarchical order within specific self-concepts. For example, beyond a global self-concept (e.g., general self-esteem), these authors assessed discrete academic self-concepts at a lower hierarchical level (e.g., science self-concept and English self-concept) but did not distinguish between different generalizations within a specific self-concept (e.g., self-concept concerning science in general vs. using learning strategies when studying for science classes). In our study, for enjoyment constructs related to the academic domain, namely enjoyment of school (L3), learning (L2), and strategy use (L1), significant and relatively strong top-down effects of adjacent enjoyment constructs at different levels of generalization were found. However, neither bottom-up nor top-down effects were found between enjoyment of life (L4) and the other enjoyment constructs specific to the academic domain. This finding is consistent with the pattern of correlations found between the four scales which showed the strongest relations between adjacent levels and a relatively weak correlation between enjoyment of life (L4) and enjoyment of school (L3).

In our study, we found evidence that top-down effects were stronger than bottom-up effects in our present student sample (grades 5–10). One possible explanation for this finding may be that bottom-up effects are more predominant in younger children who develop higher-level constructs in a more straightforward, cumulative manner (for this developmental perspective in the context of self-concept see Harter, 1999). However, once higher-level constructs have developed over time, top-down effects may become more prevalent. For example, enjoyment of school might be the cumulative consequence of enjoyment in different academic situations experienced during the first years of school

(e.g., learning, instruction, exams, extracurricular activities; see Fig. 1). When a specific level of school-related enjoyment is established, this construct is likely to be relatively stable and as such have a trickle-down effect on how much enjoyment is experienced within specific situations at school for that individual.

Concerning the promotion of students' enjoyment related to the academic domain, it might be important for educators to know that the promotion of enjoyment at level L3 (enjoyment of school) and level L2 (enjoyment of learning) can have a beneficial impact for students' experiences of enjoyment on adjacent lower levels of generalization (top-down effects). As one example, the physical arrangement of school settings and the attractiveness of the classroom environment could be changed so as to facilitate students' overall *enjoyment of school* (level L3, see Fig. 1). For instance, a more enjoyable school experience could be created for students through the use of appropriate classroom furnishings, colors, as well as architectural designs which stimulate the imagination. According to our results, fostering students' enjoyment of school might also have beneficial effects on their enjoyment of learning (top-down effects).

4.3. Links between enjoyment constructs and learning behaviour

Consistent with our assumptions, the four enjoyment scales at different levels of generalization showed clear relations with flexible learning styles involving self-regulated learning and flexible-creative problem solving. As for the relations between self-regulated learning and enjoyment of learning, Pekrun et al. (2002a) found similar results when using the same self-regulation scale and a 14-item learning-related enjoyment scale ($\alpha = 0.90$). In that study, self-regulation and learning-related enjoyment were correlated at 0.43 ($r < 0.001$), similar to the values of 0.45/0.47 (Times 1/2, each $p < 0.001$) found in the present study. This finding supports the validity of our learning-related enjoyment scale. Learning from mistakes also showed clear relations with the four enjoyment scales. This result is in line with our assumptions derived from mood research. As for the relations between the enjoyment scales and the frequency of learning with index cards, our results were exploratory in nature. Here we also found strong relationships between this learning strategy and our enjoyment scales, indicating that students who experience high intensities of enjoyment do use this strategy more often.

However, our results make clear that it is important to take the level of generalization into account when assessing relations between enjoyment and actual learning behavior, and further suggest that levels of generalization may also be important for emotions other than enjoyment (cf. Brunswik, 1952). Moreover, our results should be taken into account when conducting and interpreting meta-analyses of emotion-related research (cf. Wittmann, 1991). For example, a meta-analysis on the relation between enjoyment and achievement should consider the level of generalization of the enjoyment constructs. This assertion is further supported by existing meta-analytic research on the relation between anxiety and achievement which has found that the relations between general vs. test anxiety and subsequent achievement differ significantly (see Seipp & Schwarzer, 1991).

5. Directions for future research

The results of this study serve to highlight the need for further investigation into the hierarchical structure of discrete emotions. For instance, further research on the relations of students' experiences of enjoyment should address the replicability of our findings. To examine our entire proposed hierarchical model (see Fig. 1), one approach may be to generate a large number of items located on level L1 (activity-specific experiences of enjoyment) but involve a larger number of situations and contexts than in the present study.[1] All level L1 indicators could then be aggregated upwardly in order to represent level L2 indicators. Further upward aggregations could form level L3 indicators and finally a single latent level L4 indicator. This latent superordinate factor could then be regressed on a manifest level L4 indicator similar to the one used in the present study in order to assess the convergent validity of the hierarchically based level L4 factor and the empirical level L4 factor.

In a similar vein, additional research of both longitudinal and experimental nature is warranted to validate our findings that the amount of enjoyment at a given hierarchical level of enjoyment is primarily a consequence of top-down processes. Of particular interest would be whether in younger students, bottom-up effects are predominant in contrast to older students for whom top-down effects are more prevalent (see Harter, 1999). Our ancillary analyses of learning

[1] We want to thank an anonymous reviewer who pointed out this testing procedure.

outcomes in relation to levels of the hierarchy suggest a meaningful pattern of predictive relations within levels. Analyzing relations between enjoyment at different levels of generalization and variables that are relevant for students' learning and achievement (such as motivation, self-concepts and value cognitions) in more detail is also an area for future study. Furthermore, intervention programs aimed at the promotion of enjoyment at different levels of generalization could be developed and their impact on learning behavior investigated. Vice versa, programs for fostering student learning competencies could be analyzed with respect to their impact of students' experiences of enjoyment at different levels of generalization.

Aside from research specifically concerning students' experiences of enjoyment in the classroom, the present study also highlights the need for additional empirical research to address whether differentiable levels of generalization are also found for other emotional experiences (e.g., pride, hope, anxiety, or boredom). Moreover, whereas the present study concentrated primarily on only one vertical branch of the hierarchical model depicted in Fig. 1, future studies could investigate other vertical and horizontal series of emotion constructs, for example, the relations between enjoyment of life and of various other domains located on lower hierarchical levels (e.g., experiences of enjoyment at school, at home, with peers, or from independent activities).

Appendix. Intercorrelations for manifest variables in structural equation modeling

	M	SD	Correlation coefficient (Pearson)															
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) L4_1_T1	4.11	1.12	–															
(2) L4_2_T1	4.30	1.03	0.56	–														
(3) L3_1_T1	3.10	1.28	0.31	0.23	–													
(4) L3_2_T1	3.04	1.28	0.31	0.23	0.87	–												
(5) L2_1_T1	2.29	1.10	0.18	0.08	0.55	0.54	–											
(6) L2_2_T1	3.47	1.11	0.24	0.12	0.39	0.36	0.42	–										
(7) L1_1_T1	3.06	1.18	0.14	0.13	0.22	0.21	0.32	0.30	–									
(8) L2_2_T1	2.86	1.21	0.10	0.06	0.27	0.29	0.37	0.28	0.65	–								
(9) L4_1_T2	4.09	1.18	0.34	0.36	0.17	0.21	0.16	0.13	0.18	0.11	–							
(10) L4_2_T2	4.37	1.02	0.29	0.47	0.09	0.11	0.08	0.03	0.16	0.10	0.60	–						
(11) L3_1_T2	3.15	1.25	0.24	0.17	0.65	0.63	0.44	0.29	0.15	0.17	0.27	0.19	–					
(12) L3_2_T2	3.02	1.24	0.23	0.20	0.60	0.61	0.45	0.34	0.20	0.21	0.34	0.25	0.81	–				
(13) L2_1_T2	2.24	1.12	0.17	0.16	0.45	0.46	0.57	0.30	0.20	0.22	0.19	0.17	0.50	0.50	–			
(14) L2_2_T2	3.08	1.15	0.16	0.10	0.32	0.31	0.37	0.42	0.21	0.18	0.18	0.11	0.39	0.38	0.49	–		
(15) L1_1_T2	2.61	1.22	0.09	0.09	0.25	0.27	0.34	0.28	0.40	0.33	0.13	0.11	0.21	0.24	0.34	0.37	–	
(16) L1_2_T2	2.56	1.21	0.08	0.09	0.25	0.27	0.28	0.23	0.41	0.36	0.16	0.10	0.20	0.25	0.32	0.29	0.77	–

L1, L2, L3, and L4: levels of generalization; L1 represents the lowest level. L4, enjoyment of life; L3, enjoyment of school; L2, enjoyment of learning; L1, enjoyment of strategy use; _1, scale item 1; _2, scale item 2; _T1, Time 1; _T2, Time 2. $r \geq 0.09$, $p < 0.05$; $r \geq 0.11$, $p < 0.01$; $r \geq 0.15$, $p < 0.001$. $N = 513$.

References

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*, 238–246.

Brown, J. D. (1993). Self-esteem and self-evaluation: Feeling is believing. In J. Suls (Ed.), *Psychological perspectives on the self*, *Vol. 4* (pp. 27–58). Hillsdale, NJ: Erlbaum.

Brunswik, E. (1952). *The conceptual framework of psychology*. Oxford, England: University Chicago Press.

Byrne, B. M. (1998). *Structural equation modeling with LISREL, PRELIS, and SIMPLIS: Basic concepts, applications, and programming*. New Jersey: Lawrence Erlbaum Associates, Publishers.

Cattell, R. B., & Scheier, I. H. (1961). *The meaning and measurement of neuroticism and anxiety*. New York: Ronald Press.

Diener, E. (2000). Subjective well-being. *American Psychologist*, *55*(1), 34–43.

Endicott, J., Nee, J., Harrison, W., & Blumenthal, R. (1993). Quality of life enjoyment and satisfaction questionnaire: a new measure. *Psychopharmacology Bulletin*, *29*(2), 321–326.

Epstein, S. (1977). Traits are alive and well. In D. Magnusson, & N. S. Endler (Eds.), *Personality at the crossroads: Current issues in interactional psychology* (pp. 83–98). Hillsdale, NJ: Erlbaum.

Goetz, T. (2004a). *Emotionales Erleben und selbstreguliertes Lernen bei Schülern im Fach Mathematik*. [*Emotions and self-regulated learning of students in mathematics*]. Muenchen: Utz.

Goetz, T. (2004b). *Die Förderung selbstregulatorischer Kompetenzen von Schülerinnen und Schülern in der Sekundarstufe I. Abschlussbericht zur 1. Projektphase (01/03–01/04)*. [*Promoting self-regulatory competences in students. Final report to the first wave of the project (January 03–January 04)*]. Department of Psychology, University of Munich.

Goetz, T., Pekrun, R., Hall, N. C., & Haag, L. (2006). Academic emotions from a socio-cognitive perspective: antecedents and domain specificity of students' affect in the context of Latin instruction. *British Journal of Educational Psychology*, *76*, 289–308.

Goetz, T., Zirngibl, A., Pekrun, R., & Hall, N. C. (2003). Emotions, learning and achievement from an educational–psychological perspective. In P. Mayring, & C. v. Rhoeneck (Eds.), *Learning emotions. The influence of affective factors on classroom learning* (pp. 9–28). Frankfurt am Main: Peter Lang.

Gottfried, A. E., Fleming, J. S., & Gottfried, A. W. (2001). Continuity of academic intrinsic motivation from childhood through late adolescence: a longitudinal study. *Journal of Educational Psychology*, *93*, 3–13.

Guttman, L. (1954). A new approach to factor analysis: the radix. In P. Lazarfeld (Ed.), *Mathematical thinking in the social sciences* (pp. 258–348). New York: Free Press of Glencoe.

Harter, S. (1999). *The construction of the self: A developmental perspective*. New York: Guilford Press.

Hembree, R. (1988). Correlates, causes, effects and treatment of test anxiety. *Review of Educational Research*, *58*(1), 47–77.

Hettena, C. M., & Ballif, B. L. (1981). Effects of mood on learning. *Journal of Educational Psychology*, *73*(4), 505–508.

Hodapp, V., & Benson, J. (1997). The multidimensionality of test anxiety: a test of different models. *Anxiety, Stress, and Coping*, *10*, 219–244.

Jöreskog, K. G. (1970). Estimating and testing of simplex models. *British Journal of Mathematical and Statistical Psychology*, *23*, 121–145.

Jöreskog, K. G., & Sörbom, D. (1996). *LISREL 8: User's reference guide*. Chicago, IL: Scientific Software.

Jöreskog, K. G., & Sörbom, D. (2002). *LISREL 8.53* (updated December 2003). Chicago: Scientific Software International.

Kleine, M., Goetz, T., Pekrun, R., & Hall, N. C. (2005). The structure of students' emotions experienced during an academic achievement test. *International Reviews on Mathematical Education*, *37*(3), 221–225.

Maes, J., & Kals, E. (2002). Justice beliefs in school: distinguishing ultimate and immanent justice. *Social Justice Research*, *15*(3), 227–244.

Marsh, H. W. (1990). A multidimensional, hierarchical self-concept: theoretical and empirical justification. *Educational Psychology Review*, *2*, 77–172.

Marsh, H. W. (1993). Academic self-concept: Theory measurement and research. In J. Suls (Ed.), *Psychological perspectives on the self*, *Vol. 4* (pp. 59–98). Hillsdale, NJ: Erlbaum.

Marsh, H. W., & Shavelson, R. (1985). Self-concept: its multifaceted hierarchical structure. *Educational Psychologist*, *20*(3), 107–123.

Marsh, H. W., & Yeung, A. S. (1998). Top-down, bottom-up, and horizontal modals: the direction of causality in multidimensional, hierarchical self-concept models. *Journal of Personality and Social Psychology*, *75*(2), 509–527.

Olechowski, R. (1995). Comparing the visualization of individual process of learning as a feedback for school beginners. In R. Olechowski, & G. Kahn-Svik (Eds.), *Experimental research on teaching and learning* (pp. 167–177). Frankfurt am Main: Lang.

Pekrun, R. The control-value theory of achievement emotions: assumptions, corollaries, and implications for educational research and practice. *Educational Psychology Review*, in press.

Pekrun, R. (2000). A social-cognitive, control-value theory of achievement emotions. In J. Heckhausen (Ed.), *Motivational psychology of human development* (pp. 143–163). Oxford: Elsevier.

Pekrun, R., Goetz, T., Perry, R., Kramer, K., Hochstadt, M., & Molfenter, S. (2004). Beyond test anxiety: development and validation of the Test Emotions Questionnaire (TEQ). *Anxiety, Stress, and Coping*, *17*(3), 287–316.

Pekrun, R., Goetz, T., Titz, W., & Perry, R. (2002a). Academic emotions in students' self-regulated learning and achievement: a program of qualitative and quantitative research. *Educational Psychologist*, *37*(2), 91–105.

Pekrun, R., Goetz, T., Titz, W., & Perry, R. P. (2002b). Positive emotions in education. In E. Frydenberg (Ed.), *Beyond coping: Meeting goals, visions, and challenges* (pp. 149–174). Oxford, UK: Elsevier.

Ricci-Bitti, P., & Scherer, K. R. (1986). Interrelations between antecedents, reactions, and coping responses. In K. R. Scherer, H. G. Wallbott, & A. B. Summerfield (Eds.), *Experiencing emotion: A cross-cultural study* (pp. 129–141). Cambridge: University Press.

Ryan, R. M., & Connell, J. P. (1989). Perceived locus of causality and internalization: examining reasons for acting in two domains. *Journal of Personality and Social Psychology*, *57*(5), 749–761.

Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton, NY: Princeton University Press.

Schmitz, B. (2000). *Questionnaire for the assessment of self-regulated learning competencies*. Germany: University of Darmstadt.

Seipp, B., & Schwarzer, C. (1991). Angst und Leistung – Eine Meta-Analyse empirischer Befunde. [Anxiety and academic achievement – a meta-analysis of empirical findings]. *Zeitschrift für Pädagogische Psychologie*, *5*(2), 85–97.

Seligman, M. E. P., & Csikszentmihalyi, M. (2000). Positive psychology: an introduction. *American Psychologist*, *55*(1), 5–14.

Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Self-concept: validation of construct interpretations. *Review of Educational Research*, *46*(3), 407–441.

Shaver, P., Schwartz, J., Kirson, D., & O'Connor, C. (1986). Emotion knowledge: further exploration of a prototype approach. *Journal of Personality and Social Psychology*, *52*(6), 1061–1086.

Sperling, R. A., Howard, B. C., Staley, R., & DuBois, N. (2004). Metacognition and self-regulated learning constructs. *Educational Research and Evaluation*, *10*(2), 117–139.

Spielberger, C. D. (1972). Anxiety as an emotional state. In C. D. Spielberger (Ed.), *Anxiety: Current trends in theory and research*, *Vol. I* (pp. 23–49). New York: Academic Press.

Steiger, J. H. (1990). Structural model evaluation and modification: an interval estimation approach. *Multivariate Behavioral Research*, *25*, 173–180.

Tellegen, A., Watson, D., & Clark, L. A. (1999). On the dimensional and hierarchical structure of affect. *Psychological Science*, *10*(4), 297–302.

Tucker, L. R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. *Psychometrika*, *38*(1), 1–10.

Wallbott, H. G., & Scherer, K. R. (1988). How universal and specific is emotional experience? Evidence from 27 countries on five continents. In K. R. Scherer (Ed.), *Facets of emotion: Resent research* (pp. 31–56). Hillsdale: Larence Erlbaum.

Walls, T. A., & Little, T. D. (2005). Relations among personal agency, motivation, and school adjustment in early adolescence. *Journal of Educational Psychology*, *97*(1), 23–31.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology*, *54*, 1063–1070.

Watson, D., & Tellegen, A. (1985). Toward a consensual structure of mood. *Psychological Bulletin*, *98*, 219–235.

Wittmann, W. W. (1991). Meta-analysis and Brunswik symmetry. In H. U. Otto, & G. Albrecht (Eds.), *Social prevention and the social sciences: Theoretical controversies, research problems, and evaluation strategies* (pp. 381–393). Oxford, England: Walter De Gruyter.

Zeidner, M. (1998). *Test anxiety. The state of the art*. New York: Plenum Press.