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Control-value appraisals predicting students' boredom in accounting classes: a continuous-state-sampling approach

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Abstract

Background: Boredom is a prevalent experience in school. Findings indicate that students are bored in a notable amount of instructional time with negative consequences for learning outcomes. The control-value theory considers control and value appraisals to be important antecedents of boredom.

Methods: In our study with 95 commercial school ninth graders, we investigated control-value appraisals and students' boredom over 2 curricular weeks in the subject accounting by means of an experience sampling procedure with equally spaced measurement intervals called Continuous-State-Sampling. The CSSM data design generates a hierarchical data structure. Variability of students' boredom can be segmented into three components: between times within lessons, between lessons within students and between students. We use multilevel models to address our research questions.

Results: We found negative associations for control and value appraisals in predicting boredom over time. In addition, the value appraisal moderates the relation between subjective control and boredom: Interested students get bored when lacking time to reflect on subject matter. Our results further revealed that control and value only interact when being conceptualised as state constructs close to the situation.

Conclusions: The results show that students' in situ-experiences of boredom are related to personal and situational factors as well as their dynamic interplay.

Keywords: Boredom, Experience-sampling, Control value theory, Hierarchical linear model

Background

Students' boredom during class has been considered a major pedagogical challenge for decades (Robinson 1975) and is still an omnipresent condition in schools. There is empirical evidence that students are often and intensively bored during school lessons—several studies suggest manifestations up to 50%—with possible negative consequences for learning outcomes (Götz et al. 2007; Larson and Richards 1991; Lohrmann 2008; Pekrun et al. 2010). For instance, given that scarce educational time resources should be spent adequately *and* efficiently, it is important to address the question how the feeling of boredom as a subjective void of time arises and if there are pedagogical means to minimise this dissipation of temporal resources. In the field of vocational

education and training (VET), existing results show that students' boredom is occurring in a notable amount in the commercial core subject accounting (Kögler 2015). Accounting is said to be challenging for both teachers and students and often taught in a traditional, schematic way, which has been criticised for a long time (cf. Preiss 2001; Seifried 2004a). Hence, investigating the antecedents of students' boredom in accounting classes seems to be worthwhile.

The feeling of boredom is characterised by a subjective temporal dilatation, low arousal, and a fairly negative emotional valence (Götz and Frenzel 2006; Mikulas and Vodanovich 1993). After decades of disregard in the field of educational research, there has been a growing body of knowledge about boredom and its predictors at school (Daschmann et al. 2014). The emergence and development of boredom is attributed to both personal and situational variables and may be seen as a subjective evaluation of the fit between person and environment (Fisher 1993; Daschmann et al. 2011). More specifically and in accord with appraisal theories of emotion, the individuals' evaluation of situational control and value are supposed to be considerable antecedents of boredom as stated in the control-value theory of achievement emotions (Pekrun 2006; Pekrun and Stephens 2009, 2010). Hence, academic boredom is supposed to occur when students do not evaluate the learning contents and materials as valuable and, at once, lack the impression of control over the situation. The feeling of control during class is associated with the complexity of the learning contents and the pace being set by the teacher during lesson, while subjective value represents intrinsic qualities of academic studying as well as learning success (Pekrun 2006, pp 319).

Moreover, control and value could possibly interact when causing students' experience of boredom. Interested students should react differently when lacking the impression of control compared to students experiencing low subjective value. Studies investigating the effects of control and value on emotional experiences mostly concentrate on main effects, interactions have been widely neglected in research so far. The scarce existing results indicate significant interactions between control and value appraisals predicting everyday positive emotions (cf. Goetz et al. 2010) as well as different effects of control appraisals on academic boredom in cases of low versus high value (Bieg et al. 2013).

Nevertheless, there do exist open questions concerning the nature of the interaction. For instance, control and value have been usually framed as distinct state concepts close to the situation so far, and thus, the question whether control and value appraisals interact differently when being framed either as situational or individual resources remains an important desideratum in research. Adding to that argument, the existing findings on academic boredom are mostly based on students' trait self-reports which, in a higher degree than state reports, may be biased due to the retrospective evaluation of relevant situations (Robinson and Clore 2002). Only a few recent studies investigating students' boredom take advantage of process-oriented measurement approaches implementing well-tried experience-sampling procedures in situ (Hektner et al. 2007; Goetz et al. 2010; Nett et al. 2011). Experience sampling methods provide wide scopes for research designs concerning the quantity and frequency of measurement points as well as the type of inducement of probands' answering.

Consequently, the present experience sampling study was conducted in order to achieve two research objectives: First, we sought to examine the main effects of

control-value appraisals on students' boredom and particularly take account for different aggregation levels of control and value—either near to the situation or near to the person. In favour of this aim and in order to analyse students' appraisals on different aggregation levels, a hierarchical design which accounts for (1) variability between students (individual level), (2) variability between different school lessons (level of lessons), and (3) variability within school lessons (level of measurement points) is implemented. To this end, we made use of an experience-sampling approach with equidistant measurement intervals gathering students' self-reports over an entire curricular unit of 2 weeks. The method is called continuous-state-sampling and is well-tried in the field of VET (Rausch et al. 2010; Sembill et al. 2008). This enables us to account for differences in situational and aggregated perceptions of the students in order to find out on which level the effects are located. Second, we intended to depict the nature of the interaction between control and value appraisals by analysing interactions on different levels and especially considering cross-level interactions.

Research on the predictors of boredom

Educational research has provided a variety of highly detailed theoretical concepts to explain students' experiences of learning situations, such as motivation, interest, or academic emotions (cf. Rheinberg 2006; Deci and Ryan 1985 et passim; Krapp 2002; Eccles and Wigfield 2002; Götz 2004). Most importantly, all of these concepts assume a complex interplay of learners' individual characteristics (e.g., students' self-concept, self-efficacy, prior knowledge) on the one hand and perceived features of the task or the learning situation on the other hand (e.g. instructional quality, adaptive support, classroom management). Dual component models also exist for the explanation of boredom. For instance, in the context of work, Fisher (1993) differentiates between personal as well as situational causes of boredom and especially points to the interdependence between person and situational environment, which is—when being mismatched—a possible source of boredom. This dualistic perspective on the causes of boredom overcame the basic "understimulation model", which mainly attributed the emergence of boredom to repetitive and habituated tasks in factory work. Yet, it is an early model attributing the emergence of boredom to the absence of subjective interest (Smith 1981). Other models explaining students' boredom *in school* focus on high ability students in settings with low demands. Thus, they rather focus on the fit between individual skills and curricular standards in terms of subjective control (e.g. Sisk 1988). Here, boredom is characterised as a response to repetitive and monotonous situations, which the individual perceives to be lacking in stimulation. In corresponding empirical studies, monotony and a lack of stimulation are identified as important features of boring situations (Robinson 1975; Hill and Perkins 1985). Further, if people perceive their skills to exceed the situational challenges, they will feel bored (Csikszentmihalyi 1975 et passim). However, older findings show that boredom is not only prevalent in gifted students but also especially experienced by those with lower abilities (Roseman 1975; Fogelman 1976). More recently, evidence of empirical studies also suggests that boredom is experienced in the case of being over-challenged in a learning situation. Furthermore, Daschmann et al. (2011) found a moderately high negative correlation of the two boredom scales of being over- and under-challenged, which leads to the assumption that students are over-challenged

by one situation and under-challenged by another—a significant hint for the necessity of investigating boredom and its appraisals in a situation-specific manner.

In current research, another important construct amongst the individual precursors of students' boredom is their interest in learning contents and materials. Subjective interest is occurring either as an individual trait in terms of a stabilised construct or as a situation-specific state, which results from an abiding individual value that is allocated to certain issues or circumstances (Hidi 2000, pp 313). Accordingly, students who report lessons, contents or materials to be interesting were significantly less bored in multiple studies (Robinson 1975; Pekrun and Hofmann 1999; Titz 2001; Pekrun et al. 2002; Götz 2004; Götz et al. 2006; Sparfeldt et al. 2009, 2011). Further, some findings accentuate the meaning of subjective value and perceived usefulness of the learning materials, which are—when dismissed by students—important antecedents to the emergence of boredom during class (Mitchell 1993; Robinson 1975). Based on those findings, subjective interest is considered an important antecedent for boredom irrespectively of its operationalisation as an individual trait or a situational trait.

Control-value antecedents of achievement emotions

The linkage between person and situation is condensed in appraisal theories of emotion which are highly influential concerning the explanation for the actual genesis of emotions in general. In essence, appraisal theories assume that emotions are emerging due to individual evaluations of events and situations (Roseman and Smith 2001, pp 3). Important questions addressed by appraisal theories, comprise of the dynamics as well as individual differences in emotional response.

One highly influential theory combining expectancy-value approaches with learning emotions is Pekrun's (2006) control-value theory of achievement emotions. It integrates attributional theories of achievement emotions as well as theories of perceived control and assumptions concerning the effects of emotions on learning and performance (Pekrun 2006, pp 316). The theoretical framework considers the subjective impression of control over achievement activities and outputs as well as their value as the key determinants of emotions. Achievement emotions are by definition directly tied to either achievement activities or outcomes. Corresponding to this differentiation, boredom can also be understood as an activity-related achievement emotion, which is supposed to occur when achievement-related learning activities or situations do not offer any incentive value and when individuals lack the feeling of control (Pekrun 2006, pp 324; Pekrun et al. 2010, pp 532). In the framework of the control-value-theory, control refers to the subjective possibility of an individual to influence learning activities and outcomes and may include perceptions such as being adequately challenged in a learning situation (Frenzel et al. 2007). Concerning teaching and learning during class, the feeling of control is closely related to instructional pace and the degree of individualisation. Value, meanwhile, refers to one's subjective perception of the importance of the learning contents, tasks and achievement goals (Eccles 2005) which may correspond with subjective interest during the teaching and learning process—interest by itself "can serve as a source of task value" (Hidi and Renninger 2006).

Thus, the experience of boredom can occur either momentarily in a concrete situation or be conceptualised as a habitual experience relating to certain achievement activities.

Pertaining to the emergence of emotions, situational appraisals are presumed to be "proximal determinants" (Pekrun 2006, 317) which mediate the influence of situational factors and personal characteristics. In accord with this, empirical studies found support for the importance of value and control appraisals in predicting students' boredom. Concerning subjective values as antecedents of boredom, Goetz et al. (2006) showed that students' values of academic achievement were negatively correlated with their reported boredom. Likewise based on the control-value theory, Pekrun et al. (2014) confirmed a model of reciprocal causation of boredom and academic achievement at university by means of a longitudinal investigation. Pekrun et al. (2010) related both control and value appraisals corresponding to achievement activities to academic boredom in university settings and found strong evidence for stable negative relations over several studies. According to them, students experienced boredom especially in low-control settings, which is further evidence against the formerly proposed positive relation to boredom in routine tasks with high degrees of situational control.

In addition, one important feature of the control-value theory is not only the assumption of a linear relation between control and the emerging negative emotion boredom, but rather assuming that control *and* value appraisals determine achievement emotions in a complex non-linear pattern (Pekrun 2006). This concludes that students' boredom is not only influenced by value and control in an additive way but that they interact in a rather dynamical manner. More explicitly, the control-value theory postulates a non-compensatory relation of value and control in predicting boredom, so that the lowest degree of boredom implies increased value and control. In this regard, Goetz et al. (2010) found that control and value appraisals predict positive emotions in a multiplicative manner. They identified an interaction effect and assumed that perceived control and positive emotional experiences were greater in situations of high subjective value while controlling for the main effects. These results lead to the presumption of unique effects of both control-value appraisals as well as combined effects, which are important to consider in academic settings. Nevertheless, the study focused on positive everyday emotions and merely stated the desideratum of exploring interactions between control value appraisals and negative emotional experiences such as boredom. Distinct empirical knowledge concerning the emergence of boredom being attributed to the interaction of control and value is still rare, especially when framing the appraisals either as situational or as personal constructs. One existing study identified considerable main effects of control and value appraisals on boredom as well as an interaction, showing the relation between control and boredom to differ depending on the value appraisal (Bieg et al. 2013), but, however, did not consider cross-level effects of the appraisals due to their operationalisation.

Experience-sampling methods in the study of students' boredom

Experience sampling procedures are an adequate approach to distinguish between personal and situational effects and account for interactions on different levels when predicting emotional experiences in situ. When intending to investigate emotional experiences during lesson, the use of global and retrospective ratings may lead to interpretive problems as they are prone to recall biases and do not consider intra-individual dynamics of subjective states (Robinson and Clore 2002). Accordingly, a few recent studies

make use of experience-sampling procedures when gathering data on appraisals and emotional experiences (Goetz et al. 2014). For instance, Bieg et al. (2013) implemented an intra-individual approach with a design that combined event-based and randomized experience sampling over a period of 2 weeks in several school subjects. Students had to activate a personal digital assistant, which then randomly reacted within the next 40 min in order to gather subjective pride, anxiety and boredom as well as control-value appraisals by means of single item measures. The latter are discussed in various research contexts already for a long time (e.g. Nunnally 1978; Sackett and Larson 1990): Some studies find them to be as valid and reliable as complex multi-item scales (Bergkvist and Rossiter 2007; Wanous et al. 1997), while other results point to differences in predictive validity due to varying research contexts (Diamantopoulos et al. 2012). Thus, single-item measures should be implemented under certain circumstances when common method bias or participant's fatigue might be an issue or when statistical power is weak and the construct to be measured is relatively uncomplicated (Gardner et al. 1998). With respect to process-oriented research settings implementing experience-sampling procedures during class, single-item measures seem advantageous as the interruption of the teaching learning process has to be as short as possible and the risk of generating students fatigue or reactance by multiple measurement time points has to be minimised.

However, as boredom is a slowly intensifying emotion by definition, it seems worthwhile to gather data on state measures in a continuous manner with equidistant shaped measurement points. The so-called continuous-state sampling method (CSSM) has often been implemented in studies within the field of vocational education and training as a time-sampling version of the experience sampling method leading to several insights concerning the interrelations of subjective experiences and situational characteristics (Sembill et al. 2008). It provides the advantage of parallelised measurement intervals, which may also be easily combined with observations from the videography of lessons, and leads to hierarchical data structures with several measurements nested in students. Accordingly, it offers the opportunity to investigate personal and situational characteristics simultaneously.

In former studies, the length of the measurement intervals varied between 5 and 10 min (Sembill 2003; Seifried 2004b; Kärner 2015) depending on the volatility of the constructs and the number of implemented items. When defining the length of the intervals, the trade-off between the interruption of the teaching–learning process during class and the frequency of measurements have to be taken into consideration. Exploring the amount and predictors of students' boredom in accounting lessons, Kögler (2015) conducted a video study and implemented CSSM with parallelized measurement intervals of 7 min each. In order to investigate the effects of different situational predictors on boredom, variables from both videography and CSSM were included in the analyses. There was evidence for a notable amount of boredom during class with ranges up to 50% of instructional time and a strong influence of students' appraisals in situ which led to the conclusion of CSSM being important when exploring teaching–learning processes.

Apart from these findings, the method seems especially promising when intending to trace the development of appraisal-emotion relations over time. Being structured on several levels that account for variability *between* and *within* students, the resulting data allows for hierarchical linear modelling and other complex analysis strategies. To

summarize, studies focusing on the interaction between control and value appraisals by means of experience-sampling measures are scarce, especially concerning students' boredom. Nevertheless, the process-oriented exploration of control-value appraisals and boredom by means of CSSM holds the potential to add a new perspective to the existing findings concerning the relations of control and value appraisals with boredom as well as their dynamic interplay during class.

Aims and hypotheses of the present study

In recent years, a couple of studies shed light on the phenomenon of boredom in school, its appearance, precursors and effects. Remaining research desiderata specifically point to the question of how students' control and value appraisals affect the emergence of boredom when being conceptualised either as situational or individual constructs and how the appraisals interact when predicting boredom. Especially in VET, evidence concerning boredom and its predictors in the core commercial subject accounting is still lacking.

Consequently, the present study aims at investigating the main and interaction effects of control-value-predictors on students' boredom in accounting classes in the field of commercial education. By means of CSSM over an entire curricular unit of 2 weeks, we examined the interplay of control and value appraisals when predicting students' boredom both at the aggregation level of individuals as well as on a situational level.

Main effects of control and value on boredom

According to control-value-theory, we suppose that a lack of perceived control on the one hand and a subjective lack of value on the other hand induce boredom. Pertaining to the question whether control and value affect boredom in a different way when being aggregated either on situational or on personal levels, we assume, in line with interest theory (cf. Hidi 2000; Krapp 2002), that subjective value should be affecting boredom close to the situation as well as near to the individual. This is the fact, because subjective value is closely related to a persons' interest in content matter or a specific situation. Interest itself is being strongly associated with positive emotional experiences and an important predictor for learning outcomes irrespectively of being framed as a state or a trait construct.

Subjective control, in contrast, should be affecting boredom rather when being framed as a situational concept, due to the fact that existing findings indicate different learning contents or circumstances being over- or under-challenging from situation to situation as well as the rapidly changing didactical conditions during class. This corresponds to existing findings, which indicate the influence of different situational conditions on the subjective feeling of being over- or under-challenged. In fact, concerning situational predictors, the existence of boredom in school is often associated with the situational occurrences' lack of meaning for students on the one hand and the shortcoming of possibilities to influence the dissatisfying setting on the other hand. They are confronted with the given learning contents and opportunities and -at least in traditional didactical settings—have to adjust to the teacher's pace. First, we hypothesise that (1) there are

negative main effects of subjective value on boredom, irrespectively of its conceptualisation and that (2) there are situational negative main effects of subjective control on boredom.

Interaction effects

Furthermore, it is to assume that a lack of situational value intensifies the feeling of boredom when occurring in conjunction with a perceived lack of control. Consequently, when predicting the development of students' boredom, we suppose to find a multiplicative effect in addition to the main effects of subjective control and value. Of particular interest is a decomposition of effects on different levels in order to investigate the impact of different conceptualisations of control and value. Within the same levels, we assume to find negative interaction effects of situational control and value on the emergence of state boredom during class. Based on the assumption of subjective control being a rather situational concept, we suppose a stronger interaction close to the situation, which might show a conceptual difference between control and value.

Concerning cross-level interactions such as different framings of control and value, we assume to find effects of situational control as well. The question of how to cope with the situation during class, which is strongly determined by the teacher, should be essential for the effect of subjective value on boredom. Beyond, stabilised interest should increase the individual's wish to cope with the situation in terms of having enough time to reflect on subject matter that is considered interesting. In the following section, we describe our sample and procedure as well as the implemented measures and statistical analyses.

Methods

Sample and procedure

The study was conducted at a commercial school in southern Germany. N = 95 students (39 male) from four classes of the ninth grade (mean age M = 14.91 years, SD = .85) took part in the study that covered 2 full weeks of accounting lessons in the field of business education. Within this period, the lessons' contents were the same in each class and dealt with the basic principles of wage accounting. The study was initiated by the school itself and participation was voluntary. All of the students provided written, informed consent. The teachers were told to organise their lessons as usual, without any conceptual or didactical changes. To gather information on students' emotional experiences, we made use of an experience-sampling approach with equidistant measurement intervals collecting students' state self-reports every 7 min during class. The method is called continuous-state-sampling and is well-tried in the field of research on vocational education and training in Germany (Sembill et al. 2008; Rausch et al. 2010). By use of this experience-sampling procedure, eight school lessons with equally spaced measurement points (N = 4580 in total) were sampled in each class. Every student was equipped with a handheld prompting them every 7 min to complete a short questionnaire consisting of the experience sampling items to be answered on a scale from 0 to 100. Missing data was reconstructed by a multiple imputation based on several personal characteristics, which were investigated by means of a questionnaire before the curricular unit.

Table 1 Intercorrelations between variables

		(1)	(2)	(3)	(4)
(1)	Sex[a]				
(2)	Age	.034*			
(3)	Interest	.066***	.058***		
(4)	Time-to-reflect	− .049**	.137***	.426***	
(5)	Boredom	− .082***	.083***	− .648***	− .288***

*$p < .05$. **$p < .01$. ***$p < .001$ N = 4580

[a] 1 = male, 2 = female

Measures and statistical analyses

Students' boredom was investigated using the short item "I feel bored" (M = 38.04; SD = 32.09). Students' states concerning control and value were operationalised by implementing single items: "I have enough time to reflect on subject matter" (M = 74.21; SD = 17.17) and "I'm interested in the subject matter" (M = 63.25; SD = 18.84). All of the state items were assessed simultaneously.

The CSSM data design generates a hierarchical data structure, where students' multiple boredom ratings (level 1, k) are nested within lessons (level 2, j) which are nested within students (level 3, i). Therefore, variability of students' boredom can be segmented into three components: between times within lessons, between lessons within students and between students. Multilevel models (Bryk and Raudenbush 1992; Singer and Willett 2003), particularly three level models, can be used to address our research questions. Multilevel models are suitable to control for correlated scores within higher level units (e.g., lessons or students) and allow conceptual differences of measures at different levels of analysis. We started with a null model to estimate the variability of students' ratings at each of the levels (i.e., extent of variability between measurement points within lessons, between lessons within students and between students). In the following steps, we (1) included control and value predictors in order to test main effects on each level, (2) accounted for interaction effects within the same levels while controlling for the main effects and (3) analysed cross-level interactions while controlling for the main effects. With the exception of students' sex (57 female) and age (M = 14.91, SD = .853), all variables were group-mean centred before analysis.

Results

Preliminary analyses

First, we analysed the intercorrelations of all variables (Table 1). We found significant negative correlations of students' boredom with the control appraisal ("I have enough

Table 2 Intraclass-correlations (ICC) of students' boredom at the level of lessons and measurement time points

Fixed effects	Var.Comp.	S.E	p
γ_{000} = intercept	38.042	2.252	.000
Random effects	**Var.Comp.**	**S.E**	**p**
$\sigma^2 r_{ijk}$ = boredom (r_{ijk})	415.301	9.475	.000
$\sigma^2 u_{0jk}$ = boredom (u_{0jk})	167.011	13.161	.000
$\sigma^2 u_{00k}$ = boredom (u_{00k})	451.891	70.035	.000

Table 3 Main effects of control and value appraisals

Model 1	B	SE(B)	p
Intercept	25.192	21.769	.250
Fixed slopes			
Sex	−1.233	2.553	.630
Age	4.615	1.483	.002**
$Interest_{ijk}$	−.412	.016	.000***
$Interest_{jk}$	−.699	.034	.000***
$Interest_{k}$	−1.01	.077	.000***
$Time\text{-}to\text{-}reflect_{ijk}$	−.166	.018	.000***
$Time\text{-}to\text{-}reflect_{jk}$	.002	.040	.968
$Time\text{-}to\text{-}reflect_{k}$	.115	.085	.181

* $p < .05$. ** $p < .01$. *** $p < .00$

time to reflect on subject matter") as well as the value appraisal ("I'm interested in the subject matter"). Control and value were positively correlated, the more interested the students were, the more did they perceive to be in control.

In the next step, we analysed the variability of boredom across the three data levels by means of a null model (Table 2). Primarily, we found a significant amount of variability at each of the levels. The intraclass-correlation of variables showed 43.7% of the variance in total being attributed to differences between individuals and 28.7% of the variance in students boredom ratings were attributed to the level of lessons, indicating that substantial differences exist both at the level of lessons and individuals.

In Accordance with Hox (2002), our findings display that it is appropriate to integrate predictors into the model as the variability on each level exceeds 15% of the variance in total.

Control and value as predictors of boredom

We then included control and value appraisals on each level into the model to account for main effects (Table 3). The value appraisal shows significant negative effects on students' boredom on each level: the more interested the students are in a concrete situation as well as over several lessons and the entire curricular period, the less boredom they report during lessons. The strongest effect is manifested on the individual level. Irrespective of a specific lesson or a single measurement time point within a lesson, individual differences in interest was strongly associated with individual differences in students' boredom.

The control appraisal on the other hand is only significantly related with boredom at the level of measurement points within lessons. Students who lack enough time to reflect on subject matter during lessons feel bored at a higher degree than those who are given a sufficient amount of time to reflect. In contrast, there was no relation between control and boredom at the level of single lessons or the individual level.

Interaction effects

When accounting for interaction effects, we first added interaction terms of control-value appraisals that are located on the same level. We found a significant moderation of the interest appraisal on the level of lessons: Students, which are highly interested over

Table 4 Within-level interactions of control and value appraisals

Model 2	B	SE(B)	p
Intercept	46.843	26.391	.079
Fixed slopes			
Sex	− 1.992	2.590	.005**
Age	4.329	1.493	.000***
$Interest_{ijk}$	− .412	.018	.000***
$Interest_{jk}$	− .697	.024	.000***
$Interest_{k}$	− 1.351	.257	.000***
$Time\text{-}to\text{-}reflect_{ijk}$	− .170	.021	.000***
$Time\text{-}to\text{-}reflect_{jk}$	− .005	.028	.869
$Time\text{-}to\text{-}reflect_{k}$	− .109	.175	.532
$Interest_{ijk} \times time\text{-}to\text{-}reflect_{ijk}$	− .001	.002	.336
$Interest_{jk} \times time\text{-}to\text{-}reflect_{jk}$	− .003	.002	.032*
$Interest_{k} \times time\text{-}to\text{-}reflect_{k}$	.001	.001	.162

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

Table 5 Cross-level interactions of control and value appraisals

Model 3	B	SE(B)	p
Intercept	25.279	21.801	.249
Fixed slopes			
Sex	− 1.384	2.556	.589
Age	4.626	1.485	.002**
$Interest_{ijk}$	− .413	.018	.000***
$Interest_{jk}$	− .698	.024	.000***
$Interest_{k}$	− 1.008	.077	.000***
$Time\text{-}to\text{-}reflect_{ijk}$	− .189	.065	.004**
$Time\text{-}to\text{-}reflect_{jk}$	− .049	.077	.523
$Time\text{-}to\text{-}reflect_{k}$	.114	.085	.185
$Interest_{ijk} \times time\text{-}to\text{-}reflect_{jk}$	− .002	.001	.137
$Interest_{jk} \times time\text{-}to\text{-}reflect_{ijk}$	− .003	.001	.006**
$Interest_{k} \times time\text{-}to\text{-}reflect_{ijk}$	.000	.001	.921
$Interest_{k} \times time\text{-}to\text{-}reflect_{jk}$	.000	.001	.514

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

a period of several lessons do get bored when lacking enough time to reflect on subject matter over a period of several lessons (Table 4).

In contrast, we found no interaction on the level of measurement points or on the individual level. The main effects remain stable when including interaction terms into the model.

In the next step, we analysed cross-level interactions and found the value appraisal on the level of lessons to be moderating the effect of control on boredom during lessons: Interested students also get bored when lacking the feeling of control during a lesson (Table 5).

Again, we found no interactions on the individual level. Pertaining to interaction effects, the appraisals' variability between students over the entire curricular period is not significantly affecting students' boredom and even close to the situation on the level

of measurement points there is no moderating effect of subjective value on the relation between subjective control and boredom. The main effects of control and value also remain stable in this model as well as the effect of age.

Discussion

Predicting students' boredom with control-value appraisals

To summarise, findings of the present study showed that students' in situ-experiences of boredom are related to personal and situational factors as well as their dynamic interplay. Controlling for sex and age, students' boredom was affected substantially by their interest and the perceived time given to reflect about subject matter during lessons in terms of subjective control. In detail, our results showed that the value appraisal revealed its relevance not only on the level of measurement points and the level of lessons but also on the individual level. Hence, there is no empirical evidence to reject hypothesis 1a, which stated negative main effects of subjective value on boredom irrespectively of its conceptualisation as a state or trait construct. This result is in consonance with interest theory and its differentiation of situational (trigger/hold) and individual interest, which are represented by the implemented aggregation levels in this study.

On the other hand, the main effect of the control appraisal only occurred at the level of measurement points. The subjective feeling of control in terms of having enough time to reflect seems to be a rather situational concept whilst interest is a stable predictor on all levels, close to the situation as well as close to the individual. Hypothesis 1b assumed negative main effects of subjective control on boredom in a situational conceptualisation. As we did not identify significant effects on the level of lessons, which represents differences between the observed lessons in the curricular unit, we have to partly reject the hypothesis. When discussing this result, one could assume that the subjective impression of control is rather tied to the dynamic change of didactical conditions and complexity during class than characterised as an experience, which is stable for several lessons. The feeling of being either over- or under-challenged seems to be a rather volatile than enduring experience, which may also be a sign of instructional quality. Especially in the field of accounting, falling behind the instructional pace for a longer period is risky as curricular units are schematically built on one another. Consequently, when teaching accounting, it is of particular relevance to balance individual needs in terms of instructional pace.

In addition, our data supports the assumption of control-value appraisals interacting when predicting students' boredom. Concerning interaction effects within the same levels, we found evidence for interest being a moderator for the relation between time-to-reflect and boredom on the level of lessons: Students who are lacking a stable interest in subject matter tend to be bored when instructional pace is low over several lessons. Vice versa, interested students get bored when lacking enough time to reflect on subject matter. These findings also correspond to interest theory, as being deeply interested is associated with a change of temporal experience, the feeling of flow is potentially emerging. Thus, it appears to be relevant to keep students interested over several lessons and to give them enough time to reflect on subject matter. However, we did not find an interaction of the control-value appraisals on the level of measurement points within lessons. With respect to the interplay of stabilised subjective value and control, this might

imply the need for a coherent didactical concept for a whole curricular unit, instead of planning each lesson independently. Consequently, the presented results partly support hypothesis 2a.

Nonetheless, students with a steady interest also need time to reflect on subject matter *during* lessons to prevent boredom, which we expected in hypothesis 2b. The more an individual is interested in subject matter over a curricular unit, the more boredom emerges when lacking time to reflect on the contents in situ.

To recapitulate with respect to the conceptualisation of individuals' appraisals, subjective value and control seem to influence the emergence of boredom in different ways due to their aggregation level. Subjective value such as interest in subject matter is an important predictor of boredom, especially when being stable over time and interacting with the control appraisal in situ. In regard to general pedagogical implications, this might be an argument for the deceleration of instructional pace and, at the same time, the necessity to illustrate the relevance of the subject matter for students.

Strengths, limitations and further research

The present study intended to investigate the main and interaction effects of control and value appraisals on the emergence of students' boredom in accounting classes. Students' appraisals of subjective control and value and the experience of boredom during the teaching–learning process were collected over an entire curricular unit of 2 weeks by means of continuous-state-sampling in situ. By using parallelised measurement intervals for both the predictors and the criterion, the resulting data allowed to account for variability on different aggregation levels. The corresponding decomposition of effects led to a differential understanding of the interplay of control and value appraisals over time. By that, our results add to the existing findings on the emergence of students' boredom during teaching–learning processes and contribute to the further differentiation of the control-value theory, especially pertaining to interaction effects.

Nevertheless, there are some limitations, which have to be discussed. First, when aggregating the control and value appraisals, which were measured every 7 min during lessons, a potential shift of meaning has to be taken into account. For instance, aggregating the control appraisal ("I have enough time to reflect on subject matter") on the individual level, it may change its meaning into a personal disposition similar to cognitive ability. Further analyses should therefore include the interrelations of personality traits and aggregated state appraisals. Second, in contrast to our expectation that interest is a moderator for the effect of subjective control on boredom, there is no causal evidence for this assumption as we measured the appraisals simultaneously and did not implement an experimental design. Third, by measuring students' subjective experiences several times during class, we may have induced reactivity or reactance. During videography, there was no evidence for reactant student behaviour but in this design, we cannot control for the effects caused by a higher attentiveness on subjective experiences. The CSSM setting may have increased the measures of boredom, which is a rather silent emotion when beginning to occur. However, when investigating subjective experiences by means of self-report measures, retrospective methods are potentially fraught with problems of remembrance compared to approaches gathering data in situ. In the present study, the focus of interest lay on the reconstruction of the actual genesis of boredom,

hence, we investigated subjective experiences in situ. We implemented single-item measures in order to minimise the risk of causing reactivity and reactance. The reliability of measures at the lessons' and the students' level was ensured by aggregating single measures at higher levels of analysis. Given the relatively high intraclass-correlations of variables and the large number of measures within lessons and within individuals, this procedure appears suitable for a reliable assessment of variables including their interactions (Bryk and Raudenbush 1992; Lüdtke et al. 2006). Nevertheless, replications of the present findings using multiple-item measures is one goal for future research.

According to the specific advantages of this empirical approach and in order to substantiate our findings, furthermore it would be fruitful to analyse the temporal dynamics of the individuals' appraisals as well as the development and changes of boredom during the instructional process. Especially cross-lagged effects of the appraisals on the development of boredom would be of interest as boredom is discussed to be a slowly emerging emotion and processual knowledge about its development is still lacking. Furthermore, we intend to explore the quality of students' self-reports under changing situational conditions in terms of rating tendencies. Further evidence concerning the strengths and weaknesses of experience-sampling methods, especially when implementing single-item measures, will help to foster research on emotional experiences in teaching and learning processes. With respect to boredom, which is a prevalent experience in school, the potential of experience-sampling studies in vocational education and training has not been fully exploited yet. For instance, it seems worthwhile to investigate the effects of different didactical settings and varying degrees of individualisation on the emergence of boredom and particularly include the question of heterogeneity under different perspectives.

Authors' contributions
KK conceived, designed, and coordinated the study. KK and RG conceptualised the aim and structure of the research paper. Furthermore, both authors managed the literature searches and statistical analyses, KK drafted a first manuscript, which was revised by both authors. Both authors contributed substantially. Both authors read and approved the final manuscript.

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Competing interests
The authors declare that they have no competing interests.

Availability of data and materials
Data will not be shared as written consent of the students investigated did not comprise a publication of the data set. Further details can be obtained from authors upon request.

Ethics approval and consent to participate
All participants respectively their parents provided written consent to participate in the study. The school particularly supported to study, too.

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