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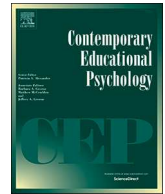
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# Adding previous experiences to the person-situation debate of achievement emotions

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## ABSTRACT

When preparing for exams, students experience various achievement emotions, which are related to their perceived academic control and achievement regarding their exams. These emotions are shaped by a trait-like stable person-specific component and a state-like variable situation-specific component. Furthermore, it is plausible that students' previous emotional experiences might influence their current emotional experiences. Therefore, the present study aimed to disentangle those three components of achievement emotions (namely person, previous-experience, and situation specific components), and to analyze the extent to which these three components relate to perceived academic control and achievement. Using experience sampling, ninety-eight undergraduate students reported their emotions during the final week of exam preparation. Via latent state-trait theory models, including an autoregressive coefficient, our results showed the three expected variance components for enjoyment, anxiety, and anger, with no person-specific variance component for pride. The more stable components (namely person and previous-experience specific components) were significantly associated with perceived academic control and achievement, particularly for negative emotions. Moreover, results suggest a reciprocal relation between anxiety and perceived academic control. Implications for educators seeking to strengthen students' success are discussed.

## 1. Introduction

In university settings, the final exam period is typically emotional for undergraduate students. They experience various achievement emotions during this demanding phase, such as enjoyment, pride, anxiety, or anger. Consider Rick, who is preparing for an exam. As variability is an essential characteristic of emotional experiences (Frijda, 2007), we can assume that Rick's current exam-related emotional experiences are likely to vary throughout the day, from one day to the next, and might be influenced by different components. In general, Rick might feel anxious. This person-specific, trait-like factor might have an impact on his current emotional experience in each specific learning situation. Furthermore, quite intuitively, previous emotional experience might also have an impact on Rick's current emotional experience, for example, previous experiences of anxiety after learning failure. Finally, the current experience of emotions is certainly also influenced by a situation-specific, state-like factor (e.g., current experiences of success). Overall, Rick's current experience of exam-related emotions might be simultaneously influenced by all three components; a person-specific, a previous emotional experience-specific, and a situation-specific component. A few prior

research studies have already distinguished between trait and state components of achievement emotions and found these components to be quite balanced within achievement emotions (e.g., Nett, Bieg, & Keller, 2017). Nevertheless, prior research in the achievement setting usually did not consider previous experiences. Taking into account all three perspectives and disentangling these different components of students' experiences of achievement emotions might help to better understand achievement emotions in general. Thus, the first study purpose focused on understanding meaningful components of exam-related emotional experiences while preparing for an exam (using the aforementioned example of enjoyment, pride, anxiety, and anger). In turn, this could help to conceptualize the relation of emotional experiences with relevant variables, such as students' perception of being in control of their own learning progress, or with academic achievement itself. On a general person-specific trait level, we know that achievement emotions are related to students' perceived academic control (e.g., Ruthig et al., 2008) and to achievement (e.g., Pekrun, Lichtenfeld, Marsh, Murayama, & Goetz, 2017). Specifying how they relate when taking the three different components of achievement emotions into account might have an impact on research and practice in terms of improving the understanding of

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interrelations and processes of emotional experiences. Thus, the second study purpose focused on the relations of the postulated three components of students' current emotional experiences with the perception of their academic control and their academic achievement.

## 2. Theoretical background

### 2.1. Person, previous-experience, and situation specificity of achievement emotions

Achievement emotions can be defined as “emotions tied directly to achievement activities or achievement outcomes” (Pekrun, 2006, p. 317). According to Pekrun, Goetz, Titz, and Perry (2002), students most often reported the following emotions: anxiety, enjoyment, hope, pride, relief, and anger. The taxonomy of achievement emotions (Pekrun, 2006) defines specific emotions by differentiating those emotions on the dimensions of valence (positive vs. negative), object focus (activity vs. outcome), and activation (activating vs. deactivating). The present study sought out to describe the most frequent emotions by simultaneously representing positive and negative, as well as prospective and retrospective emotions of both activity and outcome foci (Pekrun, 2006) in a balanced way. Specifically, we focused on enjoyment (positive, activity focused, activating), pride (positive, retrospective outcome focused, activating), anxiety (negative, prospective outcome focused, activating), and anger (negative, activity focused, activating).

In general, prior research has mostly operationalized achievement emotions as either a trait, which is person-specific (e.g., Pekrun et al., 2017), or as a state, which is situation-specific (e.g., Goetz, Frenzel, Stoecker, & Hall, 2010). A few studies have considered both trait and state components together, and have distinguished between the influence of person-specific and situation-specific components on achievement emotions (e.g., Ahmed, van der Werf, Minnaert, & Kuyper, 2010; Nett et al., 2017). The results of these studies indicate that the variability of achievement emotions is equally distributed, with approximately 50% being person-specific and 50% being situation-specific (Nett et al., 2017; similar to mood Eid, 1997; or affect Yasuda, Lawrenz, van Whitlock, Lubin, & Lei, 2016). The differences between person-specific and situation-specific aspects also become more apparent when considering how they relate to different valenced emotions. For instance, person-specific (trait) components of different valenced emotions are typically unrelated to one another, whereas situation-specific (state) components of these emotions can be negatively related to one another (i.e., enjoyment or pride with anxiety or anger; Nett et al., 2017).

Prior research into emotions outside of the achievement context points to the importance of previous emotional experiences through the duration of emotional experiences. Specifically, the duration is longer for intense emotional experience and in highly valued situations, for instance, longer duration for enjoyment compared to anxiety or anger (Verduyn, Delvaux, van Coillie, Tuerlinckx, & van Mechelen, 2009). These longer durations imply that the emotions continue from one situation to the next. Such *carryover effects* between subsequent situations also suggest an influence of previous experience on the current emotional experience. For instance, Olatunji and Cole (2009) found that children's anxiety symptoms have a time-invariant trait, time-varying state influences, and an additional slow time-varying influence, which can be interpreted as an influence by previous experiences. In summary, it can be concluded that up until now, theory as well as research focused mainly on a stable, trait-like, person-specific variable, and a state-like, situation-specific component of achievement emotions. This study addresses a third and new component: previous experiences (which theoretical fundaments of achievement emotions mostly fail to consider).

### 2.2. Disentangling the person, previous-experience, and situation specificity of achievement emotions

One prominent theoretical framework concerning the person-situation debate and separating different components is the latent state-trait (LST) theory (Steyer, Mayer, Geiser, & Cole, 2015). It states that most psychological constructs have both person-specific (cf. trait) and situation-specific (cf. state) components (Steyer, Ferring, & Schmitt, 1992). Therefore, the LST simultaneously defines a latent trait, a latent state residual, and a measurement error variable as the sources of variance for a psychological construct. Moreover, recent developments in LST theory research have additionally considered the specific relationship between two consecutive occasions by including an autoregressive coefficient (Geiser, Hintz, Burns, & Servera, 2017; Prenoveau, 2016). Those methodologically similar models (e.g. Anusic & Schimmack, 2016; Cole, Martin, & Steiger, 2005; Eid, Holtmann, Santangelo, & Ebner-Priemer, 2017; Kenny & Zautra, 2001) labeled this autoregressive coefficient very differently, such as a “carryover effect” (Eid et al., 2017, p. 291), an “autoregressive trait” (Kenny & Zautra, 2001, p. 246), or a “change factor” (Anusic & Schimmack, 2016, p. 769). The autoregressive coefficient represents the shared variance of the current and the previous measurement after accounting for stable trait variance. Consequently, it can be interpreted as the influence of the previous measurement on the current measurement, independent from the trait influence.

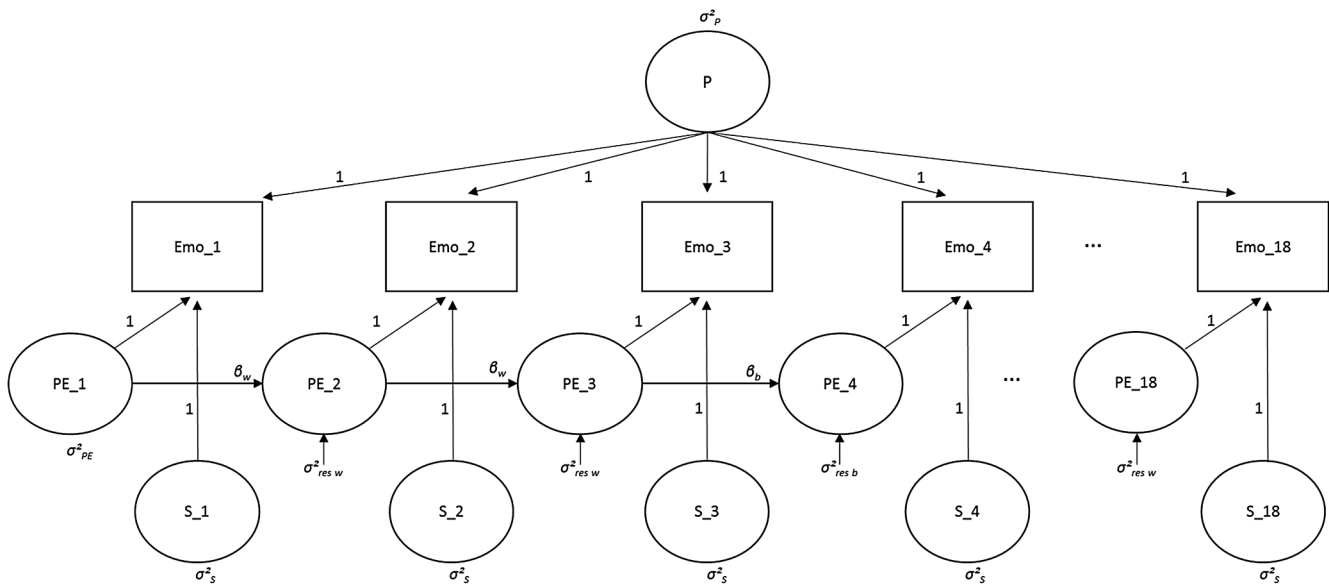
Kenny and Zautra (1995) established a more economical single indicator model that separates stable from less stable variance components of constructs (cf. Fig. 1), introduced as the trait-state-error (TSE) model (Kenny & Zautra, 1995), and subsequently labeled as the STARTS model (Kenny & Zautra, 2001). A construct, measured by a single-item measurement  $n$  times, can be disentangled from a stable person-specific component (labeled as a stable trait),  $n$  previous experience-specific components (labeled as an autoregressive trait), and  $n$  situation-specific components (labeled as a state; Kenny & Zautra, 2001.) Thus, in this model, the situation-specific coefficient is confounded by the measurement error, contrary to the multi-indicator models (e.g., Eid et al., 2017).

### 2.3. Achievement emotions and their relation to students' perceived academic control and achievement

According to Pekrun's Control-Value Theory (2006), appraisals regarding the amount of subjective control and the value of the situation are important antecedents of achievement emotions. Thereby, the subjective control appraisal can be understood as perceived academic control (Pekrun et al., 2002). Perceived academic control is an internal attribution of achievement outcomes and reflects the individual students' belief in their capacity to influence their achievement outcome (Perry, Hladkyj, Pekrun, & Pelletier, 2001). This is considered to be essential for academic achievement, for instance, freshmen are at particularly high risk of experiencing low feelings of perceived academic control (Perry, 1991). Moreover, perceived academic control is considered to be a relatively stable psychological disposition, which changes mostly due to achievement experience, such as success or failure (Hall, 2008; Perry et al., 2001; Stupnisky, Perry, Hall, & Guay, 2012).

As stated in Control-Value Theory (Pekrun, 2006), students' perception of their academic control is related to achievement emotions (Pekrun, Goetz, Frenzel, Barchfeld, & Perry, 2011; Ruthig et al., 2008). In theory, the relationship between achievement emotions and perceived academic control can be reciprocal in nature (Pekrun, 2006); that is, emotions are predicted by prior control perceptions and could have an impact on future perceived control. However, prior research lacked an analysis of this reciprocal causation assumption.

Going back to the different variance components of achievement emotions, prior empirical research confirms the relevance of



**Fig. 1.** Path diagram of the person/previous experience/situation model (analog to STARTS model by [Kenny and Zautra \(2001\)](#) with 18 measurements (cf. occasions). P = person-specific component (labeled as stable trait by [Kenny and Zautra \(2001\)](#);  $\sigma^2_P$  = variance of the person-specific component; all factor loadings are fixed to be equal. Emo = single-item measurement of an achievement emotion with 18 measurements. PE = previous experience-specific component (or autoregressive component, labeled autoregressive trait by [Kenny and Zautra \(2001\)](#);  $\beta_w$  = path coefficients representing the autoregression of  $PE_{t-1}$  on  $PE_t$  between days;  $\beta_b$  = path coefficients representing the autoregression of  $PE_{t-1}$  on  $PE_t$  between days. S = situation-specific component (labeled as state by [Kenny and Zautra \(2001\)](#));  $\sigma^2_S$  = variance of the situation-specific component, fixed to be equal across all measurements.

achievement emotions for perceived academic control and vice versa, when applying trait measures (stable person level). Perceived academic control was found to be positively related with positively valenced emotions, such as academic enjoyment ([Buff, 2014](#)) and pride ([Schonwetter, Perry, & Struthers, 1993](#)), and negatively related with negatively valenced emotions, such as anxiety ([Niculescu, Tempelaar, Dailey-Hebert, Segers, & Gijssels, 2016](#)). In general, the effect size of the interrelations with positive trait emotions seems to be weaker than with negatively valenced trait emotions (e.g., [Respondek, Seufert, Stupnisky, & Nett, 2017](#)). When applying state measures (variable situational-level), slightly weaker relations were found ([Goetz et al., 2010](#)).

Also reflected in Pekrun's Control-Value Theory ([Pekrun, 2006](#)) is the fact that students' achievement emotions while preparing for an important exam are related to the anticipated result of this exam ([Pekrun et al., 2017](#)). Again, it is important to differentiate which component of emotions interact with achievement. Prior research mostly measured stable person-specific emotions: Students who experience positively valenced achievement emotions (i.e., enjoyment and pride) are more likely to achieve good grades, whereas negatively valenced achievement emotions (i.e., anger and anxiety) are related to low achievement ([Pekrun & Stephens, 2010](#)). Initial research results indicate that there are weak relations on a situational-level ([Ketonen & Lonka, 2012](#)).

To our knowledge, prior research failed to systematically separate person-specific, previous experience-specific, and situation-specific components of achievement emotions when analyzing the relation to perceived academic control or achievement. However, understanding the component-specific relations with constructs of academic success may further our understanding of what elicits achievement emotions on a person- or a situation-specific level, and how previous experience contributes. Imagine our initial example of Rick, who is slightly anxious about exams on a person-specific level. He is more likely to achieve a poor outcome. A way to support him might be to encourage his perceived academic control by reducing his anxiety level. Thus, it is interesting to consider whether the emotional support in specific situations could reduce his person-specific anxiety, and thereby change his odds.

## 2.4. Study purpose and hypotheses

The first purpose of the current study focused on the different emotional variance components and aimed to analyze if and how discrete achievement emotions differ proportionally. We hypothesized that students' current emotional experiences are substantially due to the person-specific (cf. trait) and the situation-specific (cf. state) component (cf. [Nett et al., 2017](#)), and additionally, to students' previous emotional experiences (see [Fig. 1](#)).

Furthermore, the second purpose focused on the relationship between the achievement emotion components and perceived academic control or achievement. We hypothesized that the more stable components (i.e., the person-specific and, to a lesser extent, the previous experience-specific components) would be related to perceived academic control reciprocally (cf. [Pekrun, 2006](#)), and additionally to the exam results (cf. [Hall, 2008](#)), with these relationships to be positive with positive achievement emotions, and negative with negative achievement emotions (cf. [Ruthig et al., 2008](#)).

Finally, we focused on enjoyment, pride, anxiety, and anger, which we selected due to their high frequency among higher education students ([Pekrun et al., 2002](#)), as reference to prior research (e.g., [Ruthig et al., 2008](#)), and primarily to cover positive and negative as well prospective and retrospective emotions of both activity and outcome foci ([Pekrun, 2006](#)). Moreover, we analyzed this by using an experience sampling approach during the final exam period (a highly relevant personal experience for undergraduate students).

## 3. Material and methods

### 3.1. Participants and procedure

Participants included 98 undergraduate students (60.8% women), whose mean age was 21.09 years, with a standard deviation of 2.41 (range from 18 to 35 years), from different disciplines (computer science, economics, physics, and psychology) attending a German university, with a focus on Science, Technology, Engineering, and Mathematics (STEM). All participants were at the end of their first academic year, and in their second exam period. Participants were

recruited using convenience sampling at an exam preparation training session at university. Participation was voluntary, and students signed an informed consent form and were able to withdraw their participation from the study at any time.

Data was collected via the experience sampling method (Augustine & Larsen, 2012; Csikszentmihalyi & Larson, 2014; Goetz, Bieg, & Hall, 2016) via iPod touch®, pre-programmed with the iDialogPad software (Mutz, 2014). Participants were assessed for six days prior to a very important exam. A randomized signaling protocol activated the device to signal at three randomly selected times between 10 AM and 8 PM, with a minimum time lag of two hours and a maximum time lag of three hours between signals. At each signal, the device prompted participants with a digital questionnaire about their current achievement emotions, which was to be completed immediately. This assessment procedure resulted in a maximum of 18 completed state questionnaires for each participant (6 days  $\times$  3 signals per day) or, in other words, 1774 measurement points in total (98 participants  $\times$  18 questionnaires per person). The participants missed 246 signals (86.05% compliance). The original sample of 100 participants was reduced based on the self-reports of two of the participants, who stated having simply clicked through the state questionnaires, resulting in a final sample size of 98 participants.

In addition to the experience sampling data collection, participants answered a trait questionnaire concerning their trait emotions and their perceived academic control both before the experience sampling phase, and right after finishing their exam. The questionnaire also included sociodemographic data. Additionally, all participants gave permission to release their exam results.

### 3.2. Measures

Established self-report scales were used for all measures. When necessary, items were adapted to the tertiary education context, with a specific focus on the upcoming exam (see Appendix A1 for concrete wording of items).

**Achievement emotions.** The short experience sampling questionnaires measured participants' current experience of enjoyment, pride, anxiety, and anger.<sup>1</sup> Each emotion was measured with a single-item using a five-point Likert-type scale (0 = *strongly disagree*; 4 = *strongly agree*). Achievement emotion items were adapted from the class-related emotions scale from the Achievement Emotions Questionnaire (AEQ; Pekrun et al., 2011). The items referred to the exam, which participants were preparing for and were introduced to with the wording "At the moment..." (for descriptive statistics, see Table 1). The exact item wordings for enjoyment was "... I am looking forward to the exam" for pride "... I am proud of what I already achieved for the exam" for anxiety "... I am afraid of the exam" and for anger "... I am angry about the exam" (cf. Appendix A1). Due to the highly important context of exam preparation, overly long questionnaires were avoided. Therefore, single-items were used, which were found to be sufficiently valid in previous studies (cf. Cheung & Lucas, 2014; Gnambs & Buntins, 2017; Goetz et al., 2016; Gogol et al., 2014).

**Perceived academic control.** Participants' perceived academic control was measured using a trait questionnaire. Again, to avoid long questionnaires, perceived academic control was measured via four items from the Academic Control Scale (PAC; Perry, 1991) in its German version of Pekrun et al. (2004). An example item would be "I have a great deal of control over my academic performance." These items were also rated on a five-point Likert-type scale (0 = *strongly disagree*; 4 = *strongly agree*;  $M_{prior} = 3.02$ ,  $SD_{prior} = 0.54$ ;  $M_{post} = 2.97$ ,  $SD_{post} = 0.61$ ;  $\Omega_{prior} = 0.67$ ,  $\Omega_{post} = 0.79$ ;  $\alpha_{prior} = 0.60$ ,  $\alpha_{post} = 0.70$ ;

<sup>1</sup> The present study focused on test-related emotions according to the Achievement Emotions Questionnaire (Pekrun et al., 2011), which does not include test-related boredom (Pekrun et al., 2011).

**Table 1**

Means and standard deviation of the achievement emotion measures.

Occasion	Enjoyment		Pride		Anxiety		Anger	
	M	SD	M	SD	M	SD	M	SD
1	1.28	1.05	2.27	1.14	1.99	1.27	1.59	1.27
2	1.31	1.07	2.17	1.08	1.91	1.25	1.72	1.28
3	1.37	1.09	2.13	1.11	2.02	1.19	1.80	1.23
4	1.28	1.17	2.16	1.21	2.09	1.29	1.92	1.36
5	1.23	1.05	2.09	1.19	1.94	1.25	1.79	1.24
6	1.12	1.05	2.06	1.08	1.92	1.19	1.81	1.27
7	1.05	1.00	1.89	1.07	2.03	1.19	1.74	1.29
8	1.13	1.00	1.86	1.11	2.07	1.21	1.86	1.25
9	1.24	1.00	2.01	1.08	1.91	1.23	1.71	1.27
10	1.13	0.99	1.98	1.18	1.97	1.22	1.62	1.33
11	1.24	1.02	1.79	1.06	1.93	1.32	1.67	1.39
12	1.20	0.95	1.82	1.03	1.99	1.20	1.76	1.24
13	1.15	1.03	1.81	1.17	2.09	1.29	1.61	1.25
14	1.19	1.05	1.80	1.12	2.03	1.27	1.81	1.23
15	1.37	1.06	1.98	1.10	1.92	1.24	1.29	1.08
16	1.12	0.98	1.95	1.09	2.00	1.20	1.56	1.20
17	1.22	1.16	1.71	1.16	2.18	1.28	1.74	1.32
18	1.15	1.15	1.73	1.14	2.28	1.30	1.74	1.28

Note. Each emotion was measured with a single-item using a five-point Likert-type scale (0 = strongly disagree; 4 = strongly agree).

$\gamma_{prior} = -0.36$ ,  $\gamma_{post} = -0.39$ ).

**Academic achievement.** Academic achievement was operationalized via participants' exam results (grades), obtained from each lecturer. The exam results were transformed and group-centered by each specific course cohort overall mean, in order to accommodate for the various course requirements of the different disciplines. However, complexity or difficulty of the exam were quite similar. The exam was characterized as being foremost mathematical in nature, vital, and obligatory for participants' studies, and as having a high failure rate. In the presented data, a higher exam result reflects higher academic achievement ( $M = 0.02$ ,  $SD = 1.05$ ; ranging from  $-3.00$  to  $2.00$ ).

### 3.3. Rationale for analyses

Concerning the first study purpose, we estimated a STARTS model (Kenny & Zautra, 2001; Fig. 1) for each achievement emotion (enjoyment, pride, anxiety, and anger) and verified the three variance components by comparing them with alternative models (as recommended by Kenny & Zautra, 1995). We tested if a model that contained only the person-specific and the situation-specific component (first estimated *person/situation model*) or a model that contained only the previous experience-specific and the situation-specific component (second estimated *previous experience/situation model*) fit the observed data better than a model that specifies all three components (third estimated *person/previous experience/situation model*). In this final model (Fig. 1), the total amount of variance of all three components is assumed to be equal at all times (all factor loadings fixed at 1 and state variance  $\sigma_s$  set as equal). Moreover, we assumed that the autoregressive paths estimates were equally spaced within a day (morning to midday to evening;  $\beta_w$ ) and between two days (evening to morning;  $\beta_b$ ). Although the signaling was slightly randomized (in contrast to the autoregressive structure assumption; Biesanz, 2012; Kenny & Zautra, 1995, 2001), we assessed similar time lags within one day (from two at minimum to a maximum three-hour lag between signals). When interpreting the data, we are aware that due to our single indicator model, our state coefficient is confounded with the measurement error, and we cannot account for the method effects or measurement invariance (Prenoveau, 2016).

Concerning the second study purpose, we added perceived academic control prior to the experience sampling period, or perceived academic control after the exam, or achievement separately to each



final emotional variance component model. Using linear regression, we tested the effect of each emotional variance component on perceived academic control either prior to or following the exam, and on the exams' achievement. All analyses were executed using the *Mplus* software 7.31 (Muthén & Muthén, 1998–2012). Missing data was accounted for by using the full information maximum likelihood estimator (FIML),<sup>2</sup> applying the robust full maximum likelihood estimator (MLR) to address possible concerns about the distributions of the variables (Muthén & Muthén, 1998–2012). We considered various fit indices based on Hu and Bentler (1999). Model fit was assessed using chi-square ( $\chi^2$ ), root-mean-square error of approximation (RMSEA  $\leq 0.06$ ), comparative fit index (CFI  $\geq 0.95$ ), and standardized root mean square residual (SRMR  $\leq 0.08$ ). Syntaxes of the models are provided as [Supplementary materials](#).

## 4. Results

### 4.1. Person, previous-experience, and situation specificity of achievement emotions

Regarding our first study purpose, we compared three alternative models for each achievement emotion (Table 2) in order to distinguish between person-specific, previous experience-specific, and situation-specific components. Considering a potential multi-level structure due to the students' different disciplines, the effect of these clusters was negligible (ICCs  $\leq 0.01$ ). Moreover, we found similar results regarding model fit and model estimates when considering the multi-level structure via the command TYPE IS COMPLEX. As the number of parameters was more than the number of clusters minus the number of strata, with more than one cluster, this resulted in unreliable standard errors. Thus, we have reported the results of the model that did not consider the multi-level structure.

Considering the fit indices for *enjoyment*, the observed data fit the person/previous experience/situation model best (Table 2), with strong standardized autoregression coefficients linking two measurements ( $\beta_{within\ day} = 0.92$ ,  $p < .001$ ;  $\beta_{between\ days} = 0.87$ ,  $p < .001$ ). The variance of enjoyment was mainly explained by the person-specific component (46.83% [43.62%–47.63%],  $p < .001$ ), followed by the previous experience-specific component (29.01% [17.02%–32.16%],  $p = .010$ ) and the situation-specific component (24.16% [39.36%–20.21%],  $p < .001$ ).

Concerning *pride*, the observed data fit the alternative previous experience/situation model the best (Table 2), with very strong standardized autoregression coefficients linking two measurements ( $\beta_{within\ day} = 0.98$ ,  $p < .001$ ;  $\beta_{between\ days} = 0.94$ ,  $p < .001$ ). The more complex person/previous experience/situation model had a worse model fit, and a nonsignificant variance for the person-specific component and autoregressive coefficient. The variance of pride did not depend on a person-specific component, and was mainly explained by the previous experience-specific component (76.59% [75.20%–77.45%],  $p < .001$ ), and the situation-specific component (23.41% [24.80%–22.55%],  $p < .001$ ).

The observed data for *anxiety* fit the person/previous experience/situation model the best (Table 2), with strong standardized autoregression coefficients linking two measurements ( $\beta_{within\ day} = 0.86$ ,  $p < .001$ ;  $\beta_{between\ days} = 0.77$ ,  $p < .001$ ). The current experience of anxiety depends on the amount of person-specific anxiety, the previous experience of anxiety, and the current situation-specific anxiety. The variance of anxiety was mainly explained by the person-specific component (55.66% [56.24%–55.40%],  $p < .001$ ), followed by previous experience-specific component (24.72% [23.05%–25.55%],  $p < .001$ ), and the situation-specific component (19.62% [20.71%–19.05%],

$p < .001$ ).

Finally, we confirmed the person/previous experience/situation model for *anger* (Table 2), with strong standardized autoregression coefficients linking two measurements ( $\beta_{within\ day} = 0.84$ ,  $p < .001$ ;  $\beta_{between\ days} = 0.72$ ,  $p < .001$ ). The current experience of anger depends on the amount of person-specific anger, previous experiences of feeling angry, and the feelings of anger in the current situation. The variance of anger was also mainly explained by the person-specific component (49.05% [47.94%–49.63%],  $p < .001$ ), followed by previous experience-specific component (27.41% [25.25%–28.38%],  $p < .001$ ), and the situation-specific component (23.54% [26.81%–21.99%],  $p < .001$ ).

Overall, the results suggest three variance components for achievement emotions experienced while preparing for an exam (with the exception of pride). Moreover, the results also suggest equal variance distribution between the person-specific component and the sum of the previous experience-specific component, and the situation-specific components. We could therefore confirm our first hypothesis regarding enjoyment, anxiety, and anger.

### 4.2. Achievement emotions and their relation to students' perceived academic control and achievement

Concerning our second study purpose, we separately tested for meaningful relationships between each of the previously confirmed emotional variance components of each achievement emotion and perceived academic control and achievement (Tables 3–6).

First, we tested for meaningful reciprocal relationships between the emotional variance components and perceived academic control. For *enjoyment*, there was no systematic relationship between the three variance components and perceived academic control prior to or following the exam (Table 3). Only for a few occasions is the situation-specific variance component of enjoyment meaningfully positively related to perceived academic control following the exam. For *pride*, there were positive relationships between most of the previous experience-specific components and perceived academic control following the exam (Table 4). For *anxiety*, there were negative relationships between the person-specific component and perceived academic control prior to and following the exam, similar to the previous experience-specific component (Table 5). Occasionally, however, the situation-specific anxiety components were positively related to perceived academic control prior to and following the exam. For *anger*, the person-specific variance component was negatively related to perceived academic control following the exam. Further, there were just a few negative relationships between the previous experience-specific variance components with perceived academic control prior to, and following, the exam (Table 6). Additionally, occasionally the previous anger experience-specific component and the situations-specific anger component showed relations with perceived academic control prior to and following the exam, both positively and negatively.

In a second step, we tested for meaningful relations between the emotional variance components and achievement in the exam (Tables 3–6). For *enjoyment*, there was a positive relation between the person-specific enjoyment component and achievement (Table 3). Furthermore, the results indicated a relationship between half of the previous experience specific enjoyment components and achievement, thus not immediately before the exam. For *pride*, there was a similar positive relationship between the previous experience specific variance component and achievement, and very few meaningful relationships with the situation-specific component (Table 4). For *anxiety*, there was a negative relationship between the person-specific component and achievement. Furthermore, negative relationships occurred between previous experience-specific variance components and achievement (Table 5). Few of the situation-specific anxiety measures were positively related to the exam results. For *anger*, there was a negative relationship between the person-specific component and achievement.

<sup>2</sup> The assumption of missing completely at random (MCAR) was confirmed via Little's MCAR-test ( $\chi^2 = 4167.62$ ,  $\chi^2 df = 4360$ ,  $p = .981$ ).

**Table 2**  
Fit indices of variance decomposition models.

Model	$\chi^2$	$\chi^2/df$	RMSEA (90% C.I.)	CFI	SRMR	BIC <sup>1</sup>	AIC
<i>Enjoyment</i>							
1. Person/situation	337.97***	169	0.10 (0.05 0.12)	0.83	0.09	3259.98	3271.44
2. Previous experience/situation	229.20***	167	0.06 (0.04 0.08)	0.94	0.08	3125.10	3137.70
3. Person/previous experience/situation	228.14***	166	0.06 (0.04 0.08)	0.94	0.08	3124.33	3137.51
<i>Pride</i>							
1. Person/situation	372.89***	169	0.11 (0.10 0.13)	0.82	0.10	3430.51	3441.97
2. Previous experience/situation	227.43**	167	0.06 (0.04 0.08)	0.95	0.08	3260.78	3273.38
3. Person/previous experience/situation	226.69***	166	0.06 (0.04 0.08)	0.95	0.08	3261.11	3274.29
<i>Anxiety</i>							
1. Person/situation	391.87***	169	0.12 (0.10 0.13)	0.81	0.10	3632.09	3643.55
2. Previous experience/situation	254.92***	167	0.07 (0.06 0.09)	0.93	0.07	3463.82	3476.43
3. Person/previous experience/situation	250.56***	166	0.07 (0.05 0.09)	0.93	0.07	3459.45	3472.63
<i>Anger</i>							
1. Person/situation	326.21***	169	0.10 (0.08 0.11)	0.84	0.11	3920.76	3932.21
2. Previous experience/situation	208.10***	167	0.05 (0.02 0.07)	0.96	0.09	3780.11	3792.72
3. Person/previous experience/situation	200.00*	166	0.05 (0.01 0.07)	0.97	0.08	3771.94	3785.11

Note. person/situation model = decomposes a person-specific and situation-specific component, previous experience/situation model = decomposes a previous experience-specific and situation-specific component, person/previous experience/situation model = decomposes a person-specific, previous experience-specific, and situation-specific component.  $N = 98$ .

<sup>1</sup> Sample-size adjusted BIC.

\*  $p \leq 0.050$ .

\*\*  $p \leq 0.010$ .

\*\*\*  $p \leq 0.001$ .

There were only a few negative relationships between some previous experience-specific variance components and achievement (Table 6).

In summary, perceived academic control a week before, and immediately following, the exam was strongly related to anxiety, especially during the days before the exam. We could only confirm the impact of perceived academic control on anxiety prior to the exam. However, we could confirm the impact of the more stable variance components (person-specific and previous experience-specific) on perceived academic control following the exam. Additionally, achievement was strongly related to the more stable components of negative emotions. Overall, the results indicate different patterns for the achievement emotions' variance components. Our results also support our second hypothesis concerning the relationship between the person-specific variance component and the previous experience-specific component and achievement emotions. Those relationships were mostly as expected: positive for positive emotions and negative for negative emotions. Finally, the situation-specific component of the current emotional experience showed almost no meaningful relationship to perceived academic control and achievement.

## 5. Discussion

Preparing for an important exam is highly relevant for undergraduate students. Various emotions arise and can influence students' success. Therefore, the first purpose of the present study was to analyze to what extent a current emotional experience depends on either the person-specific, the previous experience-specific, or the situation-specific component. The second purpose was to analyze the relationships of these three emotional variance components with perceived academic control and achievement.

### 5.1. Person, previous-experience, and situation specificity of achievement emotions

Our findings confirmed all three variance components for enjoyment, anxiety, and anger. Thereby, around 50% of the variance distribution of the person-specific component is in line with previous studies (Nett et al., 2017). Students' emotional experiences of enjoyment, anxiety, and anger in a specific learning situation are

predominantly influenced by their time-stable habitual tendencies. In addition to prior research, however, the study suggests that the remaining variance is not only associated with the situation-specific component, but also depends on previous emotional experiences. The study provides further evidence that achievement emotions are characteristically different, boarding Pekrun et al. (2011), as the relative proportion of the three variance components differ considerably across the three achievement emotions. The experience of negative emotions strongly depends on the person-specific component compared to positive emotions. Thus, anxiety showed the highest amount of person-specific variance (cf. Nett et al., 2017; Spielberger, 1966) and the lowest amount of situation-specific variance. Enjoyment had the highest amount of situation-specific variance. Therefore, the study suggests that of the emotions explored, enjoyment might be the most variable emotion, and anxiety the most stable emotion.

For pride, however, previous experiences and the situational component seem to predominate the person-specific component. The person specificity might be unimportant because pride is a retrospective emotion, whereas it might be important to acknowledge the influence of previous emotional experiences rather than the influence of the person-specific component. The study supports the assumption of Pekrun (2006) that pride, an outcome orientated emotion, occurs after achievement feedback. Further, students constantly monitoring their own knowledge or learning outcome might suggest carryover effects for pride while preparing for an exam. Overall, the difference in the variance components demonstrates the importance of carefully distinguishing the different variance components of achievement emotions when considering the person-situation debate.

Regarding the strength of the autoregressive path (cf. carryover effect) for all four emotions, the confirmed high impact of previous experience on current emotional experiences might be due to the high importance of the exams in our study (cf. Verduyn et al., 2009). However, the small-time lags between the experience sampling assessments might also be a reason for the relatively high autoregressive path estimates (Eid, Courvoisier, & Lischetzke, 2014). Similarly, the study revealed smaller values overall for the autoregressive path between days (overnight) compared to within days (few hours apart). Interestingly, positive emotions seem to have stronger emotional carryover effects than negative emotions. Perhaps the experience of positive

**Table 3**  
Linear regressions between emotional variance components of enjoyment and perceived academic control and achievement.

Variable	PAC <sub>prior</sub>			PAC <sub>after</sub>			Achievement		
	Person	Previous experience	Situation	Person	Previous experience	Situation	Person	Previous experience	Situation
1		0.31 (0.110)	0.47**		0.41*	0.37*		0.38**	0.08 (0.448)
2		0.20 (0.336)	−0.06 (0.783)		0.36*	−0.18 (0.295)		0.38**	0.09 (0.394)
3		0.13 (0.575)	0.15 (0.430)		0.36*	0.39*		0.39**	0.22*
4		−0.03 (0.871)	−0.22 (0.179)		0.23 (0.244)	0.06 (0.607)		0.34**	0.07 (0.360)
5		−0.06 (0.763)	0.07 (0.736)		0.15 (0.542)	−0.11 (0.457)		0.30**	−0.07 (0.436)
6		−0.11 (0.540)	−0.15 (0.287)		0.10 (0.749)	−0.25 (0.072)		0.29**	−0.01 (0.973)
7		−0.14 (0.505)	0.24 (0.132)		0.12 (0.672)	0.28*		0.27**	0.13 (0.391)
8		−0.22 (0.301)	−0.23 (0.131)		0.06 (0.864)	−0.17 (0.373)		0.24*	−0.12 (0.357)
9		−0.24 (0.298)	−0.09 (0.622)		0.04 (0.913)	−0.22 (0.196)		0.23*	−0.08 (0.458)
10	−0.10 (0.526)	−0.24 (0.364)	−0.01 (0.980)	#128;0.19 (0.214)	0.10 (0.708)	0.12 (0.430)	0.33**	0.24 (0.068)	−0.02 (0.862)
11		−0.24 (0.398)	0.08 (0.548)		0.11 (0.703)	0.08 (0.586)		0.24 (0.077)	−0.10 (0.195)
12		−0.27 (0.293)	−0.03 (0.893)		0.08 (0.789)	0.06 (0.698)		0.28 (0.053)	0.11 (0.313)
13		−0.26 (0.271)	0.16 (0.232)		−0.01 (0.971)	0.42*		0.29 (0.052)	0.27**
14		−0.29 (0.181)	−0.08 (0.633)		−0.20 (0.460)	−0.43*		0.24 (0.132)	−0.10 (0.396)
15		−0.31 (0.138)	0.02 (0.892)		−0.23 (0.306)	−0.24 (0.053)		0.22 (0.197)	−0.02 (0.862)
16		−0.41 (0.085)	−0.18 (0.208)		−0.13 (0.581)	0.01 (0.952)		0.19 (0.357)	0.03 (0.800)
17		−0.38 (0.102)	−0.09 (0.402)		−0.06 (0.770)	−0.09 (0.541)		0.16 (0.515)	−0.07 (0.457)
18		−0.33 (0.165)	−0.01 (0.983)		−0.01 (0.963)	0.21 (0.083)		0.16 (0.536)	0.06 (0.552)

Note. standardized correlation estimates, PAC<sub>prior</sub> = perceived academic control prior to the experience sampling phase, PAC<sub>after</sub> = perceived academic control after the taken exam, person-specific component of the person/previous experience/situation model, previous experience = previous experience-specific component of the person/previous experience/situation model, situation = situation-specific component of person/previous experience/situation model, nonsignificant p-value in parentheses.  $N = 98$ .

\*  $p \leq 0.050$ .

\*\*  $p \leq 0.010$ .

\*\*\*  $p \leq 0.001$ .



**Table 4**

Linear regressions between emotional variance components of pride and perceived academic control and achievement.

Variable	Variance component	PAC <sub>prior</sub>		PAC <sub>after</sub>		Achievement	
		Previous experience	Situation	Previous experience	Situation	Previous experience	Situation
Occasions	1	0.16 (0.256)	0.10 (0.682)	0.57***	0.32 (0.099)	0.30**	0.09 (0.473)
	2	0.15 (0.250)	0.20 (0.314)	0.56***	0.21 (0.264)	0.30**	0.26*
	3	0.15 (0.265)	0.08 (0.603)	0.55***	0.19 (0.268)	0.29**	−0.01 (0.948)
	4	0.12 (0.363)	−0.14 (0.339)	0.49***	−0.25 (0.084)	0.27**	−0.02 (0.849)
	5	0.11 (0.368)	0.11 (0.401)	0.49***	0.21 (0.101)	0.27**	0.16 (0.074)
	6	0.11 (0.397)	0.00 (0.994)	0.48***	−0.12 (0.436)	0.25*	−0.17 (0.188)
	7	0.09 (0.505)	−0.13 (0.456)	0.49***	−0.09 (0.563)	0.25*	0.12 (0.396)
	8	0.08 (0.516)	0.04 (0.736)	0.49***	−0.04 (0.757)	0.23*	−0.02 (0.869)
	9	0.08 (0.542)	−0.13 (0.442)	0.49***	−0.03 (0.824)	0.23*	−0.10 (0.514)
	10	0.08 (0.518)	0.20 (0.128)	0.49***	0.31*	0.21*	0.04 (0.710)
	11	0.07 (0.580)	0.03 (0.867)	0.48***	0.02 (0.913)	0.21*	0.01 (0.855)
	12	0.06 (0.652)	−0.19 (0.419)	0.47***	−0.26 (0.122)	0.20 (0.059)	−0.31**
	13	0.04 (0.770)	−0.10 (0.458)	0.43**	0.01 (0.958)	0.20*	0.11 (0.221)
	14	0.04 (0.775)	0.17 (0.257)	0.43**	0.04 (0.756)	0.20*	0.11 (0.270)
	15	0.02 (0.858)	0.10 (0.490)	0.42**	−0.01 (0.976)	0.19 (0.068)	0.03 (0.814)
	16	−0.03 (0.829)	−0.20 (0.192)	0.38*	−0.19 (0.189)	0.16 (0.138)	−0.11 (0.336)
	17	−0.04 (0.775)	−0.16 (0.370)	0.37*	−0.09 (0.563)	0.16 (0.152)	−0.05 (0.724)
	18	−0.04 (0.759)	−0.06 (0.679)	0.38**	0.17 (0.139)	0.16 (0.157)	−0.00 (0.971)

Note. standardized correlation estimates, PAC<sub>prior</sub> = perceived academic control prior to the experience sampling phase, PAC<sub>after</sub> = perceived academic control after the taken exam, previous experience = previous experience-specific component of the previous experience/situation model, situation = situation-specific component of previous experience/situation model, nonsignificant p-value in parentheses.  $N = 98$ .

\*  $p \leq 0.050$ .

\*\*  $p \leq 0.010$ .

\*\*\*  $p \leq 0.001$ .

emotions is more memorable to students in the context of exam preparations. Further, the study also indicated very high autoregressive paths for pride, which could reflect a single latent variable rather than an autoregressive coefficient (Cole et al., 2005). Although the model comparison indicates that pride seems to have a rather different variance components structure compared to other achievement emotions, future research should investigate if these findings are stable across different time lags (see Implications for Future Research).

Overall, we assume that those high short-term stabilities or carry-over effects (Anusic & Schimmack, 2016; Eid et al., 2017) could manifest as changes of the person-specific component mean, which would expand on previous theoretical assumptions (Pekrun, 2006). In other words, if the experience of a specific emotion within a learning situation can be intensified by the experience of the same emotion in previous learning situations, these experiences in specific situations might carryover to the person-specific component. Thus, the impact of previous experiences could explain how generally stable person-specific traits might be influenced by situation-specific components via carry-over effects. This assumption, however, should be further elaborated in future research (see Implications for Future Research).

## 5.2. Achievement emotions and their relation to students' perceived academic control and achievement

Our results partially confirmed that positive emotions generally enhance perceived academic control and achievement, and are enhanced by perceived academic control, with reverse relations to negative emotions. It should be noted that this pattern of results must be seen within the context of an exam that is highly valued, as achievement emotions are less relevant when the test is of low importance to students (Peterson, Brown, & Jun, 2015).

For *enjoyment*, the mostly nonsignificant relationships between all

three variance components of enjoyment and perceived academic control were, to some extent, in line with prior research (cf. e.g., Ruthig et al., 2008). Further, similar to prior research (cf. e.g., Ahmed, van der Werf, Kuyper, & Minnaert, 2013), the more stable variance components of students' enjoyment while preparing for an exam (person- and previous experience-specific components) related positively with higher achievement on the exam.

For *pride*, the meaningful and strong positive relationships between the previous experience-specific component of pride and perceived academic control (cf. e.g., Schonwetter et al., 1993) and achievement (cf. e.g., Pekrun & Stephens, 2010) highlights the importance of the previous experience-specific component. Interestingly, the perceived control reported a week prior to the exam did not meaningfully relate to prideful experiences during the exam preparation week, contrary to the assumption of Control-Value Theory (Pekrun, 2006). This could be due to the retrospective character of pride. Perhaps participants first need to positively evaluate their learning, and experience positive learning outcomes (i.e., successfully self-testing their learning content of the upcoming exam) before experiencing pride.

For *anxiety*, the person-specific component was negatively related to perceived academic control and achievement, in line with prior research (cf. e.g., Pekrun & Stephens, 2010). Anxiety was the only emotion in our study to support the postulated feedback loops in Control-Value Theory (Pekrun, 2006). This could possibly be due to the highly valued situation of exam preparation, where the interfering effects of test anxiety might be stronger. In addition, carryover effects indicated that anxious experiences while preparing for the exam might possibly lead to maladaptive cycles: The higher the number of anxious previous experiences students had, the lower their perceived control following the exam, and the lower their achievement in the exam. These results strengthen prior research on test anxiety (for an overview, see Zuckerman & Spielberger, 2015).

**Table 5**  
Linear regressions between emotional variance components of anxiety and perceived academic control and achievement.

Variable	PAC <sub>prior</sub>			PAC <sub>after</sub>			Achievement		
	Person	Previous experience	Situation	Person	Previous experience	Situation	Person	Previous experience	Situation
1		0.20 (0.412)	0.19 (0.442)		−0.39 <sup>**</sup>	−0.08 (0.643)		−0.01 (0.961)	0.16 (0.283)
2		0.14 (0.579)	−0.06 (0.800)		−0.39 <sup>**</sup>	−0.06 (0.636)		−0.10 (0.770)	−0.12 (0.194)
3		0.11 (0.647)	−0.03 (0.894)		−0.39 <sup>**</sup>	0.05 (0.743)		−0.28 (0.112)	−0.03 (0.837)
4		0.10 (0.626)	−0.21 (0.339)		−0.39 <sup>**</sup>	−0.49 <sup>**</sup>		−0.31 <sup>*</sup>	−0.23 (0.118)
5		0.16 (0.427)	−0.05 (0.839)		−0.35 <sup>**</sup>	0.15 (0.396)		−0.05 (0.976)	0.25 (0.067)
6		0.34 (0.118)	0.44 <sup>***</sup>		−0.35 <sup>**</sup>	0.37 <sup>***</sup>		−0.33 <sup>**</sup>	0.11 (0.438)
7		0.01 (0.979)	−0.32 (0.095)		−0.48 <sup>***</sup>	−0.26 (0.109)		−0.46 <sup>***</sup>	−0.17 (0.330)
8		−0.02 (0.958)	0.09 (0.611)		−0.47 <sup>***</sup>	0.02 (0.873)		−0.46 <sup>***</sup>	−0.04 (0.747)
9	−0.29 <sup>*</sup>	−0.11 (0.797)	0.21 (0.240)	−0.38 <sup>***</sup>	−0.47 <sup>***</sup>	0.11 (0.547)	−0.37 <sup>***</sup>	−0.46 <sup>***</sup>	−0.06 (0.696)
10		−0.37 (0.112)	−0.39 <sup>*</sup>		−0.54 <sup>**</sup>	−0.53 <sup>***</sup>		−0.48 <sup>***</sup>	−0.08 (0.576)
11		−0.40 (0.058)	−0.16 (0.445)		−0.50 <sup>*</sup>	−0.19 (0.270)		−0.48 <sup>***</sup>	−0.14 (0.400)
12		−0.44	0.07 (0.674)		−0.48	0.06 (0.682)		−0.49 <sup>***</sup>	0.17 (0.335)
13		−0.48 <sup>*</sup>	−0.07 (0.652)		−0.40 <sup>*</sup>	−0.15 (0.422)		−0.50 <sup>***</sup>	−0.17 (0.198)
14		−0.47 <sup>**</sup>	−0.01 (0.974)		−0.36 <sup>**</sup>	0.23 (0.078)		−0.48 <sup>***</sup>	−0.04 (0.724)
15		−0.51 <sup>**</sup>	−0.14 (0.333)		−0.37 <sup>**</sup>	−0.17 (0.302)		−0.48 <sup>***</sup>	−0.09 (0.479)
16		−0.53 <sup>*</sup>	0.01 (0.928)		−0.36 <sup>**</sup>	−0.03 (0.827)		−0.44 <sup>***</sup>	0.06 (0.517)
17		−0.51 <sup>*</sup>	−0.04 (0.789)		−0.34 <sup>**</sup>	−0.04 (0.794)		−0.43 <sup>***</sup>	0.03 (0.739)
18		−0.50 <sup>*</sup>	−0.13 (0.387)		−0.33 <sup>*</sup>	0.03 (0.850)		−0.43 <sup>***</sup>	−0.11 (0.288)

Note. standardized correlation estimates, PAC<sub>prior</sub> = perceived academic control prior to the experience sampling phase, PAC<sub>after</sub> = perceived academic control after the taken exam, person-specific component of the person/previous experience/situation model, previous experience = previous experience-specific component of the person/previous experience/situation model, situation = situation-specific component of person/previous experience/situation model, nonsignificant p-value in parentheses.  $N = 98$ .

\*  $p \leq 0.050$ .

\*\*  $p \leq 0.010$ .

\*\*\*  $p \leq 0.001$ .

**Table 6**  
Linear regressions between emotional variance components of anger and perceived academic control and achievement.

Variable	PAC <sub>prior</sub>			PAC <sub>after</sub>			Achievement		
	Person	Previous experience	Situation	Person	Previous experience	Situation	Person	Previous experience	Situation
1		−0.04 (0.843)	−0.11 (0.560)		−0.22 (0.267)	−0.29 (0.213)		−0.38 (0.116)	0.05 (0.749)
2		−0.01 (0.985)	0.08 (0.654)		−0.18 (0.411)	0.31 <sup>*</sup>		−0.41 <sup>*</sup>	−0.25 <sup>*</sup>
3		−0.01 (0.966)	−0.04 (0.832)		−0.27 (0.154)	−0.36 <sup>**</sup>		−0.40 (0.122)	−0.10 (0.501)
4		0.02 (0.919)	−0.16 (0.345)		−0.15 (0.434)	−0.13 (0.386)		−0.21 (0.612)	−0.08 (0.555)
5		0.13 (0.504)	−0.01 (0.981)		−0.01 (0.994)	0.04 (0.827)		−0.02 (0.960)	0.06 (0.702)
6		0.25 (0.185)	0.32 <sup>*</sup>		0.12 (0.594)	0.26 <sup>*</sup>		0.11 (0.663)	0.26 <sup>*</sup>
7		0.07 (0.700)	−0.16 (0.474)		−0.03 (0.889)	−0.07 (0.735)		−0.15 (0.705)	−0.26 (0.126)
8		0.04 (0.832)	−0.02 (0.919)		−0.08 (0.706)	0.09 (0.597)		−0.17 (0.715)	0.20 (0.132)
9		0.02 (0.918)	0.16 (0.371)		−0.17 (0.356)	−0.04 (0.798)		−0.27 (0.428)	−0.02 (0.883)
Occasions	−0.28 (0.057)			−0.31 <sup>*</sup>			−0.39 <sup>**</sup>		
10		−0.15 (0.439)	−0.09 (0.573)		−0.31 (0.083)	−0.03 (0.862)		−0.41 <sup>*</sup>	−0.13 (0.379)
11		−0.21 (0.265)	−0.04 (0.874)		−0.40 <sup>*</sup>	−0.19 (0.238)		−0.47 <sup>**</sup>	−0.28 <sup>**</sup>
12		−0.29 (0.125)	−0.04 (0.825)		−0.43 <sup>*</sup>	−0.20 (0.172)		−0.49 <sup>**</sup>	0.04 (0.768)
13		−0.42 <sup>*</sup>	−0.36 <sup>*</sup>		−0.37 (0.089)	−0.35 (0.073)		−0.49 <sup>**</sup>	−0.04 (0.842)
14		−0.35 (0.174)	0.14 (0.392)		−0.21 (0.510)	0.35 <sup>*</sup>		−0.48 <sup>*</sup>	−0.14 (0.303)
15		−0.38 (0.164)	−0.04 (0.894)		−0.17 (0.632)	−0.01 (0.955)		−0.46 <sup>*</sup>	0.04 (0.863)
16		−0.38 (0.210)	−0.07 (0.725)		−0.06 (0.840)	0.16 (0.450)		−0.36 (0.225)	0.11 (0.364)
17		−0.32 (0.288)	0.12 (0.340)		−0.06 (0.788)	0.01 (0.941)		−0.11 (0.777)	−0.03 (0.825)
18		−0.37 (0.105)	−0.27 <sup>*</sup>		−0.08 (0.682)	−0.08 (0.592)		−0.05 (0.861)	0.06 (0.573)

Note. standardized correlation estimates, PAC<sub>prior</sub> = perceived academic control prior to the experience sampling phase, PAC<sub>after</sub> = perceived academic control after the taken exam, person-specific component of the person/previous experience/situation model, previous experience = previous experience-specific component of the person/previous experience/situation model, situation = situation-specific component of person/previous experience/situation model, nonsignificant p-value in parentheses.  $N = 98$ .

\*  $p \leq 0.050$ .

\*\*  $p \leq 0.010$ .

\*\*\*  $p \leq 0.001$ .

For *anger*, the negative relationship between the person-specific component and perceived academic control following the exam, and upon getting their grades, expands prior research findings, which mainly focused on anxiety as a representation of negative achievement emotions (cf. e.g., [Niculescu et al., 2016](#)). In general, only the person-specific component of the current experience of anger seems to be relevant for perceived academic control or achievement.

Overall, this study expands on previous research by analyzing the relationships separately for all three emotional variance components. Thereby, we confirmed the relevance of the more stable variance components (person- and previous experience-specific component) for the relatively stable constructs of perceived academic control and achievement, broadening the works of [Perry et al. \(2001\)](#) or [Schonwetter et al. \(1993\)](#). This was especially the case for negative or outcome-related emotions, such as pride or anxiety. If the experienced emotions are partly stable (previous experience-specific component), then those partially stable portions of emotion are still relevant for the rather stable constructs of perceived academic control and achievement. Furthermore, we only found the expected reciprocal relationship between control perception and achievement emotions for person-specific anxiety, and most of the previous experience anxiety, reflecting high significance of anxiety for exam preparation. An explanation for this could be that the postulated reciprocal relationships only occur for highly frequent emotions. Finally, the highly variable portion of emotions (situation-specific component) showed generally no meaningful relevance. However, in some occasions, the relationships were unexpectedly meaningful (contrary to the hypothesized direction). For instance, the situation-specific anxiety sometimes related negatively or even positively to prior-examination perceived academic control. These results were most likely confounded by measurement error and chance, and highlight the emotional situation-specificity or variability. Overall, the relevance of achievement emotions for perceived academic control and academic achievement appears to rise with repetitive experiences.

## 6. Implications and conclusions

In conclusion, the present study expands the person–situation debate for achievement emotions with a third variance component: previous experience. This approach could help researchers and practitioners to find more ways to evaluate students' emotions more precisely and support students' emotion regulation.

### 6.1. Implications for future research

The present study used an application of latent state–trait models with autoregressive effects and intensive longitudinal data. Future research could use this method combination for a clear separation and detailed analysis of the impact of different variance components. We established a single-indicator STARTS model ([Kenny & Zautra, 2001](#)) via adequate model fit. The single-item indicators were used in this highly intensive academic context to minimize fatigue in respondents, nonresponse, and careless responding ([Gnambs & Buntins, 2017](#)). However, our results—especially for pride—should be verified via multi-indicator latent state–trait models, such as the latest adaption from [Eid et al. \(2017\)](#). These models distinguish between state and measurement error, and can account for method effects ([Geiser & Lockhart, 2012](#)). Additionally, future research should vary the time lag for the autoregressive path. Future longitudinal studies with different time lags between the measurements (e.g., each week for one semester) might provide further insight into the structure of emotions (cf. e.g., discussion of [Anusic, Lucas, & Donnellan, 2012](#); [Eid et al., 2014](#); [Wagner, Lüdtke, & Trautwein, 2016](#)). The present study provides supplementary evidence concerning students' emotional experiences in highly valued learning situations during their first year at university.

However, the proportion of the three variance components might differ based on the context. Future research should further explore the emotional structure in different contexts, add more variability to the specific learning situations (e.g., studying during the semester without an upcoming exam), and systematically vary situational conditions (e.g., teaching methods, as recommended by [Nett et al. \(2017\)](#); or value, as recommend by [Verduyn et al. \(2009\)](#)). Moreover, the current study focused on approximately 100 freshman students. It would be beneficial to broaden the sample size and type; for instance, replicate the results for younger secondary school or older adult education students. Additionally, the present study focused only on four achievement emotions to keep the participants' workload low; however, still balanced frequency and taxonomy. Future research should address further achievement emotions throughout test preparation, such as test-related hope or boredom (e.g. boredom while test taking cf. [Goetz, Frenzel, Pekrun, & Hall, 2007](#)). Overall, more research is needed to understand, first, the variability of achievement emotions and, second, the importance of their more stable variance components for students' success. The present study is an important first step.

### 6.2. Implications for educational practice

Our results have practical implications for higher education institutions. Concerning our first aim, the present study underlines the importance of creating learning situations that enhance students' positive achievement emotions when they are preparing for highly valued exams, especially for students more prone to be anxious or angry. We found previous experience to be highly relevant for the current emotional experience. This emphasizes the importance of an early, but also consistent, support, especially in order to maintain the positive effects of enjoyment. Moreover, focusing on pride, practitioners should establish opportunities for students to repeatedly experience their own progress (e.g., perhaps via exercises, supervised learning groups, or mock exams). Concerning our second aim, the present study highlights the relevance of more stable variance components for perceived academic control and achievement. If institutions want to foster high levels of perceived academic control in their students, they can make use of interventions, such as Attributional Retraining programs (e.g., [Haynes, Perry, Stupnisky, & Daniels, 2009](#)), which enhance attributions of controllability, reduce negative emotions, and therefore enhance achievement ([Hamm, Perry, Chipperfield, Murayama, & Weiner, 2017](#)). Our results revealed that interventions might also need to consider students' previous emotional experiences. Apart from interventions, teaching characteristics—such as clear, precise language, or receptive, respectful attitudes toward students, or demonstrated interest in the subject matter—could also enhance positive emotions and perceived academic control ([Muntaner-Mas, Vidal-Conti, Sesé, & Palou, 2017](#)). Teaching characteristics could be easily implemented in specific learning situations, and could boost positive emotions over time, for example, via the impact of the previous experience-specific component.

### 6.3. Conclusions

Overall, we aimed to expand on previous research by considering previous experience as a crucial source of emotional experiences in an academic context, therefore broadening the person–situation debate. Results indicated that previous experiences possibly explain how person-specific traits might be influenced by situation-specific states via carryover effects. Subsequently, we analyzed their relationships with perceived academic control and achievement, revealing new insights for possible reciprocal effects, as postulated by the Control-Value Theory ([Pekrun, 2006](#)). Methodically, we successfully demonstrated a new analysis application for experience sampling datasets. Finally, the present study provided new information for researchers and

practitioners regarding the variability of emotional experiences as well as indications for possible supporting mechanisms, all within the context of a highly relevant experience of undergraduate students: the exam period.

### Conflict of interest

None.

### Appendix A

See [Tables A1–A3](#).

**Table A1**

Specific item wordings.

Perceived academic control	German wording adapted from <a href="#">Pekrun et al. (2004)</a>	English wording ( <a href="#">Perry, 1991</a> )
	Ich habe ziemlich viel Kontrolle über meine Studienleistungen. Je mehr ich mich in meinem Studium anstrengte, umso besser schneide ich ab. Was auch immer ich tue, ich scheine immer schlecht in meinen Leistungen zu sein. (R) Ich sehe mich selber als hauptverantwortlich für meine Leistungen im Studium.	I have a great deal of control over my academic performance. The more effort I put into my study, the better I do at it. No matter what I do, I can't seem to do well in my courses. (R) I see myself as largely responsible for my academic performance.
Achievement emotions	German wording adapted from <a href="#">Pekrun et al. (2011)</a>	English translation
Enjoyment	Im Moment freue ich mich auf die Prüfung.	At this moment, I am looking forward to the exam.
Pride	Im Moment bin ich stolz darauf, was ich für die Prüfung bisher geschafft habe.	At this moment, I am proud of what I already achieved for the exam.
Anxiety	Im Moment habe ich vor der Prüfung Angst.	At this moment, I am afraid of the exam.
Anger	Im Moment ärgere ich mich über die Prüfung.	At this moment, I am angry about the exam.

**Table A2**

Occasions-specific relations of the achievement emotion measures (enjoyment and pride).

Occasion	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	–	0.87	0.77	0.64	0.67	0.65	0.59	0.64	0.60	0.65	0.52	0.62	0.68	0.41	0.47	0.61	0.52	0.53
2	0.87	–	0.80	0.75	0.79	0.64	0.64	0.74	0.65	0.66	0.56	0.63	0.63	0.54	0.58	0.63	0.55	0.50
3	0.76	0.77	–	0.75	0.80	0.74	0.72	0.75	0.68	0.65	0.57	0.73	0.66	0.55	0.56	0.65	0.49	0.56
4	0.66	0.71	0.69	–	0.79	0.70	0.68	0.71	0.79	0.62	0.51	0.64	0.64	0.55	0.50	0.60	0.59	0.59
5	0.70	0.74	0.75	0.81	–	0.70	0.62	0.68	0.71	0.66	0.52	0.62	0.56	0.46	0.48	0.56	0.50	0.44
6	0.68	0.66	0.71	0.68	0.73	–	0.79	0.68	0.76	0.67	0.51	0.62	0.65	0.58	0.68	0.55	0.49	0.53
7	0.71	0.70	0.64	0.70	0.65	0.82	–	0.78	0.82	0.80	0.65	0.74	0.68	0.61	0.68	0.62	0.62	0.45
8	0.54	0.55	0.78	0.71	0.70	73	0.66	–	0.79	0.71	0.60	0.71	0.64	0.60	0.63	0.66	0.66	0.61
9	0.61	0.55	0.61	0.61	0.66	0.80	0.81	0.73	–	0.75	0.65	0.69	0.68	0.62	0.67	0.67	0.67	0.68
10	0.61	0.59	0.65	0.60	0.66	0.65	0.68	0.73	0.67	–	0.66	0.76	0.70	0.59	0.63	0.70	0.60	0.61
11	0.57	0.54	0.48	0.51	0.49	0.70	0.71	0.61	0.65	0.76	–	0.65	0.57	0.62	0.53	0.60	0.70	0.45
12	0.56	0.56	0.59	0.63	0.61	0.71	0.72	0.70	0.68	0.76	0.74	–	0.75	0.58	0.63	0.64	0.62	0.69
13	0.58	0.53	0.46	0.56	0.54	0.71	0.73	0.62	0.64	0.68	0.72	0.81	–	0.73	0.72	0.71	0.66	0.64
14	0.53	0.57	0.59	0.59	0.61	0.63	0.59	0.71	0.60	0.64	0.57	0.67	0.73	–	0.65	0.65	0.77	0.61
15	0.50	0.51	0.62	0.49	0.59	0.58	0.68	0.65	0.55	0.64	0.68	0.74	0.79	0.64	–	0.70	0.54	0.63
16	0.67	0.60	0.66	0.67	0.69	0.71	0.72	0.74	0.71	0.62	0.52	0.71	0.67	0.66	0.65	–	0.71	0.74
17	0.47	0.48	0.60	0.53	0.62	0.61	0.63	0.69	0.61	0.66	0.54	0.75	0.68	0.75	0.88	0.82	–	0.69
18	0.55	0.46	0.57	0.54	0.59	0.52	0.50	0.65	0.53	0.66	0.55	0.74	0.60	0.69	0.81	0.70	0.74	–

*Note.* Estimates of the MLR estimator standardized bivariate correlation, above diagonal correlations of Enjoyment, underneath diagonal correlations of Pride, all correlations significant at level  $p \leq 0.010$ ,  $N = 87$ –98.

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**Table A3**  
Occasions-specific relations of the achievement emotion measures (anxiety and anger).

Occasion	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	–	0.81	0.74	0.78	0.78	0.77	0.76	0.69	0.74	0.71	0.73	0.67	0.68	0.61	0.70	0.56	0.60	0.65
2	0.74	–	0.72	0.72	0.72	0.65	0.69	0.63	0.58	0.65	0.62	0.67	0.64	0.53	0.66	0.53	0.53	0.66
3	0.71	0.74	–	0.80	0.75	0.66	0.73	0.65	0.58	0.62	0.61	0.60	0.63	0.52	0.58	0.49	0.53	0.52
4	0.80	0.65	0.67	–	0.86	0.79	0.78	0.69	0.69	0.68	0.73	0.71	0.72	0.59	0.65	0.51	0.58	0.55
5	0.64	0.62	0.60	0.62	–	0.76	0.72	0.61	0.65	0.71	0.71	0.66	0.67	0.53	0.57	0.45	0.48	0.51
6	0.65	0.55	0.58	0.59	0.71	–	0.70	0.64	0.62	0.69	0.68	0.62	0.68	0.55	0.60	0.48	0.54	0.51
7	0.65	0.58	0.55	0.65	0.65	0.71	–	0.68	0.70	0.92	0.77	0.76	0.78	0.60	0.81	0.61	0.70	0.65
8	0.71	0.65	0.63	0.71	0.65	0.59	0.74	–	0.80	0.69	0.70	0.68	0.68	0.53	0.67	0.59	0.56	0.61
9	0.70	0.50	0.51	0.55	0.50	0.54	0.77	0.74	–	0.83	0.79	0.73	0.74	0.62	0.67	0.57	0.60	0.63
10	0.66	0.58	0.62	0.71	0.65	0.73	0.84	0.74	0.77	–	0.89	0.83	0.80	0.67	0.79	0.67	0.68	0.69
11	0.70	0.70	0.72	0.73	0.63	0.66	0.78	0.64	0.69	0.83	–	0.73	0.81	0.67	0.81	0.68	0.65	0.66
12	0.68	0.58	0.54	0.58	0.58	0.62	0.72	0.67	0.79	0.76	0.76	–	0.77	0.54	0.71	0.62	0.65	0.67
13	0.63	0.60	0.59	0.63	0.52	0.50	0.68	0.59	0.63	0.67	0.74	0.74	–	0.82	0.83	0.65	0.75	0.75
14	0.63	0.55	0.49	0.62	0.53	0.44	0.65	0.53	0.59	0.61	0.67	0.60	0.73	–	0.77	0.75	0.69	0.73
15	0.73	0.64	0.54	0.61	0.53	0.45	0.72	0.51	0.57	0.66	0.71	0.67	0.77	0.77	–	0.69	0.73	0.75
16	0.59	0.58	0.57	0.51	0.47	0.40	0.52	0.49	0.51	0.60	0.62	0.54	0.57	0.68	0.76	–	0.74	0.69
17	0.53	0.49	0.47	0.42	0.37	0.30	0.50	0.47	0.54	0.53	0.51	0.49	0.48	0.56	0.50	0.72	–	0.77
18	0.57	0.52	0.49	0.48	0.43	0.37	0.60	0.56	0.60	0.52	0.61	0.51	0.60	0.60	0.67	0.73	0.61	–

Note. Estimates of the MLR estimator standardized bivariate correlation, above diagonal correlations of Anxiety, underneath diagonal correlations of Anger, all correlations significant at level  $p \leq 0.010$ ,  $N = 87$ –98.

## Appendix B. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.cedpsych.2019.02.004>.

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