Students' Regulation of Anxiety and Hope – A Multilevel Latent Profile Analysis

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Author Note: The data used in this paper will be available in the GESIS repository. This study was not preregistered. The study was approved by the research ethics committee of Ulm University. Corresponding author is Anna-Lena Rottweiler, Empirical Educational Research, University of Augsburg, Universitaetsstr. 10, 86135 Augsburg, Germany. E-mail: anna-lena1.rottweiler@uni-a.de.

Abstract

Academic examinations are highly emotional for university students, making ER essential for preventing or reducing the negative consequences of negative emotions on well-being and academic performance. Initial theorizing and research suggests that flexibly applying combinations of strategies can promote successful ER. However, studies using intraindividual approaches to examine ER strategy use in specific contexts across multiple occasions, are lacking. Moreover, the combinations of strategies used by students within different contexts, and the adaptiveness of different strategies for regulating different emotions, remain unexplored. To address these gaps, we conducted an experience sampling study to identify patterns of students' momentary ER and to examine how context (achievement-related vs. nonachievement-related), emotions (anxiety vs. hope), and academic performance function as potential covariates. Over 200 university students rated their anxiety, hope, and use of eight ER strategies over a seven-day period, six times a day, prior to an important exam in 2016 and 2017. Results of a two-level latent profile analysis revealed distinct profiles of ER that differed on both levels. Intraindividually, ER patterns differed as a function of type of emotion and context experienced. More specifically, momentary use of multiple strategies tended to be associated with greater anxiety, while in the achievement context this association was reduced. Interindividually, students' tendencies to use different ER patterns were not related to test performance. Our findings suggest that ER strategy selection depends on both context and emotions, and advance ER research by considering intraindividual strategy use in concrete achievement situations. Yet the sample is not sufficiently representative.

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Students' Regulation of Anxiety and Hope – A Multilevel Latent Profile Analysis

Students' emotional experiences in achievement settings have received increasing empirical attention over the past decades. Specifically, evidence shows that students experience a variety of positive and negative achievement emotions, and that these can either impair or promote various outcomes, including performance and cognitive and motivational states and processes (MacIntyre & Vincze, 2017; Pekrun et al., 2017; Pekrun et al., 2022). By implication, the regulation of achievement emotions can influence performance and learning-related states and processes, such as learning gains (Strain & D'Mello, 2015), procrastination (Eckert et al., 2016), and psychosocial functioning (De France & Hollenstein, 2017; Eftekhari et al., 2009). Therefore, it is crucial for individuals to build a broad repertoire of emotion regulation strategies to buffer or, ideally, prevent negative consequences of achievement emotions on well-being, learning, and achievement.

Research on emotion regulation (ER) in general is a growing field and has generated important findings. One important finding is that ER strategies are not beneficial or maladaptive per se (Bonanno & Burton, 2013). Instead, their effectiveness may vary based on context (for a review on ER and situational/contextual fit, see Aldao, 2013). Past research has mainly focused on person-centered approaches to individuals' use and combination of ER strategies (e.g., Lougheed & Hollenstein, 2012; see Burić et al., 2016, for initial findings targeting academic achievement settings). Situation-centered approaches which allow for examining complex patterns of ER in specific situations are a more recent development (e.g. Heiy & Cheavens, 2014).

Within educational contexts, achievement settings impose specific situational affordances and constraints upon individuals that likely influence the relative effectiveness and availability of specific ER strategies (Harley et al., 2019; Rottweiler et al., 2018). For example, students may be limited in their options for skipping class or avoiding test-taking situations (i.e., engaging "situation selection" strategies; Gross, 2015) to regulate their

anxiety. More research is needed to understand the dynamics underlying adaptive ER in achievement-related contexts (see also Harley et al., 2019). One particularly important context students frequently face, pertains to managing emotions arising while preparing for an upcoming exam, such as anxiety and hope evoked by their anticipation of possible success or failure (Pekrun, 2006).

Against this background, the following questions arise: Which combinations of strategies do students who experience prospective achievement emotions, such as anxiety and hope, use over time? Is students' exam performance related to the use of specific (combinations of) strategies? Previous work has largely left these questions unanswered because research on ER in achievement situations, particularly those that use more fine-grained approaches to measure students' regulatory efforts (e.g., experience sampling methodology; ESM), is still scarce. Therefore, the aim of the present study was to examine profiles of momentary ER strategies. We employed ESM over the course of one week before an important exam and applied multilevel latent profile analysis (ML-LPA) to the data to disentangle the relative impact of occasion- (i.e., situational/contextual variation in strategy use within individuals) as well as the person-specific level (i.e., variation in strategy use between individuals across situations), as previously suggested by Grommisch et al. (2020).

ER, ER Strategies, and ER Flexibility

Scholarship on ER has produced an impressive amount of evidence on the relevance of ER for psychological functioning and health. The process model of ER (Gross, 1998a, 1998b, 2015; Gross & Thompson, 2007) provides a well-established model which describes ER as a dynamic process and distinguishes five groups of antecedent- and response-focused strategies. *Situation selection* strategies target the implementation of action that results in a different and more pleasant situation (e.g., avoidance). *Situation modification* strategies involve altering the situation to change its emotional impact (e.g., seeking social support from others). *Attentional deployment* involves directing attention toward or away from the task or

emotional stimuli (e.g., refocusing, rumination). *Cognitive change* refer to changing one's thoughts about the self or situation to influence one's emotions (e.g., reappraisal). Finally, *response modulation* strategies aim to directly alter parameters of emotional responding (e.g., suppression, expression, alcohol use, food) once an emotion has already developed. Alternative models classify ER strategies in terms of their function and targets (Koole, 2009) or based on conceptual distinctions such as cognitive (e.g., reappraisal) versus behavioral (e.g., situational avoidance) strategies and diversion (e.g., suppression) versus engagement strategies (e.g., social support seeking, reappraisal; Parkinson & Totterdell, 1999). Depending on the underlying theoretical framework, studies have examined different types of ER strategies (e.g., Brans et al., 2013; Heiy & Cheavens, 2014). The most commonly strategies examined are reappraisal and suppression. Prior research has largely viewed reappraisal as an adaptive strategy and suppression as a maladaptive strategy in terms of their impact on different emotional, cognitive, or social outcomes (e.g., Gross & John, 2003). Recently, studies have suggested a more differentiated view of the effectiveness of strategies that is closely tied to the concept of ER flexibility. Specifically, Aldao (2013) proposed examining the contextual factors that shape ER, while Bonanno and Burton (2013) suggested considering "regulatory flexibility" as a core characteristic of effective ER. The two key pillars of "regulatory flexibility" are the context sensitivity of ER and the breadth of an individual's strategy repertoire. Pruessner and colleagues suggested a framework of ER flexibility that emphasizes the importance of cognitive control because ER strategies must be flexibly stopped and shifted according to context changes or emotional states (Pruessner et al., 2020). Relatedly, ER has been conceptualized as a complex interaction of situation, individual, and strategy (Blanke et al., 2020; Doré et al., 2016). In a similar vein, according to the strategy-situation fit hypothesis (Haines et al., 2016), strategies should be adaptively applied depending on the current situation for maximum effectiveness. For example, while suppression can be maladaptive in some situations (e.g., Gross & John, 2003), it can be

adaptive to suppress anxiety when preparing for exams to improve one's mood (e.g., Rottweiler et al., 2018). In general, reappraisal can be taxing and difficult to implement, especially in highly stressful situations (Ford & Troy, 2019).

Furthermore, strategy application and effectiveness depend on the emotion experienced (Rivers et al., 2007; Schmidt et al., 2010; Southward et al., 2019). Increasing evidence shows that a flexible use of different regulatory strategies, depending on current situational demands, should be emotionally beneficial.

Blanke and colleagues (2020) found variability in the use of ER strategies to be particularly beneficial for reducing negative affect in daily life (Blanke et al., 2020). Aldao and Nolen-Hoeksema (2012) found that variability of ER strategies was associated with better mental health. More specifically, the combination of particular strategies seems to be pivotal for improving the present emotional experience. Grommisch et al. (2020) found that a so-called active regulation focus (combined use of situation selection and acceptance) predicts lower anxiety compared to a suppression focus (combined use of suppression, ignoring, and situation modification). In considering these findings, however, it should be noted that ER effectiveness and flexibility also depend on individuals' ER goals, which may not always be focused on upregulating (increasing) or sustaining pleasant feelings and downregulating (reducing) negative feelings. While such hedonic regulation likely underlies many regulatory efforts undertaken by individuals, they may, at least at times, also engage in contrahedonic regulation involving the upregulation of negative, and/or the downregulation of positive emotions (Tamir & Bigman, 2014). Such endeavors often have instrumental purposes. For instance, high school students have been found to suppress positive emotions when outperforming peers, likely to avoid negative social consequences (Schall et al., 2016). From this perspective, contrahedonic ER may be part of ER flexibility as well and contribute to ER effectiveness with respect to specific goals individuals envision. Nevertheless, taken together, ER flexibility forms a core element of effective, goal-driven regulation.

ER Combinations and Profiles

In conjunction with ER flexibility, it is necessary to consider the use and impact of different *combinations* of strategies, as ER strategies tend to co-occur in daily life (McMahon & Naragon-Gainey, 2019). In fact, up to seven ER strategies may be used concurrently (Heiy & Cheavens, 2014). Evidence indicates that combinations of ER strategies can vary and that these combinations differentially impact outcomes (e.g., psychosocial functioning and well-being) across individuals. De France and Hollenstein (2017) identified four combinations of ER strategies, namely, "average", "suppression propensity", "engagement propensity" and "multistrategy", from six common ER strategies (distraction, rumination, reappraisal, suppression, engagement, and arousal control). The "average" group was less aware of their emotions compared to the "engagement propensity" and "multistrategy" groups, while anxiety did not differ between the ER groups. Eftekhari et al. (2009) also identified four ER strategy groups among which "high regulators" constituted the most common group, while "high reappraisers/low suppressors" constituted the most adaptive group and showed the lowest levels of depression, anxiety, and posttraumatic stress disorder. Lougheed and Hollenstein (2012) identified six ER groups and found that profiles that relied on fewer strategies coincided with higher scores on depression, general anxiety, and social anxiety compared with profiles involving a broader repertoire of strategies.

Another study found that positive affect was higher and anxiety lower in individuals who exhibited a regulatory profile in which active regulation strategies, including situation selection and acceptance, dominated in comparison to a regulatory profile characterized by a suppression focus (Grommisch et al., 2020). Furthermore, Castella et al. (2018) found that avoidance-oriented ER strategies were used more by individuals who were low in ER self-efficacy. As ER flexibility is in part determined by individuals' diverse repertoire of regulatory strategies and sensitivity to context (Bonanno & Burton, 2013), there is a clear

need to examine which combinations of ER strategies individuals use in specific contexts, including academic achievement settings.

ER in Academic Achievement Settings

Emotions experienced in relation to achievement activities and achievement outcomes (Pekrun, 2006), such as studying and thinking about an exam, are defined as achievement emotions. They can be classified based on their focus (activity or outcome), valence (positive, negative) or temporal reference (current, prospective, retrospective). Control value theory (CVT; Pekrun, 2006) suggests that anxiety and hope are of particular importance while preparing for exams because these emotions emerge when students anticipate failure or success, respectively, while having moderate control over their learning process (i.e., involving uncertainty; Pekrun, 2006). The present study assessed students' regulation of anxiety and hope during a one-week preparation period before an important exam. There is no doubt about the importance of regulating emotions in achievement situations such as this highly evaluative situation because emotions can impact academic performance (Pekrun et al., 2017), motivation, and learning strategies (MacIntyre & Vincze, 2017; Schmitz, 2001), and are related to students' mood (Rottweiler et al., 2018).

Recently, Harley et al. (2019) established the "emotion regulation in achievement situations" (i.e., ERAS) model, which integrates CVT and Gross' (1998b, 2015) process model of ER. The ERAS considers situational (e.g., task difficulty), individual (e.g., personal competencies), and appraisal-related determinants of emotions pertaining to individuals' perceived control over and value (i.e., importance) of achievement activities such as studying or taking tests and their outcomes. Furthermore, it distinguishes five families of ER strategies that intervene at different stages of the emotion-generative process (Gross, 1998b, 2015; see Harley et al., 2019 for examples).

Little evidence for the effectiveness of ER strategies in achievement contexts exists. Most studies show that reappraisal or reappraisal intervention has beneficial effects on test

anxiety, performance, memory, or self-regulated learning (Brady et al., 2018; Brooks, 2014; Davis & Levine, 2013; Jamieson et al., 2010; Losenno et al., 2020; Strain & D'Mello, 2015). In contrast, suppression is associated with lower self-control (Gunzenhauser & Suchodoletz, 2014), but may be helpful for improving mood before an exam (Rottweiler et al., 2018). Furthermore, ER strategies relate to students' school burnout (Seibert et al., 2017), and use of different ER strategies has been found to depend on students' course preferences (i.e., favorite vs. least favorite course; Ben-Eliyahu & Linnenbrink-Garcia, 2013). In addition, subscales of the Academic Emotion Regulation Questionnaire (AERQ) pertaining to respiration (i.e., regulating the depth of one's breathing to reduce tension) and seeking social support are positively related to achievement, while strategies like avoiding situations (e.g., skipping class) are negatively associated with achievement and students' perceived academic control (Burić et al., 2016). There is also evidence that students use different strategies rather than the same strategy over time (Webster & Hadwin, 2015). However, no research has considered potential benefits of certain combinations of ER strategies in academic settings, let alone systematically examined use of ER strategy combinations as a function of context and emotion experienced.

Methodological Considerations: Person- and Situation-Centered Approaches

Past research has mainly focused on interindividual approaches to ER (Dixon-Gordon et al., 2015; Gross & John, 2003; Lougheed & Hollenstein, 2012). These studies typically explored individuals' habitual tendencies to use certain ER strategies by asking them to report on their typical strategy use at a single time point in the laboratory. However, the number of studies employing intraindividual approaches to ER (e.g., Brans et al., 2013; Grommisch et al., 2020; Heiy & Cheavens, 2014; Rottweiler et al., 2018) has increased. Approaches which examine ER on multiple occasions allow for exploring both inter- and intraindividual differences in ER strategy use. This helps to unpack the relative impact of the contextual variation in strategy use (intraindividual) and the variation in ER use across situations

(interindividual; McMahon & Naragon-Gainey, 2019). Using ESM to assess ER strategies in situ provides insight into how individuals regulate their emotions depending on concomitant environmental circumstances, and how effective strategies are in different situations (for an overview of ESM studies on ER, see Colombo et al., 2020). ESM has been employed to study ER frequency and effectiveness (Benson et al., 2019; Catterson et al., 2017) and shows that up to 83% of variation in ER lies within individuals (ICCs =.17 -.63; Brockman et al., 2017; Grommisch et al., 2020; Rottweiler et al., 2018). Furthermore, ER strategies reciprocally influence each other over time (Brockman et al., 2017; Pavani et al., 2017) and several strategies are associated with affective behavior (Brans et al., 2013; Jose et al., 2012; Richardson, 2017). Moreover, ESM allows for attending to context specificity (Benson et al., 2019; Catterson et al., 2017; Rottweiler et al., 2018; Webb et al., 2012) and emotion specificity (Schmidt et al., 2010; Southward et al., 2019) of ER which imply that adaptive ER involves tailoring strategy use to situational demands and the emotion experienced.

Importantly, ER profiles have also been identified on the intraindividual (i.e., situation-)level (Grommisch et al., 2020; Lay et al., 2019; Winter et al., 2021), implying that individuals employ different ER strategies depending on the situation. In other words, ER strategy use is not just a matter of interindividual tendencies but can vary substantially within individuals across time and situations. Grommisch et al. (2020) identified diverging ER profiles at the person- vs. situation-level using ESM and found different intra- and interindividual ER preferences—in other words, the use of momentary ER strategy combinations and individuals' tendencies to apply these combinations of strategies, varied at both levels. As such, intraindividual approaches to ER are indispensable in that they can contribute to our understanding of healthy ER as a complex interaction between the situation, individual, and strategies used (Doré et al., 2016). Intra- and interindividual differences can reveal momentary ER patterns that depend on context effects (i.e., occasion-level) versus habitual ER patterns pertaining to interpersonal tendencies (i.e., person-level).

Aims of the study

This study builds on prior research by adopting a previously developed approach (Grommisch et al., 2020) for studying patterns of momentary ER over time using multilevel latent profile analysis in the context of academic achievement settings. We examined patterns (i.e., profiles) of students' ER over the course of a one-week period preceding a university exam and how these patterns differ as a function of context (achievement-related vs. nonachievement-related) and as a function of the emotion experienced (anxiety vs. hope). The current approach was explorative in nature due to the lack of previous research on momentary ER profiles in achievement settings. Therefore, our hypotheses do not include assumptions pertaining to the relative frequency of specific ER profiles. The following hypotheses were tested with the help of ESM:

1. On the occasion-level, different profiles of momentary ER can be identified. It is expected that these profiles are characterized by a different pattern of ER strategies rather than just low and high levels of ER.

2. Occasion-level profiles are emotion- and context-specific; thus, profile frequency differs in terms of anxiety and hope and their interaction with context (achievement-vs. nonachievement-related).

3. On the person-level, students differ in their use of occasion-level strategy profiles.

4. Person-level profiles differ in their relations with exam performance.

Methods

Participants

Participants were 203 first-year students attending a German university ($M_{age} = 21.4$ years, $SD = 2.97$; 76% female) enrolled in psychology (56%), economic science (41%), or medical programs (3%). They were recruited during tutorial sessions designed to prepare students for the corresponding exam within the respective courses and received either monetary compensation or course credit for participating.

Procedure

Participants were invited to the lab for an introduction of the study and the electronic devices (see "Daily Self-Reports") used to collect data (in 2016 and 2017). They answered a paper-pencil questionnaire on demographics and provided informed consent. The experience sampling phase began the morning after this session and ended after seven days, immediately before the exam. In total, participants were asked to complete 43 surveys over the course of this week. Immediately after exam completion, participants returned for a second lab session to return their devices and receive compensation based on their compliance. A few weeks later, participants were asked to report their exam scores via an online questionnaire. The research was approved by the institution's review board and conducted in accordance with the American Psychological Association ethical principles.

Daily Self-Reports

The electronic devices (Motorola Moto E) used for data collection were programmed with MovisensXS (Version 0.7.4162) and randomly signaled six times per day over seven days between 9 a.m. and 10 p.m., adding up to 43 occasions per individual ($N = 203$)[1]. To ensure that signals were distributed across the whole day, they followed a semi-random interval sampling schema where a minimum of two hours and a maximum of three hours were set as possible time intervals between two signals. At each timepoint, items were presented in the same order. Of note, this study was part of a larger project comprising a total of 42 items (on average, participants needed less than 2 minutes, $M = 102.44$ seconds; $SD = 60.94$, to complete the survey); of these items, 11 were of interest to the present analyses. If surveys were not started within four minutes after the signal, the questionnaire was coded as missing.

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[1] Although there is no consensus on a minimum sample size for multilevel latent class models, sample size planning rules of thumb formulated by Park and Yu (2018) who recommend at least 20 Level 2 and 10 Level 1 measures. Since the sample size depends on the complexity of the model and the number of indicators, sample size was adjusted according to the sample size from Grommisch et al. (2020), who had similar data and indicators.

Measures

For economic reasons, as is common in ESM research (Bieg et al., 2014; Brans et al., 2013; Goetz et al., 2010; Goetz et al., 2016; Heiy & Cheavens, 2014; Nett et al., 2011; Résibois et al., 2018), single items were used to assess the target constructs. Prior research shows that single-item measures can provide reliable and valid assessments (Goetz et al., 2016; Gogol et al., 2014).

Context

To identify the context (achievement- vs. nonachievement-related) in which students found themselves, we asked them to report whether they were currently engaging in achievement-related thoughts. To this end, participants responded *yes* (1) or *no* (0) to the item "In the past hour, I thought about [name of the exam]". If the answer was "yes", the emotions assessed in the following step were identified as achievement-related emotions.

Emotions

Depending on the context, we measured achievement- or nonachievement-related emotions by asking participants to rate their emotions ("In the past hour, while thinking about the exam, I experienced [anxiety/hope]" or "In the past hour, I experienced [anxiety/hope]").[2] This was measured on a five-point Likert scale ranging from 0 (*do not agree*) to 4 (*agree*).

ER Strategies

Participants rated the implementation intensity of eight ER strategies on a five-point Likert scale ranging from 0 (*do not agree*) to 4 (*agree*). ER items referred to the emotions assessed before and were introduced with, "In the following, please rate how you regulated these emotions." These eight items represent the five strategy families of Gross' process model: avoidance (situation selection), taking action and seeking social support (situation modification), refocusing and rumination (attentional deployment), reappraisal (cognitive

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[2] Because this study was part of a larger project, four more emotions were assessed, namely, joy, pride, boredom, and anger.

change), and suppression and expression (response modulation). These items were adapted from the emotion regulation questionnaire (Gross & John, 2003), the cognitive emotion regulation questionnaire (Garnefski & Kraaij, 2007), and the COPE inventory (Carver et al., 1989). We confirmed a high factor loading from the original work of these questionnaires. To adapt them for our purposes and ESM design, we sought to keep item formulations as short as possible. All ER items were based on the same word stem, "In the past hour…", and were assessed as follows: avoidance ("…I did something else to distract myself from it"), taking action ("…I concentrated my efforts on doing something different"), seeking social support ("…I tried to get advice from fellow students"), refocusing ("…I thought about something else"), rumination ("…I often thought about how I felt"), reappraisal ("…I made myself aware of the positive things in the situation"), suppression ("…I kept my emotions to myself"), and expression ("…I let my feelings out").

Performance

Most participants (72%) agreed to report their exam scores (grades) a few weeks after the written exam. Exam performance and ESM data were matched based on a personalized, anonymous code. The grades had a possible range from 1.0 (best) to 5.0 (worst).

Data Analysis

We conducted multilevel latent profile analysis following recommendations by Vermunt (2003) and as implemented in Latent GOLD 5.1 (Vermunt & Magidson, 2016) to identify the number of Level 1 ($n = 43$ occasions) and Level 2 ($N = 203$ individuals) profiles of ER strategies. Anxiety and hope (continuous variables representing intensity of emotional experience), context (dichotomous: achievement-related vs. nonachievement-related), and exam performance (continuous variable representing achievement) were included as covariates to examine further characteristics of these profiles.

To find the model with the best fit and meaningfully interpretable latent profiles at both levels, we followed the three-step procedure recommended by Lukočienė et al. (2010).

The first step is to identify the number of profiles at Level 1 (occasions) only; clustering of occasions within persons is not considered in this step. Therefore, ER profiles at the occasion-level were determined by including ER strategies as observed continuous variables in the analysis. In step 2, the multilevel structure is accounted for by conducting multilevel latent profile analysis to find profiles at Level 2, and the number of Level 1 profiles is fixed to equal the result of step 1. Therefore, the profiles of ER at the person-level (Level 2) were determined by adding a grouping variable that identified the occasions according to persons. In the third step, the profiles at Level 1 were reexamined by fixing the number of Level 2 profiles to equal the result of step 2; thus, the number of Level 1 profiles was reevaluated by considering the multilevel structure.

To avoid local maxima, Hipp and Bauer (2006) suggest to use at least 50 to 100 sets of starting values. We followed Grommisch et al. (2020), who, to our knowledge, have presented the only published ML-LPA analysis targeting profiles of ER strategies to date, and used 500 random starting values.

To identify the best model, we considered the Bayesian information criterion (BIC; Schwarz, 1978) and the Akaike information criterion 3 (AIC3; Bozdogan, 1987). Entropy R-squared, classification error, and size of the smallest profile as selection criteria were also reviewed to find the best-fitting model and describe the quality of profile separation. Profile interpretability was also taken into account.

After identifying the final model of Level 1 and Level 2 profiles, we included the covariates in the analysis by using the *step 3* modeling procedure implemented in Latent GOLD. The final ML-LPA model provided profile probabilities. In a next step, these profile probabilities were predicted by covariates. The first profile extracted was specified as the reference profile. In two separate models, anxiety, hope, context, anxiety × context and hope × context (full regression model in Table 2) and performance (full regression model in Table 2) were included as covariates. While the Level 1 covariates were group-mean centered, the Level 2

covariate performance was centered for every cohort and study course. For ease of interpretation, performance was multiplied by -1 so that higher values indicate better performance.

Missing Data

There were 8,729 possible occasions (43 per person) on Level 1 across 203 students on Level 2. In total, participants responded to 8,009 questionnaires, of which 8,004 were fully completed, resulting in a compliance rate of 92%.

Transparency and Openness

The data will be available in the GESIS repository. The study was not preregistered.

Results

Descriptive statistics including ICCs and standardized bivariate correlations of all variables are reported in the supplementary materials.

Identification of Profiles

To identify the best model for the ML-LPA, we followed the three-step procedure outlined above (Lukočienė et al., 2010) and initially conducted a latent profile analysis (i.e., ignoring the multilevel structure) using models with a sufficient number of profiles to avoid local maxima. Model fit statistics for this step are displayed in Table 1. As model complexity increased, BIC and AIC3 decreased. The largest drop in BIC emerged for the models with five and seven profiles. However, the seven-profile solution had lower entropy and a slightly higher classification error than the five-profile solution such that the latter model with fewer parameters, which presented the more parsimonious solution, was preferred. This model (except for the one- and two-profile solutions) also showed the best entropy. Therefore, five profile solution was selected in the first step of the process.

Next, we considered the multilevel structure. We fixed the number of Level 1 profiles (five profiles) and extracted models with up to five Level 2 profiles (see Table 1 for model fit statistics). Again, as model complexity increased, BIC and AIC3 decreased. From the four-

profile solution onward, BIC dropped only negligibly. Entropy increased from profile 1

onward, but compared to the three-profile solution, the four- and five-profile solutions did not

show a noticeable improvement in entropy. Considering the BIC for the three-profile solution

compared to the four-profile solution, we concluded step two by selecting the model with the

larger drop in BIC, namely, the three-profile solution.

In step three, we reexamined the Level 1 profiles by fixing the number of Level 2

profiles (three profiles; see Table 1 for all model fit statistics for models with up to nine

profiles). Again, we had the largest drop in BIC for the five-profile solution, except for the

drop for the seven-profile solution. The first difference between the five- and seven-profile

solutions lies predominantly in the smallest profile of the five-profile solution, which in the

seven-profile solution is subdivided into two profiles only differing in the intensity of "social

support", which only account for 7% and 5% of the total occasions. The second difference

results from the formation of a seventh profile from the two biggest profiles of the five-profile

solution, which accounts for 9% of the occasions and differs primarily in the intensity of

"expression". In the interest of model parsimony, we selected the five-profile solution on

Level 1 and the three-profile solution on Level 2 for the final model.

Interpretation of Profiles

To enhance profile interpretability, we computed the standardized deviation from the

means for each strategy within each profile (see Figure 1). In profile 1, all ER strategies

except suppression, which was on the mean level, deviated negatively (implying they were

used below the mean level); thus, we named this profile "low ER". This profile comprised

31% (representing 2,473 occasions) of all answered occasions across individuals. In profile 2,

refocusing and avoidance deviated positively, and social support deviated negatively from the

mean while the remaining strategies approached the mean; therefore, we labeled this profile

"avoidance" (30%, $N = 2,401$ occasions) because both endorsed strategies implied avoidance-

oriented regulation, with "refocusing" pertaining to cognitive avoidance (i.e., attentional

deployment; Gross, 2014) and "avoidance" to behavioral avoidance (i.e., situation selection). In profile 3, none of the ER strategies deviated noticeably from the mean; therefore, this profile was named "average ER" (14%, N = 1,120 occasions). Profiles 4 and 5 were both characterized by a multifaceted use of different strategies but differed noticeably in seeking social support. Accordingly, the label "multi-ER + medium social support" (13.5%, N = 1,088 occasions) was applied to profile 4, and "multi-ER + high social support" (11.5%, N = 920 occasions) to profile 5. Strategies' distributions across occasions were symmetrical (skewness ranges from -0.04 to 0.28), except for social support (skewness = 1.31) and rumination (0.71), which were strongly and moderately skewed-right, respectively. This implies that for both strategies, there were many occasions at which they were not used at all.

Figure 2 displays the final ML-LPA model with five profiles at Level 1 and three profiles at Level 2. There are two person-level profiles that entail reliance on only one occasion-level profile, while the third person-level profile relates to multiple occasion-level profiles. The person-level profile that mostly uses "low ER" was labeled "predominantly low ER" and represents the most common profile on the person-level (used by 38% of individuals, N = 78). The profile that mostly uses "avoidance" was labeled "predominantly avoidance" (31%, N = 63). The remaining person-level profile related to three Level 1 profiles to approximately the same extent; therefore, it was labeled "multi-ER profiles" (31%, N = 62).

Covariates

To examine the differences among profiles in terms of relations with anxiety, hope, context (achievement- vs. nonachievement-related), and performance, they were included as covariates in the final model by conducting logistic regressions. The emotion and context covariates were group-mean-centered to explore the situational variation in strategy use within individuals; performance scores as a Level 2 covariate were centered for every cohort and study course. For ease of interpretation, performance was multiplied by -1 so that higher values indicate better performance. We followed the *step 3* method implemented in Latent

GOLD, which is described in the Latent GOLD manual data analysis section (Vermunt & Magidson, 2016). We included anxiety, hope, context, and the interactions between anxiety and context as well as hope and context on the occasion-level (Level 1) and performance on the person-level (Level 2) in two separate models. The nesting of occasions into persons was accounted for in the first model where Level 1 covariates were analyzed, while we used an aggregated file for the second model, where a Level 2 covariate was analyzed.

Occasion-Level (Level 1)

The full regression model on Level 1 is displayed in Table 2. For interpretability, the "low ER" profile was set to zero as a reference profile as this profile can be understood as representing 'null regulation'. Therefore, the remaining profiles are compared with the reference standard "low ER". The intercepts in the first row describe the probability of profile use of every profile relative to the "low ER" profile. The intercepts are all significantly different from profile 1, except profile 2 (see Table 3 for paired comparisons with reference profile 1). The findings suggest that profiles 3 (the "average"), 4, and 5 (the two "multi-ER" profiles) are used significantly less frequently, while profile 2 ("avoidance") is not more or less frequently used by students across occasions compared with the "low ER" profile. Profile use was associated with the experience of emotions and context (Table 2; for paired comparisons, see Table 3). A correction for multiple testing following the Benjamini and Hochberg (1995) procedure was applied.

Specifically, when students experience anxiety, the two "multi ER" profiles are more frequently used than the "low ER" profile. While thinking about the exam is also associated with a more frequent use of the "multi ER + high social support" profile, the interaction term between anxiety and context reveals that the use of the "average ER" profile and the "multi ER + medium social support" profile is significantly less frequent when experiencing achievement-related anxiety. This shows the difference in strategy profile use when students experience achievement-related anxiety vs. nonachievement-related anxiety.

Additional simple slope tests were analyzed as suggested by Robinson et al. (2013) and findings show a significant difference between contexts for profiles 3,4, and 5 (t_{p3} = 4.67, p < .001; t_{p4} = 3.76, p < .001; t_{p5} = 3.59, p < .001). In other words, thinking about the exam (or not) matters for the relationship between anxiety and strategy profiles 3, 4, and 5, characterized by average use of strategies and medium or high reliance on the strategy seeking social support respectively. In contrast, when students experience hope, the "avoidance" profile is lowest in profile probability as compared with the "no ER" profile. Experiencing achievement-related hope does not impact the use of the "avoidance" profile.

Person-Level (Level 2)

Table 2 shows the results for the full regression model with the covariate "performance" modeled at the person-level. Concerning person-level profiles, profile 1, referred to as "predominantly low ER", was chosen as the reference group for comparisons between the Level 2 profiles. The intercept comparisons show that there is no difference between the profiles use on the person-level (Table 2). The second row shows the results for the covariate "performance", which indicates that the probabilities of belonging to profiles 2 and 3 are not related to students' exam performance. The "predominantly avoidance" and "multi-ER" profiles neither coincide with lower nor higher levels of performance relative to the profile "predominantly low ER", there appears to be no systematic connection.

Discussion

The objective of this study was to identify patterns of ER strategies used by students before an important exam. Specifically, we sought to provide insight into how university students manage their emotions over the course of one week of preparing for a specific exam. In contrast to prior research on achievement ER, which has primarily focused on interindividual differences in students' relative use of single ER strategies (Brady et al., 2018; Davis & Levine, 2013; Jamieson et al., 2010; Webster & Hadwin, 2015), we examined emotions and ER in situ using ESM with repeated measurement. Thus, we were able to

contrast regulatory behaviors for achievement- versus nonachievement-related emotions and advance ER research by illustrating that, in educational settings, too, ER is person-, emotion-, and context-specific. Moreover, because recent research indicates that ER typically involves combinations of different strategies rather than sole reliance on a single strategy, and to also account for intraindividual variation in strategy use across situations, we used ML-LPA to model profiles of eight different ER strategies on two-levels – the occasion- and person-levels. Furthermore, we examined how students' exam performance is linked to these ER profiles. To our knowledge, the present study is the first to investigate profiles of ER strategies used by students in academic achievement settings. There are four key findings of the present research connected to our hypotheses that we will discuss, beginning with the identified occasion-level profiles (1) and their link to emotions and context (2) and continuing with the identified person-level profiles (3) and their relation to performance (4).

Identification of Occasion-Level Profiles

First, starting with the occasion-level (i.e., intraindividual level), five distinct profiles were identified, namely, the "low ER", "avoidance", "average ER", "multi ER + medium social support" and "multi ER + high social support" profiles. The "low ER" and "avoidance" profiles were the largest profiles in terms of their frequency of use across occasions. The profiles differed in their combination of ER strategies. While reliance on social support seemed especially relevant for the "multi ER + medium social support" and "multi ER + high social support" profiles, refocusing and avoidance were relevant for the "avoidance" profile because they showed high positive deviation from the mean compared to the other strategies. According to the estimated means in the profiles, which differ drastically, it seems that among all strategies considered, social support is one of the main drivers of profile differences. This might be due to its unique distribution across situations, as there were more than 50% of occasions at which social support was not used at all. This distributional pattern might be linked to the achievement situation considered in this research: Students were preparing for

exams, which might be often done alone. Some patterns of results overlap with several profiles identified by Grommisch et al. (2020), who also found profiles labeled "low ER", "multi ER," and "social sharing". However, the results differ in terms of frequencies (i.e., number of occasions) of the use of similar profiles: The profile "low ER" in this study comprised 30% of all occasions, while the profile "no ER" in the Grommisch et al. study comprised only 10%. A possible explanation for this difference could be that the combination of strategies in our study was measured in a special week for students, the preparation week before exams, which differs markedly from individuals' everyday lives (i.e., the focus of the Grommisch et al. study). During this week, students were likely faced with increased pressure and had to manage their time and energetic/personal resources; they may have been overwhelmed by their emotions, with little capacity to regulate them effectively. As such, they may have engaged in avoidance-based strategies more frequently because strategies such as reappraisal may be too taxing given the circumstances (Ford & Troy, 2019).

Occasion-Level Profiles Linked to Emotions and Context

ER profiles at the occasion-level were linked to the type and intensity of emotions experienced by students. Anxiety and hope were relevant for profile probability (i.e., the frequency of use of specific strategy combinations underlying different profiles). Anxiety was strongly related to more frequent use of the two strategy combinations underlying the "multi ER + medium and high social support" profile, while hope was highly linked to less frequent use of the strategy combination underlying the "avoidance" profile. These patterns parallel prior research indicating that ER is emotion-specific (Rivers et al., 2007; Schmidt et al., 2010; Southward et al., 2019). Anxiety seems to coincide with more complex ER (the use of multiple strategies) and confiding in others becomes very important. Hope, on the other hand, is associated with less frequent use of avoidance-based strategies, maybe because it enhances motivational resources and leads to a lower need for regulation.

Furthermore, the present study attests to the importance of context in shaping ER and extends prior research by examining whether and how academic achievement settings may impact the use of strategies and strategy combinations in particular. The results revealed that on those occasions where students thought about the exam, the strategy combination underlying the "multi ER + high social support" profile is used more often. Using different strategies seems more important in academic achievement contexts than in nonachievement contexts. In contrast, the use of the strategy combinations underlying the "average ER", the "multi ER + medium social support" and the "multi ER + high social support" was less frequent when experiencing specifically achievement-related anxiety.

The strategy combination underlying the "avoidance" profile (i.e., the only profile with a positive deviation suppression, meaning higher than average) was *not* used more frequently when experiencing achievement-related anxiety compared to nonachievement-related anxiety. We expected the opposite, namely, that avoidance-based regulation should be more common than no ER use when experiencing achievement-related anxiety. In summary, when students experience anxiety, they might feel the need more intensely to regulate to reduce their anxiety and try a vast range of approach strategies, including taking action, rumination, and reappraisal.

There is rare evidence that individuals deploy multiple ER strategies simultaneously (Heiy & Cheavens, 2014), yet analyzing combinations of ER strategies might provide a more realistic picture. However, the present results do not reveal whether students deploy strategy combinations characterized by the use of multiple strategies due to the experience of high anxiety or whether they experience anxiety as a result of using these strategy combinations. Both scenarios are possible: Students may seek to manage intense anxiety using multiple strategies on the one hand, but on the other, the use of multiple strategies might also be leading to high anxiety (for instance, because they increase the focus on its experience). Furthermore, experiencing hope coincided with less frequent use of the strategy combination

underlying the "avoidance" profile irrespective of whether it is experienced in achievement or nonachievement-related contexts. In hopeful situations, there may be no urge to downregulate emotions, but also no urge to upregulate it or share it with others. Given our findings, we cannot deduce a clearly ideal strategy combination that helps to reduce achievement-related anxiety and simultaneously fosters achievement-related hope.

In interpreting our findings, it is important to consider the operationalization of "context". Specifically, when an individual indicated to not have been thinking about the target exam, it might still be possible that they were thinking about another exam and therefore experiencing achievement-related emotions targeting a different course. Therefore, "no" answers might also incorporate achievement-related situations, and this could be the reason why only one interaction term was significant. We expect that when comparing achievement-related situations to situations in which exams are not in focus, even stronger differences in ER and experienced emotions should emerge. Nevertheless, achievement-related emotions are important factors in students' ER. Working toward a match between context and regulation strategies to maximize strategy effectiveness (Haines et al., 2016), requires further inquiry into students' ER in achievement settings. Additionally, it remains unclear to what extent more regulation (in terms of multiple strategies) indicates more effective ER. The question we cannot answer here is whether the use of multiple strategies exists due to ineffective implementation of ER (e.g., Ford & Troy, 2019).

Identification of Person-Level Profiles

For person-level differences in ER strategy use, three distinct profiles were identified. The findings suggest that students systematically differ in their use of the occasion profiles as described above. More than two-thirds of students predominantly relied on one specific occasion profile, while the remaining students exhibited multiple occasion profiles. These results are similar to those reported by Grommisch et al. (2020), who also found individual differences in terms of predominantly one strategy combination versus reliance on diverse

combinations (profiles). However, our results show more students predominantly using one profile, while Grommisch and colleagues (2020) found that half of their participants used a diverse range of strategy combinations. This difference could be due to the achievement-related context under focus in the present investigation. A general lack of cognitive capacity available to regulate emotions could be one explanation; students were likely under pressure and cognitively taxed by studying for their exams. According to Raio et al. (2013), stressful situations can impair the use of certain ER strategies because the controllability of emotions under stress might be limited (see also Ford & Troy, 2019).

Person-Level Profiles and Performance

Exam performance was not related to person-level strategy profiles. Our results imply that for exam performance, it does not matter which of the person-level profiles is used predominantly. While reciprocal relations between achievement emotions and performance are well-documented (e.g., Pekrun et al., 2022), research linking ER strategies or profiles to academic performance is lacking. Predominantly "low ER" users or "multiple ER" users are not simply better students compared with the predominantly avoidance users. As procrastination is known to impair performance (Kim & Seo, 2015), one might have expected lower performance within the group of avoiders, but this was not the case in our data. The association between performance and ER seems to be more complex and warrants further investigation. However, again, the causality question remains: To date, there is no evidence that demonstrates a causal mechanism linking different ER profiles to achievement outcomes. Indeed, there is evidence for an influence of people's regulation tendency (e.g., high regulators vs. low regulators) on levels of psychopathology (Dixon-Gordon et al., 2015), but there is no such research within the achievement context.

Limitations

When interpreting the present findings, several limitations need to be considered and provide directions for future research. First, this study focused on a select number of ER

strategies identified as important strategies in prior research. Nevertheless, the array of possible ER strategies students can draw on to manage emotions in academic contexts is much broader. The question remains whether examining additional ER strategies beyond those considered here would produce additional profiles or even different strategy combinations. For example, acceptance of an experienced emotion could be helpful in achievement contexts given that under immense pressure and when allocating resources to cognitively demanding tasks, it might be easier to accept nervousness rather than dwelling on it or investing effort in more taxing ER strategies (e.g., reappraisal). Furthermore, substance (ab-)use might be a relevant strategy to consider because it showed a high impact on positive emotions in the work of Heiy and Cheavens (2014).

Second, this study was demanding for students because they had to respond several times a day while preparing for an exam (see Colombo et al., 2018, for a critical review of ESM design implications). Although we did screen the data for common indicators of careless responding (unusually fast responding; conspicuous response patterns such as repeated selection of the same response category), we cannot entirely rule out that students provided inauthentic answers. Moreover, our ESM design may have had an intervention effect in the sense that students might not have regulated their emotions as much as they reportedly did if they had not been prompted to attend to their emotions several times a day.

Third, because the current study assessed students' ER with a one-hour lag (e.g., "In the past hour I thought about something else"), it is possible that students used strategies consecutively instead of simultaneously. Research with more delicate sampling schemes (e.g., event sampling) is needed.

Fourth, the present study does not allow for causal interpretation. As such, more research is needed to clarify which profiles are truly beneficial and should be supported in academic settings to foster positive achievement emotions and better learning outcomes.

Constraints on Generality

As the present study was not pre-registered, is exploratory in nature and the study sample is not sufficiently representative, there is need to replicate these findings to confirm the robustness and generalizability of our results.

Future Directions

Examining ER profiles is important because they show the "big picture" of ER and account for the finding that individuals typically draw on multiple strategies to manage their emotions. As research on ER employing ESM continues to grow, it would be helpful for scholars to develop more standardized questionnaires and a pool of reliable, short measures and single items to assess ER strategies to ensure comparability of results across studies. ER items differ substantially from study to study, which likely influences the number and nature of strategy profiles that are identified.

Furthermore, there is a need for experimental studies to explore how ER strategies or profiles can enhance well-being, and performance (for a framework on longitudinal ER intervention studies, see Denny, 2020). A logical first step would be to prompt different combinations of strategies (according to our identified profiles) in different students and examine subsequent differences in emotions and performance. In addition to the ESM phase, an intervention group could be prompted with a combination of strategies at the beginning and/or end of the day on the electronic study devices (e.g., taking action and seeking social support of a stimulative nature) while the control group receives no such prompts. Prompts could include items such as "Today, study at a place where you can concentrate deeply" or "Talk to a good fellow student about your study progress". Deeper insight into the causal mechanisms linking emotions, ER, well-being, and performance is pivotal for identifying principles for fostering adaptive ER patterns in academic settings.

To gain more insight into research on ER in academic achievement situations, future research should consider different achievement contexts, including studying at home, being in

a lecture, or taking tests. The current study focused on thinking about the exam in a very broad manner, which might have hidden differences in more subtle contexts.

Conclusion

To our knowledge, this study is the first to examine ER profiles on the occasion- and person-levels in academic achievement contexts. It provides important insights into the nature of students' ER using an ESM approach that accounts for the dynamic nature of emotions and ER and highlights the importance of considering both the context and the combination of strategies students may use to manage their achievement-related emotions. Applying ML-LPA to the study of contextualized ER is a promising approach for handling the complexity of ER. By attending to the dynamic and multifaceted nature of ER with ML-LPA in combination with experimental studies, future research can provide a more nuanced understanding of ER which is needed for designing positive interventions (Quoidbach et al., 2015) that enhance well-being by fostering flexible and effective ER repertoires.

References

Aldao, A. (2013). The future of emotion regulation research: Capturing context. *Perspectives on Psychological Science*, *8*(2), 155–172. https://doi.org/10.1177/1745691612459518

Aldao, A., & Nolen-Hoeksema, S. (2012). The influence of context on the implementation of adaptive emotion regulation strategies. *Behaviour Research and Therapy*, *50*(7-8), 493–501. https://doi.org/10.1016/j.brat.2012.04.004

Aldao, A., Sheppes, G., & Gross, J. J. (2015). Emotion regulation flexibility. *Cognitive Therapy and Research*, *39*(3), 263–278. https://doi.org/10.1007/s10608-014-9662-4

Ben-Eliyahu, A., & Linnenbrink-Garcia, L. (2013). Extending self-regulated learning to include self-regulated emotion strategies. *Motivation and Emotion*, *37*(3), 558–573. https://doi.org/10.1007/s11031-012-9332-3

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: a practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society: Series B (Methodological)*, *57*(1), 289–300.

Benson, L., English, T., Conroy, D. E., Pincus, A. L., Gerstorf, D., & Ram, N. (2019). Age differences in emotion regulation strategy use, variability, and flexibility: An experience sampling approach. *Developmental Psychology*, *55*(9), 1951–1964. https://doi.org/10.1037/dev0000727

Bieg, M., Goetz, T., & Lipnevich, A. A. (2014). What students think they feel differs from what they really feel-Academic self-concept moderates the discrepancy between students' trait and state emotional self-reports. *PloS One*, *9*(3), e92563. https://doi.org/10.1371/journal.pone.0092563

Blanke, E. S., Brose, A., Kalokerinos, E. K., Erbas, Y., Riediger, M., & Kuppens, P. (2020). Mix it to fix it: Emotion regulation variability in daily life. *Emotion*, *20*(3), 473–485. https://doi.org/10.1037/emo0000566

Bonanno, G. A., & Burton, C. L. (2013). Regulatory flexibility: An individual differences

perspective on coping and emotion regulation. *Perspectives on Psychological Science*,

8(6), 591–612. https://doi.org/10.1177/1745691613504116

Bozdogan, H. (1987). Model selection and Akaike's Information Criterion (AIC): The general

theory and its analytical extensions. *Psychometrika*, *52*(3), 345–370.

https://doi.org/10.1007/BF02294361

Brady, B., Kneebone, I. I., Denson, N., & Bailey, P. E. (2018). Systematic review and meta-

analysis of age-related differences in instructed emotion regulation success. *PeerJ*, *12,* 1-

27. https://doi.org/10.7717/peerj.6051

Brans, K., Koval, P., Verduyn, P., Lim, Y. L., & Kuppens, P. (2013). The regulation of

negative and positive affect in daily life. *Emotion*, *13*(5), 926–939.

https://doi.org/10.1037/a0032400

Brockman, R., Ciarrochi, J., Parker, P., & Kashdan, T. (2017). Emotion regulation strategies

in daily life: Mindfulness, cognitive reappraisal and emotion suppression. *Cognitive

Behaviour Therapy*, *46*(2), 91–113.

Brooks, A. W. (2014). Get excited: Reappraising pre-performance anxiety as excitement.

Journal of Experimental Psychology: General, *143*(3), 1144–1158.

https://doi.org/10.1037/a0035325

Burić, I., Sorić, I., & Penezić, Z. (2016). Emotion regulation in academic domain:

Development and validation of the academic emotion regulation questionnaire (AERQ).

Personality and Individual Differences, *96*, 138–147.

https://doi.org/10.1016/j.paid.2016.02.074

Carver, C. S., Scheier, M. F., & Weintraub, J. K. (1989). Assessing coping strategies: A

theoretically based approach. *Journal of Personality and Social Psychology*, *2*(56), 267-

283.

Castella, K. de, Platow, M. J., Tamir, M., & Gross, J. J. (2018). Beliefs about emotion:

Implications for avoidance-based emotion regulation and psychological health. *Cognition*

& Emotion, *32*(4), 773–795. https://doi.org/10.1080/02699931.2017.1353485

Catterson, A. D., Eldesouky, L., & John, O. P. (2017). An experience sampling approach to

emotion regulation: Situational suppression use and social hierarchy. *Journal of Research*

in Personality, *69*, 33–43. https://doi.org/10.1016/j.jrp.2016.04.004

Colombo, D., Cipresso, P., Fernández-Álvarez, J., Díaz-García, A., Riva, G., & Botella, C.

(2018). An overview of factors associated with adherence and dropout to ecological

momentary assessments in depression. In B. K. Wiederhold, G. Riva, & S. Bouchard

(Eds.), *Annual Review of CyberTherapy and Telemedicine* (Vol. 16, pp. 11–17). Interactive

Media Institute.

Colombo, D., Fernández-Álvarez, J., Suso-Ribera, C., Cipresso, P., Valev, H., Leufkens, T.,

Sas, C., Garcia-Palacios, A., Riva, G., & Botella, C. (2020). The need for change:

Understanding emotion regulation antecedents and consequences using ecological

momentary assessment. *Emotion*, *20*(1), 30–36. https://doi.org/10.1037/emo0000671

Davis, E. L., & Levine, L. J. (2013). Emotion regulation strategies that promote learning:

Reappraisal enhances children's memory for educational information. *Child Development*,

84(1), 361–374. https://doi.org/10.1111/j.1467-8624.2012.01836.x

De France, K., & Hollenstein, T. (2017). Assessing emotion regulation repertoires: The

Regulation of Emotion Systems Survey. *Personality and Individual Differences*, *119*, 204–

215. https://doi.org/10.1016/j.paid.2017.07.018

Denny, B. T. (2020). Getting better over time: A framework for examining the impact of

emotion regulation training. *Emotion*, *20*(1), 110–114.

https://doi.org/10.1037/emo0000641

Dixon-Gordon, K. L., Aldao, A., & Los Reyes, A. de (2015). Repertoires of emotion

regulation: A person-centered approach to assessing emotion regulation strategies and links

to psychopathology. *Cognition & Emotion*, *29*(7), 1314–1325.

https://doi.org/10.1080/02699931.2014.983046

Doré, B. P., Silvers, J. A., & Ochsner, K. N. (2016). Toward a personalized science of

emotion regulation. *Social and Personality Psychology Compass*, *10*(4), 171–187.

https://doi.org/10.1111/spc3.12240

Eckert, M., Ebert, D. D., Lehr, D., Sieland, B., & Berking, M. (2016). Overcome

procrastination: Enhancing emotion regulation skills reduce procrastination. *Learning and

Individual Differences*, *52*, 10–18. https://doi.org/10.1016/j.lindif.2016.10.001

Eftekhari, A., Zoellner, L. A., & Vigil, S. A. (2009). Patterns of emotion regulation and

psychopathology. *Anxiety, Stress, and Coping*, *22*(5), 571–586.

https://doi.org/10.1080/10615800802179860

Ford, B. Q., & Troy, A. S. (2019). Reappraisal Reconsidered: A Closer Look at the Costs of

an Acclaimed Emotion-Regulation Strategy. *Current Directions in Psychological Science*,

28(2), 195–203. https://doi.org/10.1177/0963721419827526

Garnefski, N., & Kraaij, V. (2007). The Cognitive Emotion Regulation Questionnaire.

European Journal of Psychological Assessment, *23*(3), 141–149.

https://doi.org/10.1027/1015-5759.23.3.141

Goetz, T., Bieg, M., & Hall, N. C. (2016). Assessing academic emotions via the experience

sampling method. In M. Zembylas & P. A. Schutz (Eds.), *Methodological advances in

research on emotion and education* (pp. 245–258). Springer International Publishing.

https://doi.org/10.1007/978-3-319-29049-2_19

Goetz, T., Frenzel, A. C., Stoeger, H., & Hall, N. C. (2010). Antecedents of everyday positive

emotions: An experience sampling analysis. *Motivation and Emotion*, *34*(1), 49–62.

https://doi.org/10.1007/s11031-009-9152-2

Gogol, K., Brunner, M., Goetz, T., Martin, R., Ugen, S., Keller, U., Fischbach, A., &

Preckel, F. (2014). "My Questionnaire is Too Long!": The assessments of motivational-

affective constructs with three-item and single-item measures. *Contemporary Educational Psychology*, *39*(3), 188–205. https://doi.org/10.1016/j.cedpsych.2014.04.002

Grommisch, G., Koval, P., Hinton, J. D. X., Gleeson, J., Hollenstein, T., Kuppens, P., & Lischetzke, T. (2020). Modeling individual differences in emotion regulation repertoire in daily life with multilevel latent profile analysis. *Emotion*, *20*(8), 1462–1474. https://doi.org/10.1037/emo0000669

Gross, J. J. (1998a). Antecedent- and response-focused emotion regulation: Divergent consequences for experience, expression, and physiology. *Journal of Personality and Social Psychology*, *74*(1), 224–237. https://doi.org/10.1037/0022-3514.74.1.224

Gross, J. J. (1998b). The emerging field of emotion regulation: An integrative review. *Review of General Psychology*, *2*(3), 271–299. https://doi.org/10.1037/1089-2680.2.3.271

Gross, J. J. (2015). Emotion regulation: Current status and future prospects. *Psychological Inquiry*, *26*(1), 1–26. https://doi.org/10.1080/1047840X.2014.940781

Gross, J. J., & John, O. P. (2003). Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology*, *85*(2), 348–362. https://doi.org/10.1037/0022-3514.85.2.348

Gross, J. J., & Thompson, R. A. (2007). Emotion regulation: Conceptual foundations. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 3–24). Guilford Press.

Gunzenhauser, C., & Suchodoletz, A. von (2014). Preschoolers' use of suppression influences subsequent self-control but does not interfere with verbal memory. *Learning and Individual Differences*, *32*, 219–224. https://doi.org/10.1016/j.lindif.2014.03.007

Haines, S. J., Gleeson, J., Kuppens, P., Hollenstein, T., Ciarrochi, J., Labuschagne, I., Grace, C., & Koval, P. (2016). The Wisdom to Know the Difference. *Psychological Science*, *27*(12), 1651–1659. https://doi.org/10.1177/0956797616669086

Harley, J. M., Pekrun, R., Taxer, J. L., & Gross, J. J. (2019). Emotion regulation in

achievement situations: An integrated model. *Educational Psychologist*, *54*(2), 106–126.

https://doi.org/10.1080/00461520.2019.1587297

Heiy, J. E., & Cheavens, J. S. (2014). Back to basics: A naturalistic assessment of the

experience and regulation of emotion. *Emotion*, *14*(5), 878–891.

https://doi.org/10.1037/a0037231

Hipp, J. R., & Bauer, D. J. (2006). Local solutions in the estimation of growth mixture

models. *Psychological Methods*, *11*(1), 36–53. https://doi.org/10.1037/1082-989X.11.1.36

Jamieson, J. P., Mendes, W. B., Blackstock, E., & Schmader, T. (2010). Turning the knots in

your stomach into bows: Reappraising arousal improves performance on the GRE. *Journal

of Experimental Social Psychology*, *46*(1), 208–212.

https://doi.org/10.1016/j.jesp.2009.08.015

Jose, P. E., Lim, B. T., & Bryant, F. B. (2012). Does savoring increase happiness? A daily

diary study. *The Journal of Positive Psychology*, *7*(3), 176–187.

https://doi.org/10.1080/17439760.2012.671345

Kim, K. R., & Seo, E. H. (2015). The relationship between procrastination and academic

performance: A meta-analysis. *Personality and Individual Differences*, *82*, 26–33.

Koole, S. L. (2009). The psychology of emotion regulation: An integrative review. *Cognition

& Emotion*, *23*(1), 4–41. https://doi.org/10.1080/02699930802619031

Lay, J. C., Pauly, T., Graf, P., Biesanz, J. C., & Hoppmann, C. A. (2019). By myself and

liking it? Predictors of distinct types of solitude experiences in daily life. *Journal of

Personality*, *87*(3), 633–647. https://doi.org/10.1111/jopy.12421

Losenno, K. M., Muis, K. R., Munzar, B., Denton, C. A., & Perry, N. E. (2020). The dynamic

roles of cognitive reappraisal and self-regulated learning during mathematics problem

solving: A mixed methods investigation. *Contemporary Educational Psychology*, *61*,

101869. https://doi.org/10.1016/j.cedpsych.2020.101869

Lougheed, J. P., & Hollenstein, T. (2012). A limited repertoire of emotion regulation

    strategies is associated with internalizing problems in adolescence. *Social Development*,

    21(4), 704–721.

Lukočienė, O., Varriale, R., & Vermunt, J. K. (2010). 6. The simultaneous decision (s) about

    the number of lower-and higher-level classes in multilevel latent class analysis.

    Sociological Methodology, *40*(1), 247–283.

MacIntyre, P. D., & Vincze, L. (2017). Positive and negative emotions underlie motivation for

    L2 learning. *Studies in Second Language Learning and Teaching*, *7*(1), 61–88.

    https://doi.org/10.14746/ssllt.2017.7.1.4

McMahon, T. P., & Naragon-Gainey, K. (2019). The multilevel structure of daily emotion-

    regulation-strategy use: An examination of within- and between-person associations in

    naturalistic settings. *Clinical Psychological Science*, *7*(2), 321–339.

    https://doi.org/10.1177/2167702618807408

MovisensXS. (Version 0.7.4162) [Computer software]. movisens GmbH. Karlsruhe,

    Germany.

Nett, U. E., Goetz, T., & Hall, N. C. (2011). Coping with boredom in school: An experience

    sampling perspective. *Contemporary Educational Psychology*, *36*(1), 49–59.

    https://doi.org/10.1016/j.cedpsych.2010.10.003

Park, J., & Yu, H.-T. (2018). Recommendations on the Sample Sizes for Multilevel Latent

    Class Models. *Educational and Psychological Measurement*, *78*(5), 737–761.

    https://doi.org/10.1177/0013164417719111

Parkinson, B., & Totterdell, P. (1999). Classifying affect-regulation strategies. *Cognition &*

    Emotion, *13*(3), 277–303. https://doi.org/10.1080/026999399379285

Pavani, J.-B., Le Vigouroux, S., Kop, J.-L., Congard, A., & Dauvier, B. (2017). A network

    approach to affect regulation dynamics and personality trait–induced variations:

    Extraversion and neuroticism moderate reciprocal influences between affect and affect

regulation strategies. *European Journal of Personality*, *31*(4), 329–346.

https://doi.org/10.1002/per.2109

Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions,

corollaries, and implications for educational research and practice. *Educational Psychology*

Review, *18*(4), 315–341. https://doi.org/10.1007/s10648-006-9029-9

Pekrun, R., Lichtenfeld, S., Marsh, H. W., Murayama, K., & Goetz, T. (2017). Achievement

emotions and academic performance: Longitudinal models of reciprocal effects. *Child*

Development. Advance online publication. https://doi.org/10.1111/cdev.12704

Pekrun, R., Marsh, H. W., Suessenbach, F., Frenzel, A. C., & Goetz, T. (2022). School grades

and students' emotions: Longitudinal models of within-person reciprocal effects. *Learning*

and Instruction, Advance online publication.

https://doi.org/10.1016/j.learninstruc.2022.101626

Pruessner, L., Barnow, S., Holt, D. V., Joormann, J., & Schulze, K. (2020). A cognitive

control framework for understanding emotion regulation flexibility. *Emotion*, *20*(1), 21–

29. https://doi.org/10.1037/emo0000658

Quoidbach, J., Mikolajczak, M., & Gross, J. J. (2015). Positive interventions: An emotion

regulation perspective. *Psychological Bulletin*, *141*(3), 655–693.

https://doi.org/10.1037/a0038648

Raio, C. M., Orederu, T. A., Palazzolo, L., Shurick, A. A., & Phelps, E. A. (2013). Cognitive

emotion regulation fails the stress test. *Proceedings of the National Academy of Sciences of*

the United States of America, *110*(37), 15139–15144.

https://doi.org/10.1073/pnas.1305706110

Résibois, M., Kalokerinos, E. K., Verleysen, G., Kuppens, P., van Mechelen, I., Fossati, P., &

Verduyn, P. (2018). The relation between rumination and temporal features of emotion

intensity. *Cognition & Emotion*, *32*(2), 259–274.

https://doi.org/10.1080/02699931.2017.1298993

Richardson, C. M. (2017). Emotion regulation in the context of daily stress: Impact on daily

    affect. *Personality and Individual Differences*, *112*, 150–156.

    https://doi.org/10.1016/j.paid.2017.02.058

Rivers, S. E., Brackett, M. A., Katulak, N. A., & Salovey, P. (2007). Regulating anger and

    sadness: an exploration of discrete emotions in emotion regulation. *Journal of Happiness*

    Studies, *8*(3), 393–427. https://doi.org/10.1007/s10902-006-9017-2

Robinson, C., Tomek, S., & Schumacker, R. (2013). Tests of moderation effects: Difference

    in simple slopes versus the interaction term. *Multiple Linear Regression Viewpoints*, *39*,

    16–24. http://www.glmj.org/archives/articles/Robinson_v39n1.pdf

Rottweiler, A.-L., Taxer, J. L., & Nett, U. E. (2018). Context matters in the effectiveness of

    emotion regulation strategies. *AERA Open*, *4*(2), 1-13.

    https://doi.org/10.1177/2332858418778849

Schall, M., Martiny, S. E., Goetz, T., & Hall, N. C. (2016). Smiling on the Inside: The Social

    Benefits of Suppressing Positive Emotions in Outperformance Situations. *Personality and*

    Social Psychology Bulletin, *42*(5), 559–571. https://doi.org/10.1177/0146167216637843

Schmidt, S., Tinti, C., Levine, L. J., & Testa, S. (2010). Appraisals, emotions and emotion

    regulation: An integrative approach. *Motivation & Emotion*, *34*(1), 63–72.

    https://doi.org/10.1007/s11031-010-9155-z

Schmitz, B. (2001). Self-Monitoring zur Unterstützung des Transfers einer Schulung in

    Selbstregulation für Studierende. *Zeitschrift Für Pädagogische Psychologie*, *15*(3/4), 181–

    197. https://doi.org/10.1024//1010-0652.15.34.181

Schwarz, G. (1978). Estimating the dimension of a model. *The Annals of Statistics*, *6*(2).

    https://doi.org/10.1214/aos/1176344136

Seibert, G. S., Bauer, K. N., May, R. W., & Fincham, F. D. (2017). Emotion regulation and

    academic underperformance: The role of school burnout. *Learning and Individual*

    Differences, *60*, 1–9. https://doi.org/10.1016/j.lindif.2017.10.001

Southward, M. W., Heiy, J. E., & Cheavens, J. S. (2019). Emotions as context: Do the

naturalistic effects of emotion regulation strategies depend on the regulated emotion?

Journal of Social and Clinical Psychology, *38*(6), 451–474.

https://doi.org/10.1521/jscp.2019.38.6.451

Strain, A. C., & D'Mello, S. K. (2015). Affect Regulation During Learning: The Enhancing

Effect of Cognitive Reappraisal. *Applied Cognitive Psychology*, *29*(1), 1–19.

https://doi.org/10.1002/acp.3049

Tamir, M., & Bigman, Y. (2014). Why might people want to feel bad? Motives in

contrahedonic emotion regulation. In W. G. Parrott (Ed.), *The positive side of negative*

emotions (pp. 201–223). The Guilford Press.

Vermunt, J. K. (2003). Multilevel latent class models. *Sociological Methodology*, *33*(1), 213–

239. https://doi.org/10.1111/j.0081-1750.2003.t01-1-00131.x

Vermunt, J. K., & Magidson, J. (2016). Upgrade manual for Latent GOLD 5.1. *Belmont, MA:*

Statistical Innovations Inc.

Webb, T. L., Miles, E., & Sheeran, P. (2012). Dealing with feeling: A meta-analysis of the

effectiveness of strategies derived from the process model of emotion regulation.

Psychological Bulletin, *138*(4), 775–808. https://doi.org/10.1037/a0027600

Webster, E. A., & Hadwin, A. F. (2015). Emotions and emotion regulation in undergraduate

studying: examining students' reports from a self-regulated learning perspective.

Educational Psychology, *35*(7), 794–818. https://doi.org/10.1080/01443410.2014.895292

Winter, T., Conner, T. S., & Jose, P. E. (2021). Identifying profiles of affective change: An

ecological momentary assessment of flourishers. *Emotion*, *21*(3), 584–594.

https://doi.org/10.1037/emo0000741

Tables

Table 1

Model Fit Statistics for LPA Models Step 1-3.

Nr of P (L1)	Nr of P (L2)	LL	BIC(LL)	Size of Drop in BIC	AIC3(LL)	Npar	Classif. error (L1)	Entropy R² (L1)	Size of smallest P (L1)	Classif. error (L2)	Entropy R² (L2)	Size of smallest P (L2)
Step 1: Model Fit Statistics for LPA Models with Different Numbers of Level 1 Profiles (and One Level 2 Profile).												
1	1	-104417.87	208979.54		208883.74	16	0	1	1			
2	1	-101572.39	203369.47	5610.07	203219.78	25	0.0045	0.9632	0.2506			
3	1	-99559.33	199424.24	3945.24	199220.65	34	0.0729	0.8322	0.248			
4	1	-98050.15	196486.77	2937.47	196229.3	43	0.0693	0.8721	0.1147			
5	**1**	**-94719.55**	**189906.46**	**6580.3**	**189595.1**	**52**	**0.0503**	**0.9217**	**0.1147**			
6	1	-94156.89	188862.03	1044.43	188496.78	61	0.0681	0.8995	0.0929			
7	1	-70490.86	141610.85	47251.18	141191.71	70	0.0681	0.9039	0.0467			
8	1	-69898.52	140507.07	1103.78	140034.04	79	0.0906	0.8855	0.0476			
9	1	-69473.34	139737.59	769.48	139210.68	88	0.1103	0.8693	0.0476			
Step 2: Model Fit Statistics for ML-LPA Models with Different Numbers of Level 2 Profiles (and Five Level 1 Profiles).												
5	1	-94719.55	189906.46		189595.1	52	0.0503	0.9217		0	1	1
5	2	-93608.68	187729.66	2176.81	187388.36	57	0.0504	0.9217		0.0074	0.9712	0.3825
5	**3**	**-92932.97**	**186423.17**	**1306.48**	**186051.94**	**62**	**0.0399**	**0.9362**		**0.0131**	**0.9677**	**0.3071**
5	4	-92753.01	186108.2	314.97	185707.03	67	0.0397	0.9366		0.0397	0.9657	0.2003
5	5	-92555.51	185758.13	350.07	185327.02	72	0.0391	0.9375		0.0179	0.97	0.1564
Step 3: Model Fit Statistics for ML-LPA Models with Different Numbers of Level 1 Profiles (and Three Level 2 Profiles).												
1	3	-104417.87	208997.52		208889.74	18	0	1	1			
2	3	-100352.56	200965.75	8031.76	200792.11	29	0.0565	0.7986	0.4209			
3	3	-98008.04	196375.58	4590.17	196136.07	40	0.0592	0.8594	0.2474			
4	3	-96216.26	192890.89	3484.69	192585.52	51	0.0538	0.8992	0.1152			
5	**3**	**-92932.97**	**186423.17**	**6467.72**	**186051.94**	**62**	**0.0399**	**0.9362**	**0.1151**			
6	3	-92329.82	185315.74	1107.43	184878.64	73	0.0661	0.9045	0.1103			
7	3	-68646.35	138047.66	47268.08	137544.69	84	0.0616	0.9135	0.0476			
8	3	-67922.73	136699.28	1348.38	136130.45	95	0.0773	0.9021	0.0476			
9	3	-67435.05	135822.79	876.49	135188.09	106	0.0807	0.9009	0.0476			

Note. LL = log-likelihood. L1 = Level 1; L2 = Level 2. P = Profile(s); Bold numbers show best profile solution.

Table 2

Full Regression Models on Level 1 and 2. (Profile 1 as Reference Group).

Level 1: Model of Anxiety, Hope and Context on Profile Probability.

	Profile 2		Profile 3		Profile 4		Profile 5			
	B	SE	B	SE	B	SE	B	SE	Wald	*p*
Intercept	-0.057	0.144	-0.759	0.123	-0.796	0.132	-0.997	0.128	89.961	$1.30e^{-18}$
Anxiety	-0.019	0.039	0.062	0.040	0.212	0.048	0.294	0.057	49.504	$4.60e^{-10}$
Hope	-0.144	0.040	-0.081	0.041	-0.008	0.043	0.012	0.053	18.326	0.001
Context	0.132	0.084	-0.087	0.100	-0.056	0.104	0.326	0.119	16.612	0.002
Anxiety x Context	-0.035	0.124	-0.312	0.117	-0.299	0.117	-0.294	0.138	13.017	0.011
Hope x Context	0.298	0.136	0.018	0.124	-0.044	0.123	-0.090	0.157	8.664	0.070

Level 2: Model of Performance on Profile Probability.

	B	SE	B	SE					Wald	*p*
Intercept	-0.329	0.208	-0.285	0.204					3.136	0.210
Performance	-0.212	0.229	-0.138	0.244					0.912	0.630

Note: Profile 1 is reference profile. Level 1 covariates are group-mean-centered. Performance is centered for every cohort and study course and multiplied by -1 so that higher values indicate better performance.

Table 3

*Paired Comparisons between the reference profile 1
and profiles 2, 3, 4, 5.*

	Wald	df	p	sign.
Intercept				
Profile 1 and 2	0.155	1	$6.90e^{-01}$	
Profile 1 and 3	379.253	1	$7.40e^{-10}$	*
Profile 1 and 4	366.284	1	$1.40e^{-09}$	*
Profile 1 and 5	603.573	1	$7.90e^{-15}$	*
Anxiety				
Profile 1 and 2	0.241	1	0.62	
Profile 1 and 3	23.994	1	0.12	
Profile 1 and 4	191.387	1	$1.20e^{-05}$	*
Profile 1 and 5	268.319	1	$2.20e^{-07}$	*
Hope				
Profile 1 and 2	131.573	1	0.00029	*
Profile 1 and 3	38.378	1	0.05	
Profile 1 and 4	0.036	1	0.85	
Profile 1 and 5	0.053	1	0.82	
Context				
Profile 1 and 2	24.579	1	0.12	
Profile 1 and 3	0.749	1	0.39	
Profile 1 and 4	0.292	1	0.59	
Profile 1 and 5	75.352	1	0.0061	*
Anxiety x Context				
Profile 1 and 2	0.081	1	0.78	
Profile 1 and 3	71.038	1	0.01	*
Profile 1 and 4	64.958	1	0.01	*
Profile 1 and 5	45.721	1	0.03	
Hope x Context				
Profile 1 and 2	48.026	1	0.028	
Profile 1 and 3	0.021	1	0.88	
Profile 1 and 4	0.128	1	0.72	
Profile 1 and 5	0.324	1	0.57	

Note. Profile 1 is reference profile. A correction for

multiple testing following the Benjamini and Hochberg

(1995) procedure was applied and is depicted in the

column "adjusted p-value" The asterisks in the final

column indicate significance following this correction.

Figures

Figure 1

ER Profiles on the Occasion-Level (Standardized Deviations from the Means)
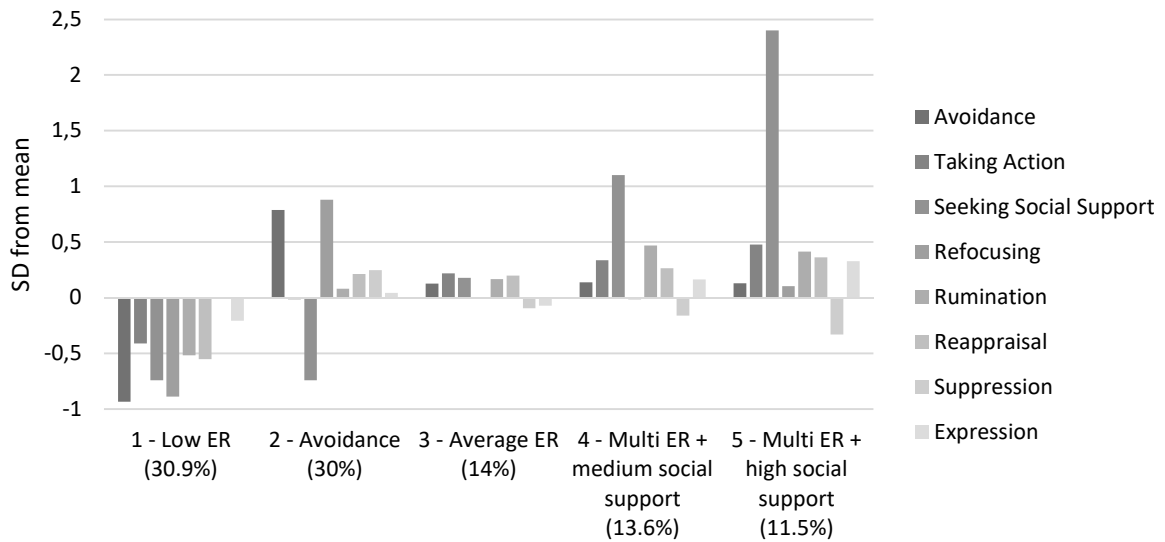
Note. Bars represent the standardized deviation from the mean of the ER strategies of each profile. Numbers in parentheses represent the profile size (percentage of occasions in reference to a profile).

Figure 2

ER Profiles on the Person-Level
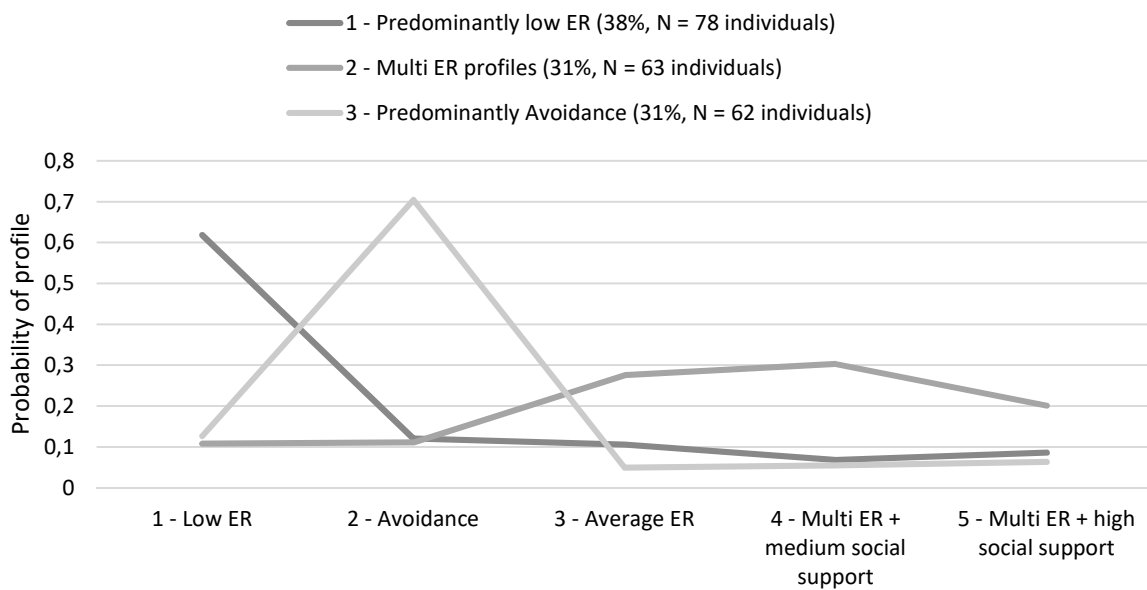
Note. Final model with 5 profiles on the occasion-level and three profiles on the person-level.

Displayed are the individual distribution of occasion profiles. The number in parentheses

represents the profile size (percentage of persons in reference to a profile).