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THE ROLE OF APPRAISALS ON EMOTIONS IN ACADEMIC PERFORMANCE

CONTEXT

Master's thesis

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Running head: Academic performance appraisals

Tartu 2026

## **The role of appraisals on emotions in academic performance context**

### **Abstract**

The aim of the present study was to investigate the relationship between emotions and appraisals in a personalized experiment in academic performance context. For this, a paradigm was created. 50 university students were shown hypothetical academic outcomes based on the expected results of their current graded courses. The stimuli represented expected, better-than-expected, and worse-than-expected outcomes. The results showed that better-than-expected outcomes elicited significantly stronger positive affect and greater *zygomaticus major* activity, whereas worse-than-expected outcomes elicited significantly stronger negative affect and greater *corrugator supercilii* activity. Significant differences were also found across all appraisal dimensions. Better-than-expected results were appraised as more relevant, congruent, fair, and with higher emotional coping, whereas worse-than-expected results were appraised as more relevant and urgent, and less congruent, fair, controllable, and with less emotional coping as opposed to expected results. Furthermore, several appraisal dimensions such as relevance, congruence, fairness, control, urgency, and emotional coping moderated the relationship between the condition of hypothetical result and emotional responses. The findings suggest that personalized academic expectancy violations can successfully evoke differentiated emotional and appraisal-related responses under laboratory conditions and may provide a useful framework for future research on emotions and appraisals in achievement contexts.

*Keywords:* affect, appraisals, academic performance, expectancy violation, facial EMG, emotional responses, personalized stimuli

## Tõlgenduste roll emotsioonides akadeemilise soorituse kontekstis

### Kokkuvõte

Käesoleva töö eesmärk oli eksperimentaalselt uurida emotsioonide ja tõlgenduste vahelist seost akadeemilise soorituse kontekstis personaliseeritud stiimulitega. Selle jaoks loodi eksperimentaalne katseparadigma. Uuringus näidati 50 üliõpilasele personaliseeritud hüpoteetilisi tulemusi nende enda läbitavate õppeainete kohta, võttes arvesse nende oodatud lõpptulemusi. Stiimulid kujutasid, ootuspäraseid, oodatust paremaid ja oodatust halvemaid tulemusi. Tulemused näitasid, et oodatust paremad tulemused kutsusid esile tugevamat positiivset afekti ja suuremat *zygomaticus major* aktiivsust, samas kui oodatust halvemad tulemused kutsusid esile tugevamat negatiivset afekti ja suuremat *corrugator supercilii* aktiivsust. Samuti ilmsid statistiliselt olulised erinevused kõigis tõlgendusdimensioonides sõltuvalt esitatud tulemuse tüübist. Oodatust paremaid tulemusi hinnati rohkem relevantseteks, eesmärkidega kooskõlas olevateks, õiglasemateks ja emotsionaalselt paremini hallatavateks, samas kui oodatust halvemaid tulemusi hinnati relevantsemateks kiireloomulisemateks ning vähem eesmärkidega kooskõlas olevateks, õiglasemateks, kontrollitavateks ja emotsionaalselt hallatavateks võrreldes oodatud tulemustega. Lisaks esines mitmete tõlgendusdimensioonide nagu relevantsus, kooskõlalatus, õiglus, kontroll, kiireloomulisus ja emotsionaalne toimetulek ning ootuste tingimuste koosmõju emotsionaalsetele reaktsioonidele. Tulemused viitavad sellele, et loodud paradigma võimaldab laboritingimustes edukalt esile kutsuda eristuvaid emotsionaalseid reaktsioone ja tõlgendusmustreid akadeemilise soorituse kontekstis ning võib pakkuda kasulikku raamistikku tulevasteks uuringuteks teistes soorituskontekstides.

*Märksõnad:* afekt, tõlgendused, akadeemiline sooritus, ootuste rikkumine, näolihaste EMG, emotsionaalsed reaktsioonid, personaliseeritud stiimulid

Although previous research has explored the relationship between emotions and cognitive appraisals, relatively few experimental paradigms have been developed to investigate these processes under controlled laboratory conditions. The present study addresses this gap by developing a personalized experimental paradigm to examine how individuals experience emotions in the context of academic performance and to what extent are the emotions influenced by appraisals.

### **Appraisal theories of emotion**

Appraisal theories conceptualize emotions as multicomponent responses generated and shaped by the appraisal of a situation's motivational meaning (Moors et al., 2013). Appraisals represent abstract interpretations of what a situation means for an individual's goals, needs, and other motives (Yeo & Ong, 2024). Appraisals shape both the intensity and quality of action tendencies, physiological responses, behavior, and subjective feelings (Clore & Ortony, 2000; Frijda, 2007; Lazarus, 1991; Reisenzein, 1994; Roseman & Smith, 2001; Scherer, 2001). A central assumption of appraisal theories is that the same stimulus may elicit different emotions depending on how it is interpreted, while similar appraisal configurations are expected to give rise to similar emotional experiences (Moors et al., 2013). Therefore, emotional responses are determined not by the objective properties of events, but by the meanings individuals assign to them (Ellsworth & Scherer, 2003; Moors et al., 2013).

Cognitive appraisal has been described as a key mechanism underlying both stress reactions and emotional experience (Lazarus & Folkman, 1984). Appraisal allows people to respond flexibly rather than reacting automatically to events (Scherer, 1984). This helps individuals interpret the personal significance of situations, which then shapes their emotional responses (Scherer, 1984). It has been shown that there are some specific patterns of appraisals, that may produce maladaptive emotional responses to situations (Roseman & Kaiser, 2001). For example, it has been shown that dysfunctional attitudes and negative inferential styles increase the likelihood of maladaptive emotional outcomes, including depressive symptoms (Hankin & Abramson, 2001). Additionally, there have been found stable tendencies, such as dispositional appraisal styles or appraisal biases which modulate how individuals tend to interpret events (Lazarus, 1991; Van Reekum & Scherer, 1997). Appraisal biases have been proposed to contribute to dysfunctional emotional dispositions and to represent potential risk factors for emotional disorders (Scherer, 2015; Scherer & Brosch, 2009).

### **The role of expectations and expectations violations in emotions**

Expectations can be defined as beliefs about events or experiences that will or might happen in the future (Hoorens, 2012). Expectations are important as accurate expectations can help the individuals to prepare for future situations and respond to them in a more adaptive manner, as well as influence future outcomes in a desired direction (Roese & Sherman, 2007).

A substantial body of theoretical, as well as laboratory research suggests that emotional reactions are at least partly driven by how much an outcome deviates from one's expectations (Bhatia et al., 2019; Carver & Scheier, 2001; Feather, 1967; Medvec et al., 1995; Mellers, 2000). At a basic level, the direction of this deviation plays a key role on emotions (Verinis et al., 1968). Outcomes that are better-than-expected tend to elicit positive emotions, whereas outcomes that are worse-than-expected are associated with negative emotional responses (Villano et al., 2020). More recent computational approaches to affect further emphasize that emotional reactions are shaped not only by the outcome itself but also by the discrepancy between the outcome and prior expectations, which is commonly referred to as prediction error (Eldar et al., 2016; Eldar & Niv, 2015; A. Otto et al., 2016; A. R. Otto & Eichstaedt, 2018; Rutledge et al., 2014).

Importantly, expectations in real-world contexts are not arbitrary, but they are formed based on individuals' prior experiences within their environment and therefore need to be measured rather than assumed (Mobbs et al., 2018). As expectations could differ depending on the context, then they should be measured in the specific context as well. Academic situations in higher education frequently elicit high-intensity emotions (Pekrun, 2016), making them an important context for examining the role of expectations in emotional experiences.

### **The role of expectations and appraisals in academic performance**

It has been shown that students regularly evaluate their ability to meet academic demands and form specific expectations regarding their academic performance (Gadbois & Sturgeon, 2011). However, these expectations are not always accurate. For example, Hacker et al. (2000) found that less than half of undergraduate students accurately predicted their future test performance, with many students being overly optimistic about their expectations. Because discrepancies between expected and actual academic outcomes may influence students' emotional reactions as well as their future motivation, it is important to understand how students interpret and respond to expectation violations in academic settings.

Previous research in academic performance has been relying mainly on attribution theory, which explains how academic performance, expectations of future performance, and emotional reactions to performance, are all influenced by causal attributions (Weiner, 1979, 1985, 1986). For example, it has been shown that students high in achievement motivation tend to attribute success to ability and effort and failure to lack of effort rather than lack of ability (Weiner, 1979). However, there has been variability in previous research which has been linked to differences in how attributional style is measured, including the use of composite scores across internality, stability, and globality dimensions (Peterson & Barrett, 1987).

Another framework for understanding emotions in academic settings is Control-Value Theory, according to which students' emotional reactions to academic situations are primarily determined by their appraisals (Pekrun et al., 2007). Additionally, attributional styles have been linked to motivational and performance outcomes in academic contexts, and it has been suggested that individuals differ systematically in how they interpret success and failure (Houston, 1994). For example, it has been shown that students who habitually explain negative academic events using internal, stable, and global causes (e.g., "I failed because I lack ability") have been proposed to be at greater risk of maladaptive outcomes compared to those endorsing external, unstable, and specific explanations (Peterson & Barrett, 1987).

Previous research has shown that positive emotions are associated with greater interest, effort, and achievement (e.g. Pekrun et al., 2004), whereas negative emotions, especially anxiety and anger, can undermine academic performance (e.g. Owens et al., 2014). More broadly, emotional and self-regulatory processes in academic settings have also been linked to academic persistence and dropout-related outcomes (Enguítanos et al., 2023; Leow et al., 2025). This may be especially important, given that university students constitute a population with elevated risk for mental health difficulties (Duffy et al., 2020). Together, these findings highlight the importance of examining how emotional experiences are shaped by appraisals in academic contexts. As there are different ways to examine appraisals in academic context, then in this study we do not rely on one specific framework but explore the role of appraisals more broadly.

### **Methods for studying the associations between appraisals and emotions**

There are various ways to study emotions and appraisals. One possibility is to use the experience-sampling-method to capture individuals' normal daily life including their thoughts, feelings and the context (Myin-Germeys et al., 2009). There have also been

attempts to study emotional responses to personally meaningful outcomes in academic experiences, by tracking changes in positive and negative affect across an academic semester (Villano et al., 2020). While emotions experienced in daily life are arguably more vivid, personally meaningful, and consequential than those evoked in laboratory settings, naturalistic methods inherently involve substantial variability and reduced experimental control (Kuppens et al., 2022). Therefore, prior studies regarding emotions and appraisals have primarily used standardized stimuli, including affective images, emotional words, videos, and vignettes (e.g. Beauregard et al., 2001; Buhle et al., 2014; Goldin et al., 2008; Hajcak et al., 2010; Krajuškina et al., 2025; Olofsson et al., 2008). However, it has been shown, that emotional responses to the same event or stimulus could differ based on a person's individual goals, needs, motives, and wants (Ellsworth & Scherer, 2003; Frijda, 2007). Therefore, it would be an important addition to study emotional responses and appraisals using personalized stimuli.

There have been some promising examples of combining personal stimuli with experimental control. These include mental imagery usage for studying emotional reactions on physiological level (e.g. MacNamara, 2018; Suess & Abdel Rahman, 2015), as well as examples involving imagining or recalling events in evaluative terms, such as negative experiences involving low perceived control (e.g. Fast & Chen, 2009; Kuppens & Tong, 2010). Building on the previously discussed importance of academic experiences in young people's emotional lives, previous research has also examined emotions and academic expectations in educational contexts (e.g. Gollwitzer et al., 2017; Levi et al., 2014; Pinquart et al., 2021; Zamora et al., 2018). Together, these approaches suggest that combining personally meaningful academic stimuli with experimentally controlled paradigms may provide a promising way to examine emotional experiences in academic contexts while retaining ecological relevance.

### **Measures of emotions and appraisals**

According to dimensional theories of emotion, emotional responses can be organized along a small number of fundamental dimensions, most commonly valence, arousal, and approach–avoidance tendencies (Lang et al., 1997; Russell & Barrett, 1999; Watson et al., 1999). While some theorists conceptualize positive and negative affect as opposite ends of a single dimension (Russell, 1980), others suggest that they represent relatively independent dimensions (Larsen et al., 2001; Tellegen et al., 1999). In the present study, positive and negative affect were examined separately.

Emotional responses can be assessed using both subjective and objective methods. Subjective methods generally rely on individuals' self-reports of their emotional experiences (Scherer & Moors, 2019). Previous research suggests that self-reports of current emotional states are generally more reliable than retrospective reports of emotions experienced further in the past (Robinson & Clore, 2002). Self-report measures have been widely used to capture core emotional dimensions such as valence, arousal, and approach–avoidance tendencies, which account for a substantial proportion of variance in emotional experience (Russell & Barrett, 1999; Watson et al., 1999). Accordingly, dimensional self-reports are considered an important approach for examining emotional experiences.

As there are some limitations to self-report measurement, including socially desirable responses (Vanman et al., 1997), as well as the possibility that individuals may not be fully aware of changes in their emotional states (Öhman & Soares, 1994), then it is common to additionally use objective methods. One option is to use overt behavioral measures, such as facial muscle reactivity (Scherer & Moors, 2019). This can be assessed using facial electromyography (EMG), which measures the electrical activity of muscles through electrodes placed on the face (Mauss & Robinson, 2009). There are two facial muscles that are commonly used to measure emotional responding – *zygomaticus major* and *corrugator supercilii* (e.g. Aue & Scherer, 2008, 2011; Larsen et al., 2003; Larsen & Norris, 2009). It has been previously shown that *zygomaticus major* is sensitive to the positive valence of emotion and *corrugator supercilii* is sensitive to the negative valence of emotion (e.g. Davidson & Irwin, 1999; Larsen et al., 2003; Mauss et al., 2005). Therefore, measuring facial muscle activity using EMG may help validate the experimental paradigm objectively.

It has been proposed that appraisals can be described using appraisal dimensions, however there is a disagreement between theorists regarding which specific dimensions are important for eliciting emotions (Yeo & Ong, 2024). The appraisal dimensions used for the current study were selected based on their theoretical relevance to academic performance context. Specifically, relevance and congruence can illustrate to which extent the academic outcomes matter for students' goals and align with their expectations or motives (Davis et al., 2008; C. Smith & Lazarus, 1990). Self- and other-accountability, fairness, and control reflect evaluations of responsibility, justice, and perceived agency, which have been linked to emotional and motivational reactions following positive and negative outcomes (Schutz & Davis, 2000; Yeo & Ong, 2024). Urgency and emotional coping capture the perceived need for action and individuals perceived ability to emotionally adapt to the situation, both of

which are considered important components of emotional adjustment and coping processes (Frijda, 1986; Lazarus & Folkman, 1984; Scherer, 2001). Together, these dimensions provide an overview of appraisals for examining how students interpret and emotionally respond to academic expectancy violations.

### **Present Study**

The aim of the current study was to investigate the relationship between emotions and appraisals in a personalized experiment. For this, a personalized experimental paradigm was created. Specifically, hypothetical academic outcomes as a model of violation of expectations were used, which allows to examine whether and in which way is the student's experience of success or failure in a personally relevant academic performance context related to their positive and negative subjective emotional experience, and facial expressions of negative and positive affect.

In the experiment, the participants were presented with the personalized hypothetical academic outcomes related to their own university courses. The stimuli were divided into three categories: expected, better-than-expected, and worse-than-expected results. After each stimulus, they evaluated their subjective emotional reaction and described how they perceived receiving the hypothetical result on different appraisal dimensions. In addition to self-reported subjective experience, facial expressions (by electromyography or EMG of the activity of the facial muscles *corrugator supercilii* and *zygomaticus major*) were measured.

The first aim of the current study was to develop a personalized experimental paradigm to investigate how expectations and their violations influence emotional responses and to evaluate whether the developed paradigm successfully elicited differentiated subjective and physiological emotional reactions. Based on previous research, two hypotheses were proposed to examine the validity of the created paradigm. Firstly, worse-than-expected results evoke a higher negative subjective emotion, stronger *corrugator supercilii* and weaker *zygomaticus major* activity, as opposed to an expected result. Secondly, better-than-expected results evoke a higher positive subjective emotion, stronger *zygomaticus major* and weaker *corrugator supercilii* activity as opposed to expected results.

The second aim was to explore how the appraisals change depending on the types of results presented (expected, better-than-expected and worse-than-expected). For this exploratory analyses were conducted with no hypothesis proposed.

The third aim was to explore whether some appraisal dimensions moderate the effect of experimental conditions on subjective emotional experience and EMG activity. For this,

additional exploratory analyses were conducted. Most of these analyses were exploratory with no hypothesis proposed, except for the appraisal dimensions relevance and self-accountability. Based on previous research, greater goal relevance has been associated with stronger emotional responses (Davis et al., 2008), whereas self-accountability has been associated with emotional reactions related to success and failure attribution (Zeelenberg & Beattie, 1997). Therefore, two hypotheses were proposed. Firstly, greater self-reported relevance is associated with stronger subjective affect responses and larger changes in facial EMG activity. More specifically, it was predicted that with greater self-reported relevance for worse-than-expected results, there will be a stronger subjective negative affect and greater increases in *corrugator supercilii* activity. In addition, with greater self-reported relevance for better-than-expected results, there will be a stronger subjective positive affect and greater increases in *zygomaticus major* activity. Secondly, for self-accountability, there are asymmetrical effects across conditions, reflecting a different impact of taking responsibility for success and failure. More specifically, it was predicted that lower self-reported self-accountability for better-than-expected results is associated with lower subjective positive affect and lower *zygomaticus major* activity. Meanwhile higher self-reported self-accountability for worse-than-expected results is associated with higher subjective negative affect and higher *corrugator supercilii* activity. Explanatory analyses were conducted for the appraisal dimensions congruence, other-accountability, fairness, control, urgency and emotional coping.

### **Contribution of the Author**

The author of this master's thesis took part in designing and piloting the study. The author contributed to the preparation of the ethics committee application, the selection and collection of the pre- and post-experiment questionnaires, the creation of laboratory experiment design and instructions. The author contributed to the recruitment process for the study, and was responsible for the logistics of the laboratory experiment. The author also helped to conduct the pilot studies, as well as conducted 30 laboratory experiments, wrote the current thesis and executed all the statistical analysis on preprocessed data presented in the current master's thesis.

A bachelor level research paper was also written on the laboratory experiment of this paper focusing on the EEG data (Armulik, 2026).

## Method

### Participants

A total of 50 people (44 female, age range 18 and 59 years,  $M = 25.90$  years,  $SD = 8.47$ ) participated in the laboratory experiment. Due to missing EMG data 1 participant was excluded from analyses (see the EMG Recording and Preprocessing section; final  $N = 49$ , 43 female; aged  $M = 25.94$  years,  $SD = 8.56$ ). Table 1 presents the distribution of the final sample by field of study, highest level of education, and current year of studies.

**Table 1**

*Distribution of participants in the final sample by field of study, highest level of education and current year of studies*

	The number of participants	Proportion of the final sample
<b>Field of study</b>		
Psychology	36	73.5%
Natural Sciences and Technology	5	10.2%
Health Sciences	3	6.1%
Economics and Business	2	4.1%
Education	2	4.1%
Other	1	2.0%
<b>Highest level of education</b>		
Secondary Education	29	59.2%
Vocational Education	1	2.0%
Bachelor's Degree	12	24.5%
Master's Degree	7	14.3%
<b>Current year of studies</b>		
Bachelor's I year	14	28.6%
Bachelor's II year	16	32.7%
Bachelor's III year	8	16.3%
Master's I year	5	10.2%
Master's II year	6	12.2%

*Notes.* Time spent on academic leave is not included in the current year of studies.

Only adult Estonian-speaking students from bachelor's, master's and integrated medicine programs at the University of Tartu who took at least four graded courses in the fall semester of the 2025/2026 academic year, were invited to take part in the study.

The participants were primarily recruited using an advertisement on the website of the Department of Psychology, posters placed in the academic buildings of the University of Tartu, as well as using social media and the mailing lists of the University of Tartu and through student organizations. In addition, some of the participants were recruited using an earlier survey study in May 2025 on individual differences and the appraisal of academic performance. Participants who confirmed their consent to being invited to participate in a laboratory experiment were asked to enter their email address, where an invitation was sent.

### **Procedure and Design**

The study consisted of four parts: pre-experiment questionnaire, laboratory experiment, post-experiment questionnaire, and a follow-up questionnaire.

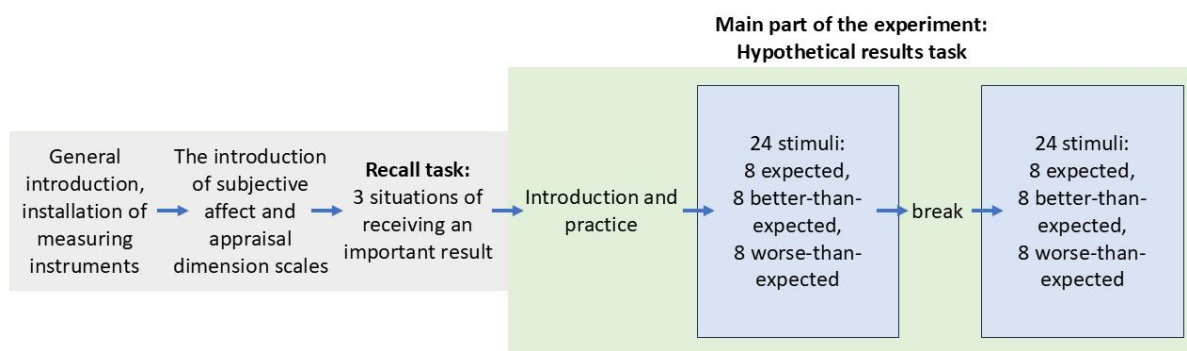
In the pre-experiment questionnaire on the Formr.org platform, the participants were asked to list all the courses with a distinct final grade in which they were enrolled during the fall semester of 2025, and for which they had not yet received a final grade. They were asked to list the courses from the most to least important. The participants were then asked to think about the expected outcome of each course and assess what the expected final grade would be in terms of a percentage and a distinct grade from F to A. The participants were also asked to assess what result would make them feel very good and very bad, as well as provide a short name for each course that they would use in everyday settings. The participants were then asked to fill out various questionnaires regarding their self-beliefs, attribution styles, emotion regulation habits and beliefs, and individual differences, that are not analyzed in this master's thesis. The participants who were recruited using the earlier study completed only sections about demographics and predicted results of their current courses. The complete list of questionnaires included in the pre-experiment questionnaire is in Appendix 1.

The laboratory experiments were conducted individually at the University of Tartu Laboratory of Experimental Psychology at Ravila 14a Tartu, Estonia from 22<sup>nd</sup> of October to 7<sup>th</sup> of December 2025. Upon arrival the participants confirmed informed consent. The experiments were conducted in an electrically shielded, quiet, and dimly lit room. The participants sat 80 cm from the monitor and used a mouse and keyboard placed on their lap to progress in the experiment. The PsychoPy desktop application (version 3.2.4) was used to display stimuli (Peirce, 2007).

The main part of the laboratory experiment was a hypothetical results task using stimuli created based on the information the participant had provided in the pre-experiment questionnaire (see below for the description of the task). Additionally, there was a recall task before the main part of the experiment, which is not analyzed in this master's thesis. During the recall task the participants were asked to recall three different situations when they had received an important exam or course results. The purpose of this task was to familiarize the participants with the scales as well as to encourage more vivid imagination for the hypothetical results task. Before the recollection task, the subjective affect and appraisal dimension scales were introduced (See section Self-Report Measures for the description of subjective affect scales and appraisals used). The complete experimental design is presented in Figure 1.

**Figure 1**

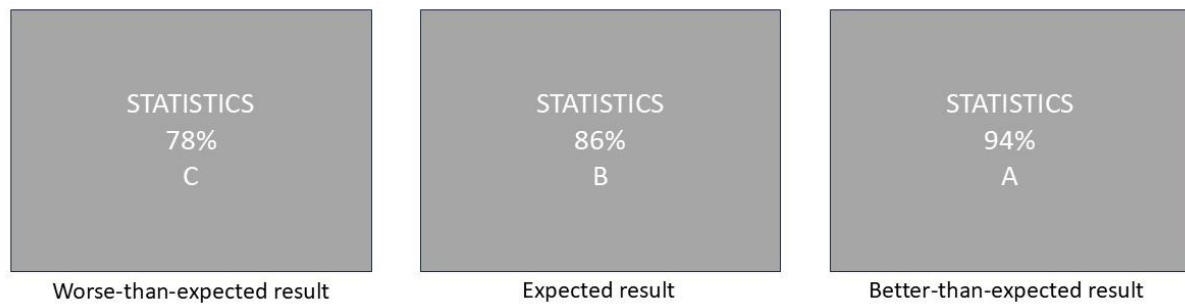
*Experimental design*



For the main part of the laboratory experiment, a personal set of stimuli was created using the input from the pre-experiment questionnaire. The participants were asked to list the courses from most to least important and the set was created using the four subjectively most important courses (the first four courses listed). The stimulus consisted of the name of the course that the participant had provided in the pre-experiment questionnaire as “How do you usually call this course?”, a hypothetical result of the course as a percentage, and a final grade as a letter using the scheme where A = 91-100%, B = 81-90%, C = 71-80%, D = 61-70%, E = 51-60%, F = <51% (Figure 2). The stimuli were generated falling into three experimental conditions: *expected* results, *better-than-expected* results, and *worse-than-expected* results, based on the percentages provided by the participant for the expected grade, grade that would evoke a very positive emotional reaction, and grade that would evoke a very negative emotional reaction, as reference points.

**Figure 2**

*An example set of stimuli*



For the creation of hypothetical results, the 100% scale was divided into 5-point ranges in a way that each letter grade was divided into two corresponding ranges, in accordance with the predominant grading scheme in Estonia (96-100% and 91-95% for A, 86-90% and 81-85% for B, etc.). For each category (*expected*, *better-than-expected*, and *worse-than-expected* results) four stimuli were randomly generated within the 5-point range where the participant's corresponding response fell. This procedure resulted in 48 total stimuli (four results for the category of *expected* results, four results for the category of *better-than-expected* results, and four results for the category of *worse-than-expected* results). If the *expected* result and *better-than-expected* result the participant provided fell into the same 5-point radius category, the stimuli for the latter were generated within the next 5-point radius. Similarly, if the *expected* result and *worse-than-expected* result the participant provided fell into the same 5-point radius category, the stimuli for the latter were generated within the preceding 5-point radius. If both the predicted and very positively perceived results fell the 96-100% range, the scale was extended by 5 points and a new category of A+ (with a result of 101-105%) was used for the *better-than-expected* results condition. The means and standard deviations of the results participants provided themselves as well as results that were shown during the experiment by condition are presented in Table 2.

**Table 2**

*The means (M) and standard deviations (SD) of the results by percentage participants provided, and results by percentage shown depending on the condition*

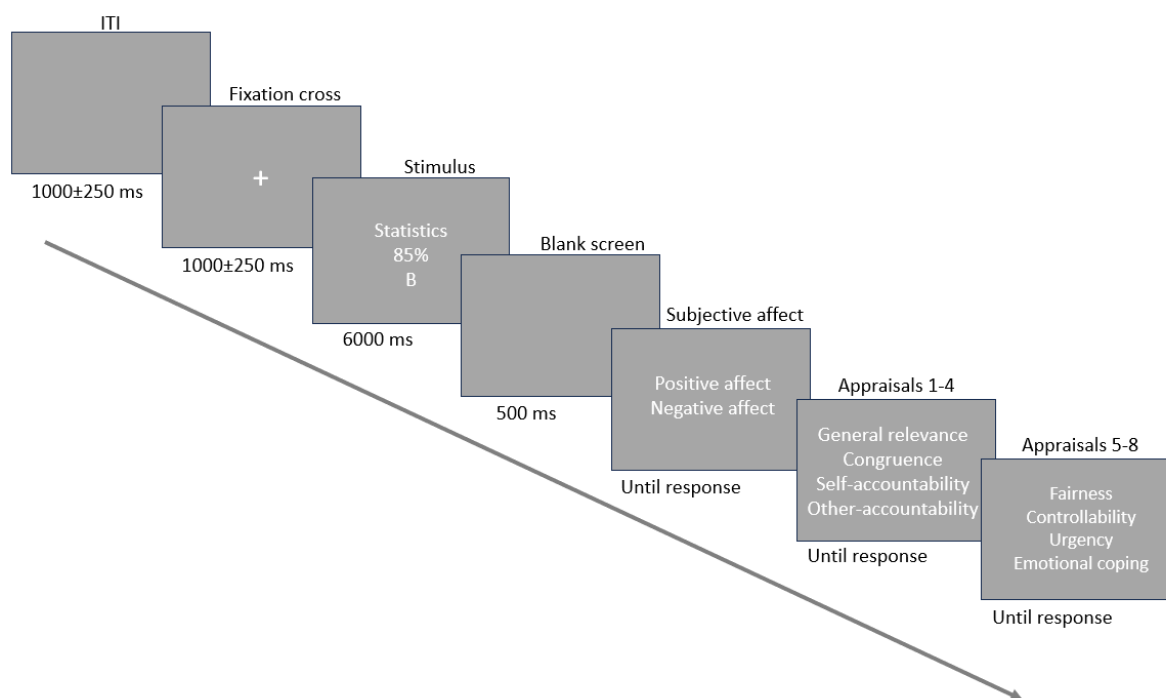
	Results provided		Results shown	
	M (%)	SD	M (%)	SD
<b>Condition</b>				
Expected	80.97	10.58	80.43	11.08
Better-than-expected	89.69	8.37	90.13	8.664
Worse-than-expected	57.02	13.47	56.36	12.72

Notes. Sample size: participants = 49; courses = 196; observations = 2149 including 730 for expected, 706 for better-than-expected, and 713 for worse-than-expected results.

During the experiment the stimuli were pseudorandomized, meaning that the stimuli were presented with the rule that the same course was not displayed more than twice in a row and no more than two grades from the same category (*better-than-expected*, *worse-than-expected* and *expected* results) were displayed in a row. The 48 stimuli were divided into two equal parts with a short break in between the blocks.

During the task, the participants were instructed to imagine receiving the result displayed in the given course. The participants were to imagine the moment of getting the result as realistically as possible. Before the start of the task, the participants were familiarized with the task as well as practicing the task with three example stimuli.

Each trial (see Figure 3) began with an inter-trial interval (ITI) for ( $1000 \pm 250$  ms), followed by a fixation cross ( $1,000$  ms  $\pm 250$  ms), followed by a stimulus (6,000 ms), and a blank screen (500 ms). This was followed by the scales assessing subjective affect and appraisals in a fixed order (until response). See Self-Report Measures for the description of subjective affect scales and appraisals used.

**Figure 3***Single trial*

Notes. ITI – inter-trial interval

After the end of the experiment, the participants were asked to complete a post-experiment questionnaire on the Formr.org platform regarding the difficulty answering the self-report questions and the overall task, as well as questions regarding their mood, symptoms of depression and anxiety disorders, and use of emotion regulation. The results of the post-experiment questionnaires are not analyzed in this master's thesis. The complete list of questionnaires included in the post-experiment questionnaire is provided in Appendix 2. After completing the post-experiment questionnaire, the participants were debriefed regarding the general aim of the experiment.

The follow-up questionnaire was sent to the participants emails provided in the pre-experiment questionnaire. The participants were asked to fill the follow-up questionnaire on the Formr.org platform from 27<sup>th</sup> February to 31<sup>st</sup> March in 2026. The participants were asked to report the actual results of the courses they provided in the pre-experiment questionnaire. They were then asked to assess their subjective affect and appraisals regarding each result (see Measures). The participants also answered again questions regarding their mood, symptoms of depression and anxiety disorders, and use of emotion regulation. The complete list of questionnaires included in the follow-up questionnaire is provided in Appendix 3.

## Measures

### *Self-Report Measures*

Subjective positive and negative affect were assessed using two unipolar scales measuring how negative and how positive participants would feel if they were to receive a particular hypothetical result. Responses were recorded on 9-point Likert scales ranging from “not negative at all” (0 points) to “very negative” (8 points), and “not positive at all” (0 points) to “very positive” (8 points).

The appraisals were assessed using eight items using a prompt “If I were in this situation, I would think that...”. The participants were asked to assess the agreement with the statements on 9-point Likert scales ranging from “completely disagree” (0 points) to “completely agree” (8 points). The items targeted four appraisal dimensions: congruence, relevance, control, and accountability. The prompts presented to participants in Estonian are provided in Appendix 4.

The congruence was assessed using one item (“This is a good result.”). The relevance was assessed using two items – one for general relevance (“This result is important to me.”) and another for urgency (“I need to do something about the result right away.”). The control was assessed using two items – one for general controllability (“This outcome was under my control.”) one for emotional coping (“I can cope with the emotions caused by this result.”). The accountability was assessed using three items – one for self-accountability (“I am responsible for this outcome.”), one for other-accountability (“Someone else is responsible for this outcome.”), and one for fairness (“This result was fair.”). Therefore, a total of eight items were prompted.

### *EMG Recording and Preprocessing*

EEG and EMG signals were recorded using a BioSemi ActiveTwo system at a frequency of 512 Hz. EEGLAB and Matlab software were used for data preprocessing. A total of four electrodes were attached to the participant's face with double-sided tape to measure the activity of the muscles involved in emotional facial expressions. To measure the activity of the *corrugator supercilii*, two electrodes were placed above the left eyebrow. One electrode was placed above the inner corner of the eye, and the second electrode 1 cm away from the first. To measure the activity of the *zygomaticus major*, two electrodes were placed on the left cheek. One electrode was placed 2.5 cm from the corner of the mouth along an imaginary line from the corner of the mouth to the ear, and the second electrode 1 cm away from the first electrode along an imaginary line from the corner of the mouth to the ear.

Additionally, continuous EEG recordings were made using 32 electrodes on the scalp, two electrodes on the temples to detect eye movements and blinks, as well as two reference electrodes on the earlobes. The data from EEG recordings is not analyzed in the current study.

For both facial muscles, the signal from one electrode was subtracted from the other. The bipolar signal was first band-pass filtered between 20 and 500 Hz and then notch filtered between 48-52 Hz. The signal was then corrected by taking the square root of each time point and smoothed by computing a moving average within a 125 ms window. The signal was then segmented from -750 ms before the onset of the image presentation to 6000 ms after the onset of the image presentation. Segments were excluded from the analysis as artifacts if their values differed from the baseline level by more than 5 within-subject standard deviations at any point. EMG scores for both face muscles were calculated as the change in activity relative to the baseline period (i.e., -750 ms to the stimulus onset) and averaged over the period 0 ms to 6000 ms (i.e., until stimulus offset).

If after cleaning the EMG data, more than 50% of trials in any of the three experimental conditions (*expected* result, *better-than-expected* result, *worse-than-expected* result) by four courses (provided by the participant) cells were missing, all the EMG data from the participant collected in response to that course was pairwise removed from the final analysis. In addition, if more than 50% of trials in any of the three experimental conditions were missing, the data of that participant was pairwise removed from the final analysis. The EMG data for one participant was not recorded due to an error in recording process and was therefore excluded from the final sample. The data of all the other participants met the criteria described above and was included in the analyses.

### **Research Ethics**

An approval for the experiment was obtained from the Human Research Ethics Committee of the University of Tartu (approval number 403/T-11). Participation in the study was voluntary and did not involve significant health or social risks. Participation in the study was not recommended for people who may experience epileptic seizures or migraines due to forced posture or a flashing screen.

The participants approved their informed consent after reviewing the informed consent form separately before the pre-experiment questionnaire and the laboratory experiment. The research participants were also informed of their right to withdraw from the study at any time and that it would not result in any consequences. In addition, the research

participants were informed of the possibility of requesting that their data not be used in the analysis and that they will be deleted until the data is anonymized in August 2026.

The data collected during the study was processed in accordance with the General Data Protection Regulation (GDPR). Data that allows the identification of the participants will be retained until the end of the study period (August 2026), after which the data of the participants will be anonymized and, no later than August 2026, all data will be transferred to the University of Tartu and the public archiving servers of scientific data. Anonymous data will be stored indefinitely.

Students of the Department of Psychology at the University of Tartu were able to receive the study credit necessary for the methodology courses for participating in the study. For the pre-experiment survey and the laboratory experiment participants were able to receive a total of four credits for new recruits, or a total of three credits for participants recruited through the earlier study in May 2025. An additional 0,5 credits were possible to receive for completing the follow-up questionnaire in February to March 2026. A raffle of bookstore gift card worth 100 EUR will be held among participants in the study who completed all four stages of the study (pre-experiment questionnaire, laboratory experiment, post-experiment questionnaire, and follow-up questionnaire). In addition, participants received feedback on the results of the personality test completed as part of the study and they could review the results of the master's thesis and research papers prepared based on the study.

### **Statistical Analyses**

The data was analyzed using a statistics program JASP (version 0.96). To test the main effects, 12 separate linear mixed model (LMM) analyses were conducted, one for each dependent variable. The following dependent variables included: self-reported positive and negative affect, changes in facial muscle reactivity (*zygomaticus major* and *corrugator supercilii* activity), and eight appraisal dimensions. Condition (*expected*, *better-than-expected*, and *worse-than-expected* results) was included as a fixed effect. Random intercepts and random slopes for condition were included for both participants and courses nested within participant. Model parameters were estimated using the Satterthwaite approximation for degrees of freedom. For statistically significant main effects, pairwise comparisons with Holm correction were conducted. The results were interpreted using a statistical significance level of  $\alpha = 0.05$ .

Additionally, we used a mass-univariate approach (Groppe et al., 2011) to investigate the timing of condition effects on EMG responses by conducting separate analyses of

variance at each time point and controlling for multiple comparisons using the false discovery rate (FDR) algorithm (Benjamini & Yekutieli, 2001).

To analyze whether some appraisal dimensions moderate the effects of condition on the dependent variables, additional LMMs were conducted in which each appraisal dimension was entered separately as a continuous moderator of the effect of condition. In total, 32 models were conducted across the four dependent variables (subjective positive affect, subjective negative affect, *zygomaticus major* activity, and *corrugator supercilii* activity). The same random-effects structure was initially specified as in the main-effect models. In cases of singular model fit, the random-effects structure was simplified until an acceptable model fit was achieved. The final random-effects structures for all models are reported in Appendix 5. For statistically significant interaction effects, follow-up pairwise comparisons with Holm correction were conducted.

## Results

### Descriptive statistics

Table 3 presents the means and standard deviations of subjective affect, facial muscle reactivity and appraisal ratings depending on whether the presented result was as expected, better-than-expected or worse-than-expected. The correlations between the subjective affect, facial muscle activity and appraisal ratings are presented in Appendix 6.

**Table 3**

*The means (M) and standard deviations (SD) of subjective positive and negative affect, zygomaticus major and corrugator supercilii activity and appraisals depending on the condition*

	Expected		Better-than-expected		Worse-than-expected	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
<b>Subjective Affect</b>						
Positive subjective	5.32	2.31	7.02	1.74	0.82	1.22
Negative subjective	1.81	2.06	0.46	1.17	6.53	1.65
<b>Facial Muscle reactivity</b>						
<i>Zygomaticus major</i>	0.12	0.57	0.25	0.69	-0.02	0.53
<i>Corrugator supercilii</i>	-0.10	0.72	-0.49	0.94	0.02	0.82
<b>Appraisals</b>						
Relevance	6.40	1.70	6.71	1.53	6.56	1.69
Congruence	5.87	2.07	7.50	1.25	0.95	1.37
Self-Accountability	7.18	1.12	7.23	1.13	6.71	1.59
Other-Accountability	1.04	1.680	1.04	1.78	1.29	1.85
Fairness	6.60	1.50	6.99	1.06	4.00	2.67
Control	7.01	1.32	7.14	1.21	6.12	2.07
Urgency	0.66	1.49	0.45	1.29	4.16	3.22
Emotional Coping	7.26	1.20	7.68	0.71	5.00	2.34

*Notes.* Positive and negative subjective affect are measured on a scale of 0 (not positive/negative at all) to 8 (very positive/negative), *zygomaticus major* and *corrugator supercilii* activity are measured in microvolts, appraisals are measured on a scale of 0 (completely disagree) to 8 (completely agree).

### **The effect of expectation violation on subjective affect**

To explore how the subjective positive and negative affect were influenced by the outcome of the condition (expected result, better-than-expected result or worse-than-expected result), two separate linear mixed-effects models were conducted. A statistically significant main effect of condition was found for both subjective positive and negative affect (see Table 4). To further examine these effects, pairwise comparisons with Holm correction were conducted for both models.

**Table 4***The main effects on subjective affect, facial muscle activity and appraisals.*

	df1	df2	<i>F</i>	<i>p</i>
<b>Subjective affect</b>				
Positive subjective affect	2	48.04	408.9	<.001
Negative subjective affect	2	48.04	388.4	<.001
<b>Facial muscle activity</b>				
<i>Zygomaticus major</i> activity	2	48.48	9.18	<.001
<i>Corrugator supercilii</i> activity	2	48.35	26.04	<.001
<b>Appraisals</b>				
Relevance	2	48.34	9.71	<.001
Congruence	2	48.01	587.9	<.001
Self-Accountability	2	48.95	6.49	.003
Other-Accountability	2	49.06	3.52	.037
Fairness	2	48.01	42.66	<.001
Control	2	48.14	11.46	<.001
Urgency	2	47.89	46.67	<.001
Emotional coping	2	48.04	43.41	<.001

*Notes.* df1 ja df2 – degrees of freedom, *F* – F-test statistic, *p* – probability value. Sample size: participants = 49; courses = 196; observations = 2149. Hypothetical results conditions: expected results, better-than-expected results and worse-than-expected results. Each row represents a separately conducted LMM.

The pairwise comparisons showed that subjective positive affect was significantly higher for expected results compared to worse-than-expected results, and significantly higher for better-than-expected results compared to expected results and worse-than-expected results (see Table 5 and Figure 4A). Subjective negative affect was significantly higher for worse-than-expected results compared to expected results and better-than-expected results, as well as significantly higher for expected results compared to better-than-expected results (see Table 5 and Figure 4B).

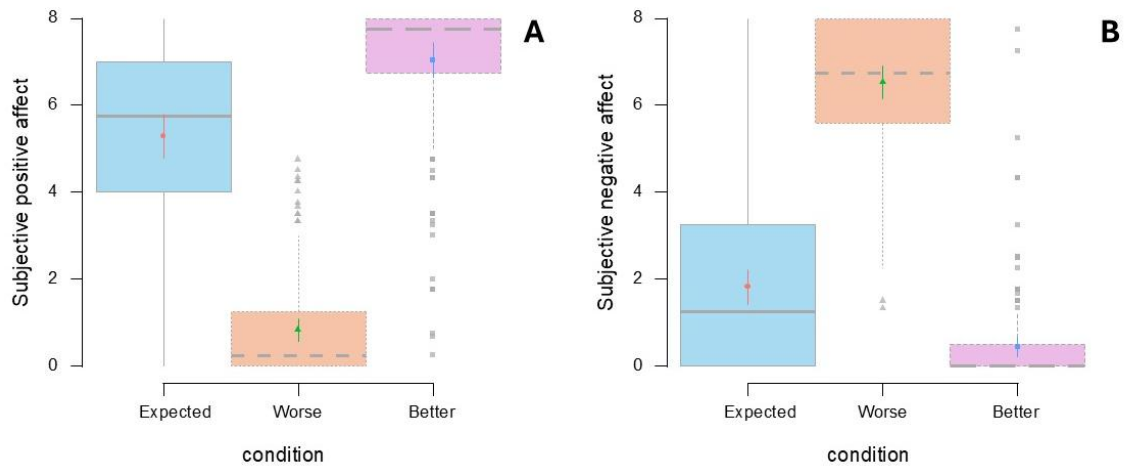
**Table 5***Pairwise condition comparisons for subjective affect, facial muscle activity and appraisals*

Measure	Expected vs Worse							Better vs Expected							Better vs Worse						
	Est.	SE	df	95% CI		<i>t</i>	<i>p</i>	Est.	SE	df	95% CI		<i>t</i>	<i>p</i>	Est.	SE	df	95% CI		<i>t</i>	<i>p</i>
				Lower	Upper						Lower	Upper						Lower	Upper		
<b>Subjective affect</b>																					
Positive affect	4.47	0.24	48.05	3.98	4.96	18.30	<.001	1.75	0.23	48.15	1.28	2.22	7.52	<.001	6.21	0.22	47.99	5.77	6.66	28.20	<.001
Negative affect	-4.70	0.22	48.03	-5.15	-4.25	-20.98	<.001	-1.38	0.22	48.10	-1.81	-0.94	-6.39	<.001	-6.08	0.23	48.08	-6.54	-5.63	-26.81	<.001
<b>Facial muscle activity</b>																					
<i>Zygomaticus major</i>	0.14	0.04	48.09	0.06	0.22	3.448	.002	0.14	0.05	49.38	0.04	0.24	2.86	.006	0.28	0.07	48.64	0.15	0.41	4.21	<.001
<i>Corrugator supercilii</i>	-0.13	0.07	48.74	-0.26	0.00	-1.950	.057	-0.39	0.06	47.39	-0.50	-0.28	-7.00	<.001	-0.51	0.09	48.59	-0.69	-0.34	-5.94	<.001
<b>Appraisals</b>																					
Relevance	-0.14	0.10	48.20	-0.34	0.07	-1.364	.0358	0.32	0.08	48.47	0.16	0.49	3.97	<.001	0.19	0.14	48.24	-0.09	0.46	1.33	.358
Congruence	4.87	0.21	47.96	4.45	5.29	23.25	<.001	1.68	0.20	48.11	1.28	2.07	8.52	<.001	6.54	0.19	48.00	6.15	6.93	33.7	<.001
Self-Accountability	0.47	0.13	48.16	0.21	0.74	3.58	.002	0.04	0.05	49.38	-0.07	0.15	0.80	.427	0.52	0.15	47.29	0.22	0.82	3.49	.002
Other-Accountability	-0.29	0.12	48.13	-0.54	-0.05	-2.42	.058	0.03	0.04	49.35	-0.05	0.12	0.74	.466	-0.26	0.13	47.06	-0.53	0.01	-1.96	.112
Fairness	2.65	0.29	48.01	2.06	3.23	9.15	<.001	0.41	0.13	48.09	0.14	0.68	3.10	.003	3.06	0.34	47.99	2.37	3.74	8.95	<.001
Control	0.90	0.19	48.03	0.52	1.28	4.78	<.001	0.12	0.06	47.84	-0.01	0.25	1.920	.061	1.02	0.22	47.77	0.58	1.46	4.66	<.001
Urgency	-3.50	0.37	47.97	-4.25	-2.76	-9.47	<.001	-0.21	0.16	47.84	-0.52	0.10	-1.34	.187	-3.71	0.39	47.97	-4.50	-2.92	-9.46	<.001
Emotional coping	2.26	0.26	47.99	1.75	2.78	8.86	<.001	0.42	0.11	48.13	0.195	0.64	3.79	<.001	2.68	0.29	48.02	2.10	3.26	9.29	<.001

Notes. Est. (Estimate) = the difference between two conditions; SE = standard error; CI = 95% confidence interval; df = degrees of freedom; *p*-values are adjusted using the Holm correction. Sample size: subjects = 49; courses = 196 observations = 2149. Each row represents a separately conducted LMM.

**Figure 4.**

*Estimated marginal means of subjective positive (A) and subjective negative (B) affect ratings across conditions.*



*Notes.* Boxes represent the interquartile range (25th–75th percentile), with the horizontal line indicating the median. Whiskers extend to 1.5 times the interquartile range. Dots represent outliers. Error bars indicate 95% confidence intervals derived from the linear mixed-effects model. Positive and negative subjective affect are measured on a scale of 0 (not positive/negative at all) to 8 (very positive/negative).

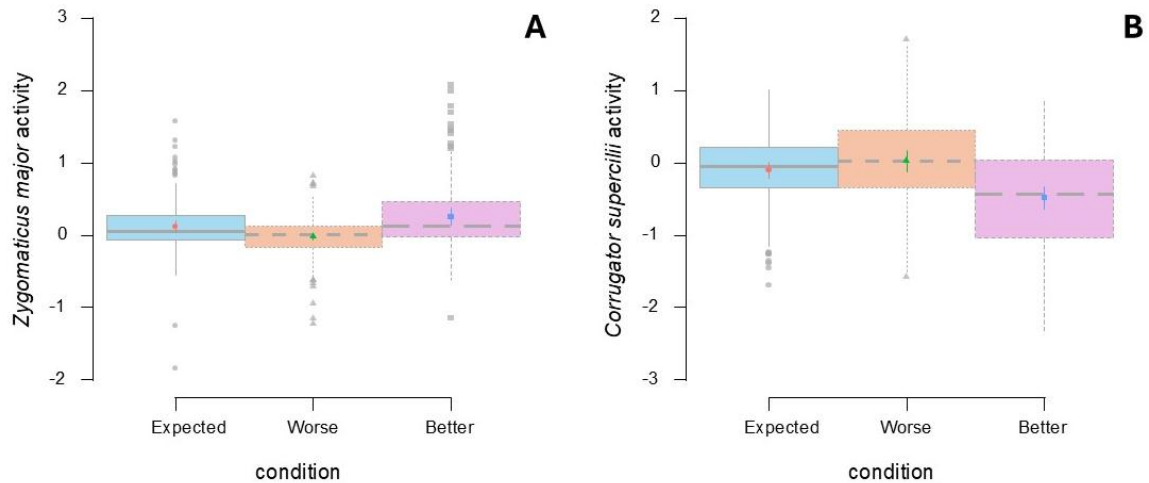
### **The effect of expectation violation on facial myography**

To explore how the *zygomaticus major* and *corrugator supercilii* activity were influenced by the outcome of the condition (expected result, better-than-expected result or worse-than-expected result), 2 separate linear mixed-effects models were conducted. A statistically significant main effect of condition was found for both *zygomaticus major* and *corrugator supercilii* activity (see Table 4). To further examine these effects, pairwise comparisons with Holm correction were conducted for both models.

The pairwise comparisons for facial myography activity showed that *zygomaticus major* activity was significantly higher for expected results compared to worse-than-expected results, as well as significantly higher for better-than-expected results compared to expected results and worse-than-expected results (see Table 5 and Figure 5A). *Corrugator supercilii* activity was significantly higher for worse-than-expected result compared to expected results and better-than-expected results, as well as significantly higher for expected results compared to better-than-expected results (see Table 5 and Figure 5B).

**Figure 5.**

Estimated marginal means of *zygomaticus major* (A) and *corrugator supercilii* (B) activity across conditions.

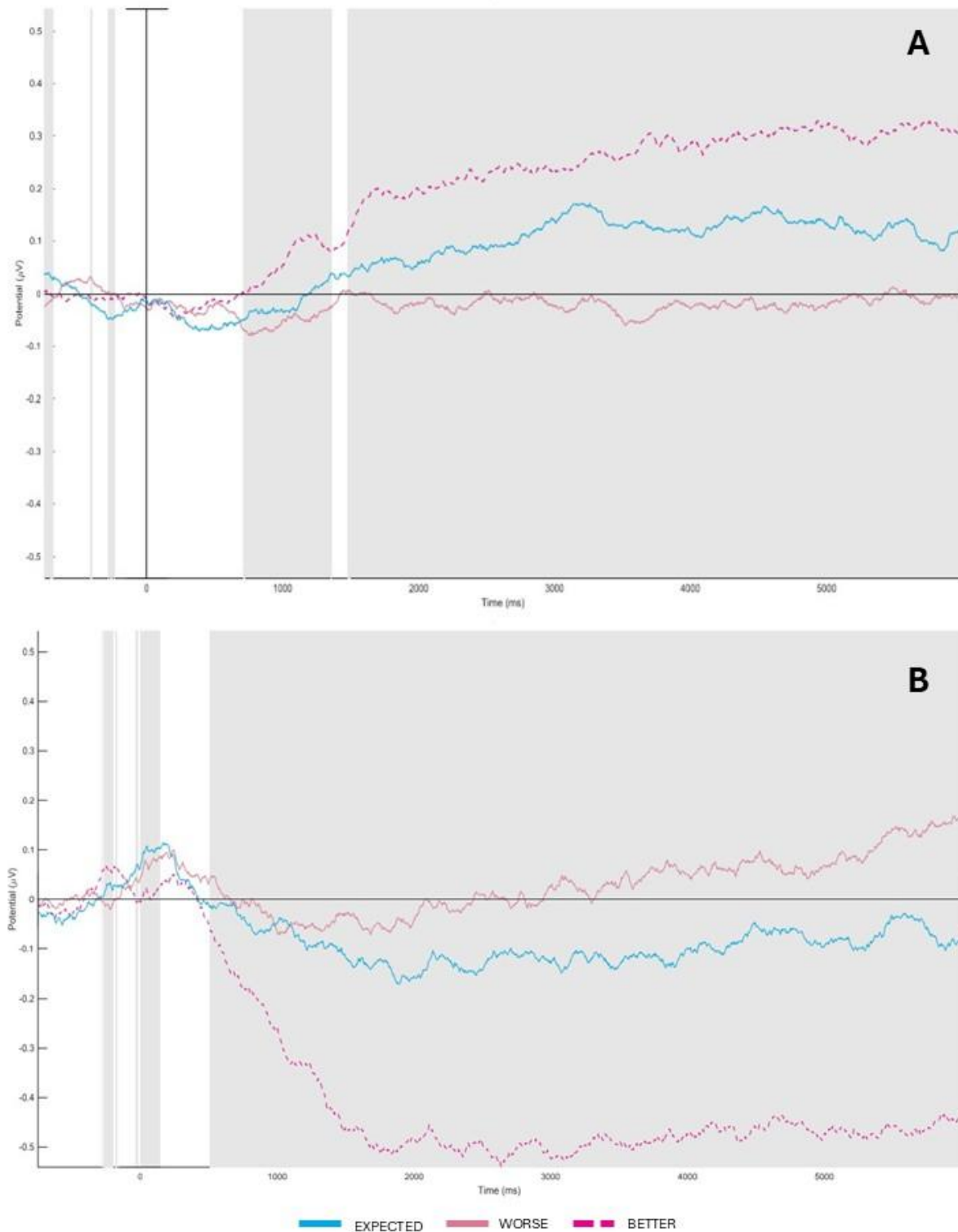


*Notes.* Boxes represent the interquartile range (25th–75th percentile), with the horizontal line indicating the median. Whiskers extend to 1.5 times the interquartile range. Dots represent outliers. Error bars indicate 95% confidence intervals derived from the linear mixed-effects model. *Zygomaticus major* and *corrugator supercilii* activity are measured with the unit of microvolts.

The detailed time course of affective modulation was analyzed using a mass-univariate approach (see the Statistical Analyses section). Figure 6 shows the *zygomaticus major* and *corrugator supercilii* activity response to the expected, better-than-expected and worse-than-expected results with a mass-univariate ANOVA analyses. The grey areas mark a statistically significant difference ( $p < .05$ ) between the conditions using the FDR correction. For *zygomaticus major* activity (Figure 6A), there is a statistically significant difference between the conditions from 720ms to 1350ms, as well as from 1480ms to 6000ms. For *corrugator supercilii* activity (Figure 6B), there is a statistically significant difference between the conditions from 510ms to 6000ms.

**Figure 6.**

*Zygomatcus major* (A) and *corrugator supercilii* (B) activity across conditions.



*Notes.* The x-axis represents time (ms) and the y-axis represents mean activity ( $\mu\text{V}$ ). The grey areas represent time points at which statistically significant differences between conditions were observed using the FDR correction ( $p < .05$ ).

### **The effect of expectation violation on appraisals**

To explore how the appraisal dimensions were influenced by the condition (expected result, better-than-expected result or worse-than-expected result), 8 separate linear mixed-effects models were conducted, one for each dimension. A statistically significant main effect of condition was found for all eight dimensions (see Table 4). To further examine these effects, pairwise comparisons with Holm correction were conducted for all models. The pairwise comparisons for appraisals are shown in Table 5 and corresponding estimated marginal means in Figure 7.

According to the pairwise comparisons relevance was significantly higher for better-than-expected results compared to expected results, as well as significantly higher for worse-than-expected results compared to expected results. There was no statistically significant difference between better-than-expected results and worse-than-expected results.

Congruence was significantly higher for better-than-expected results compared to expected results and worse-than-expected results, as well as significantly higher for expected results compared to worse-than-expected results.

Self-accountability was significantly higher for expected results and better-than-expected results compared to worse-than-expected results but there was no statistically significant difference between better-than-expected results and expected results.

Even though a significant main effect of condition was found for other-accountability, pairwise comparisons with Holm correction did not reveal any statistically significant differences between the conditions.

Fairness was significantly higher for better-than-expected results compared to expected results and worse-than-expected results, as well as significantly higher for expected results compared to worse-than-expected results.

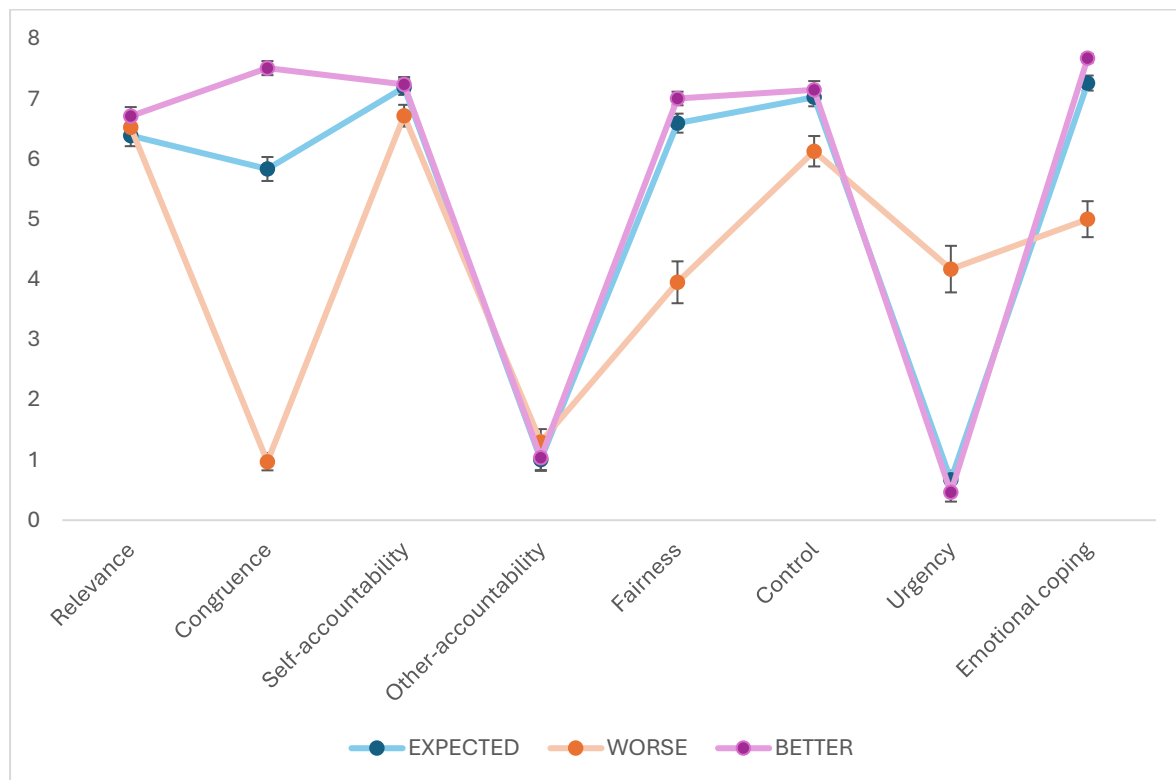
Control was significantly higher for expected and better-than-expected results compared to worse-than-expected results. However, there was no statistically significant difference between better-than-expected results and expected results.

Urgency was significantly higher for worse-than-expected results compared to expected results and better-than-expected results. However, there was no statistically significant difference between better-than-expected results and expected results.

Emotional coping was significantly higher for better-than-expected results compared to expected results and worse-than-expected results, as well as significantly higher for expected results compared to worse-than-expected results.

**Figure 7.**

*Estimated marginal means of appraisal ratings across conditions.*



*Notes.* The points represent estimated marginal means of appraisal rating across conditions; the error bars represent standard errors of the estimated marginal means. Appraisals are measured on a scale of 0 (completely disagree) to 8 (completely agree).

### The Moderating Role of Appraisals

To examine whether appraisal dimensions moderated the effect of condition on each dependent variable (subjective positive affect, subjective negative affect, *zygomaticus major* activity, and *corrugator supercilii* activity), additional LMM analyses were conducted in which each appraisal dimension was entered separately as a continuous moderator of the effect of condition. Model specifications followed those described in the Statistical Analyses section, and the final random-effects structures are reported in Appendix 5.

#### *The Moderating Role of Appraisals on Subjective Positive Affect*

There was a significant main effect of relevance on positive affect (see Table 6). Additionally, there was a statistically significant interaction between condition and relevance for positive affect. As shown in Figure 8A, the association between relevance and positive affect was positive for the expected ( $\beta = 0.20$ ;  $SE = 0.05$ ,  $t_{(47.75)} = 4.44$ ;  $p < .001$ ) and even more positive for the better-than-expected results ( $\beta = 0.33$ ;  $SE = 0.05$ ;  $t_{(59.53)} = 6.78$ ;  $p < .001$ ). In contrast, the association was negative for worse-than-expected results ( $\beta = -0.14$ ;  $SE$

= 0.05;  $t_{(51.93)} = -2.96$ ;  $p = .005$ ) (see Appendix 7 for the pairwise comparisons between the conditions).

There was a significant main effect of congruence on positive affect (see Table 6). Additionally, there was a statistically significant interaction between condition and congruence for positive affect. As shown in Figure 8B, even though the association between congruence and positive affect was positive across all conditions, it increased in strength from the worse-than-expected results ( $\beta = 0.41$ ;  $SE = 0.05$ ;  $t_{(104.2)} = 8.11$ ;  $p < .001$ ) to expected results ( $\beta = 0.65$ ;  $SE = 0.04$ ,  $t_{(60.44)} = 15.11$ ;  $p < .001$ ), and was strongest for the better-than-expected results ( $\beta = 0.76$ ;  $SE = 0.06$ ;  $t_{(164.8)} = 13.17$ ;  $p < .001$ ) (see Appendix 7 for the pairwise comparisons between the conditions).

There was a significant main effect of fairness on positive affect (see Table 6). Additionally, there was a statistically significant interaction between condition and fairness for positive affect. As shown in Figure 8C, the positive association between fairness and positive affect increased in strength from the worse-than-expected results ( $\beta = 0.17$ ;  $SE = 0.05$ ;  $t_{(42.04)} = 3.33$ ;  $p = .002$ ), to better-than-expected results ( $\beta = 0.35$ ;  $SE = 0.07$ ;  $t_{(151.2)} = 5.04$ ;  $p < .001$ ), and was the strongest for the expected results ( $\beta = 0.56$ ;  $SE = 0.06$ ,  $t_{(70.84)} = 9.83$ ;  $p < .001$ ) (see Appendix 7 for the pairwise comparisons between the conditions).

There was a significant main effect of self-accountability on positive affect but no significant interaction between condition and self-accountability (see Table 6). This indicates that increased self-accountability was overall associated with more positive affect ( $\beta = 0.23$ ;  $SE = 0.10$ ,  $t_{(20.62)} = 2.31$ ;  $p = .032$ ), regardless of the hypothetical exam outcome. There was no statistically significant main effect of other-accountability on positive affect (see Table 6). The interaction between condition and other-accountability was also not statistically significant.

There was a significant main effect of control on positive affect (see Table 6). Additionally, there was a statistically significant interaction between condition and control for positive affect. As shown in Figure 8D, the association between control and positive affect was positive for the worse-than-expected ( $\beta = 0.13$ ;  $SE = 0.04$ ;  $t_{(20.41)} = 3.63$ ;  $p = .002$ ), and even more positive for expected results ( $\beta = 0.44$ ;  $SE = 0.10$ ,  $t_{(30.08)} = 4.26$ ;  $p < .001$ ). In contrast, there was no statistically significant association between control and positive affect for better-than-expected results ( $\beta = 0.07$ ;  $SE = 0.12$ ;  $t_{(27.68)} = 0.60$ ;  $p = .555$ ) (see Appendix 7 for the pairwise comparisons between the conditions).

There was a significant main effect of urgency on positive affect (see Table 6). Additionally, there was a statistically significant interaction between condition and urgency for positive affect. As shown in Figure 8E, even though the association between urgency and positive affect was negative across all conditions, it increased in strength from the worse-than-expected results ( $\beta = -0.17$ ;  $SE = 0.04$ ;  $t_{(47.86)} = -4.20$ ;  $p < .001$ ) to the better-than-expected results ( $\beta = -0.28$ ;  $SE = 0.07$ ;  $t_{(250.3)} = -4.21$ ;  $p < .001$ ), and being the strongest for the expected results ( $\beta = -0.44$ ;  $SE = 0.06$ ,  $t_{(158.5)} = -7.55$ ;  $p < .001$ ). Pairwise comparisons indicated that the association differed significantly between the expected and worse-than-expected results ( $p < .001$ ), and between the better-than-expected and expected results ( $p = .044$ ), whereas the difference between the better-than-expected and worse-than-expected results was not statistically significant ( $p = .067$ ). Full pairwise comparisons are reported in Appendix 7.

There was a significant main effect of emotional coping on positive affect (see Table 6), indicating that greater emotional coping was overall associated with more positive affect. Additionally, there was a statistically significant interaction between condition and emotional coping for positive affect. As shown in Figure 8F, even though the association between emotional coping and positive affect was positive across all conditions, it increased in strength from the worse-than-expected results ( $\beta = 0.31$ ;  $SE = 0.07$ ;  $t_{(29.48)} = 4.42$ ;  $p < .001$ ), to better-than-expected results ( $\beta = 0.51$ ;  $SE = 0.10$ ;  $t_{(118.1)} = 5.04$ ;  $p < .001$ ), and was the strongest for the expected results ( $\beta = 0.95$ ;  $SE = 0.08$ ,  $t_{(49.10)} = 11.85$ ;  $p < .001$ ) (see Appendix 7 for the pairwise comparisons between the conditions).

**Table 6**

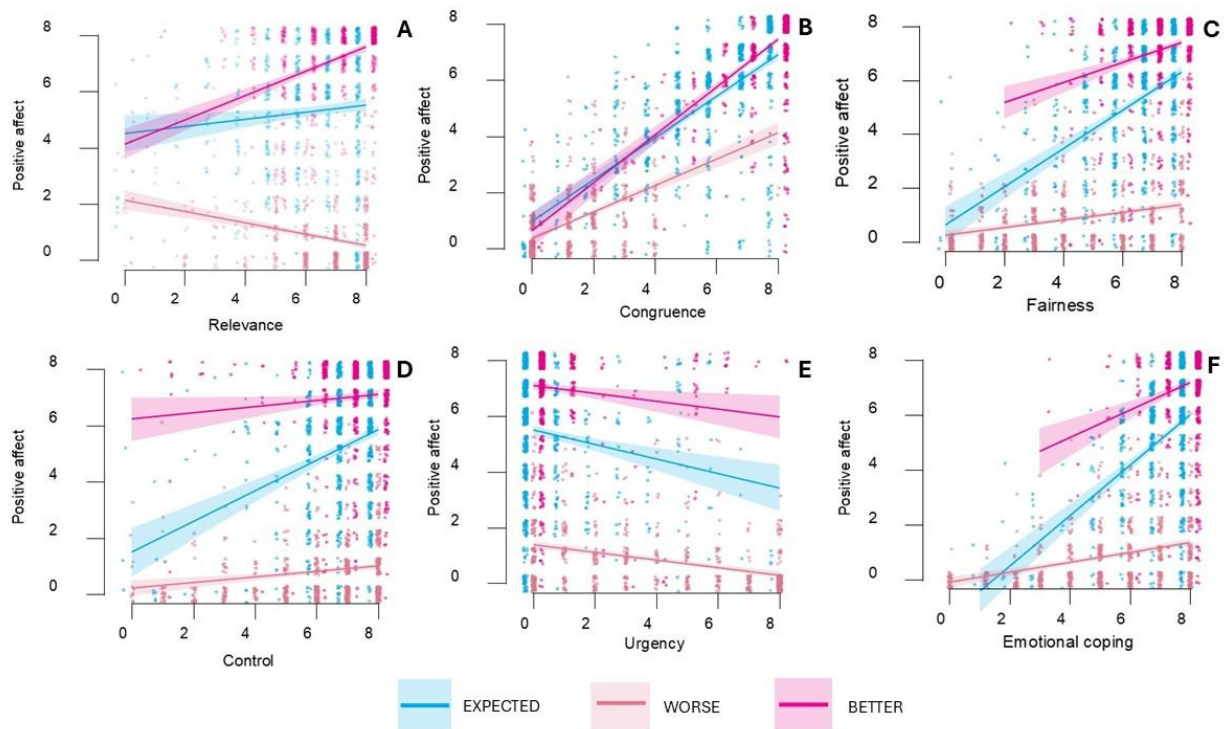
*Summary of LMMs predicting subjective positive affect according to appraisal dimension incorporated in the model*

	Condition main effect				Appraisal dimension main effect				Condition by appraisal dimension interaction			
	df1	df2	<i>F</i>	<i>p</i>	df1	df2	<i>F</i>	<i>p</i>	df1	df2	<i>F</i>	<i>P</i>
Relevance	2	286.54	37.30	<.001	1	25.59	11.56	.002	2	1760.67	53.33	<.001
Congruence	2	96.55	10.51	<.001	1	54.38	210.8	<.001	2	1177.92	23.22	<.001
Self-Accountability	2	16.98	35.57	<.001	1	15.61	7.35	.016	2	17.84	1.00	.389
Other-Accountability	2	42.42	451.3	<.001	1	21.14	<0.001	.986	2	14.26	0.24	.790
Fairness	2	289.52	46.57	<.001	1	38.20	54.82	<.001	2	1209.51	33.85	<.001
Control	2	23.55	26.79	<.001	1	28.24	14.47	<.001	2	23.16	4.48	.023
Urgency	2	52.85	234.3	<.001	1	65.10	43.98	<.001	2	1086.43	14.68	<.001
Emotional Coping	2	531.03	24.98	<.001	1	32.49	67.05	<.001	2	1199.07	64.47	<.001

*Notes.* df1 ja df2 – degrees of freedom, *F* – F-test statistic, *p* – probability value. Sample size: participants = 49; courses = 196; observations = 2149. Hypothetical results conditions: expected results, better-than-expected results and worse-than-expected results. Each row represents a separately conducted LMM.

**Figure 8.**

*Interaction between condition and appraisal in predicting subjective positive affect*



*Notes.* Points represent individual observations. Lines represent linear fits of positive affect on appraisal for each condition, and shaded areas indicate standard errors. Only appraisal dimensions with statistically significant interaction effects are presented. Positive subjective affect is measured on a scale of 0 (not positive) to 8 (very positive), appraisals are measured on a scale of 0 (completely disagree) to 8 (completely agree). A – the interaction between condition and relevance for positive affect, B – the interaction between condition and congruence for positive affect, C – the interaction between condition and fairness for positive affect, D – the interaction between condition and control for positive affect, E – the interaction between condition and urgency for positive affect, F – the interaction between condition and emotional coping for positive affect

### ***The Moderating Role of Appraisals on Subjective Negative Affect***

There was a significant main effect of relevance on negative affect (see Table 7). Additionally, there was a statistically significant interaction between condition and relevance for negative affect. As shown in Figure 9A, the association between relevance and negative affect was positive for the expected ( $\beta = 0.10$ ;  $SE = 0.05$ ,  $t_{(49.79)} = 2.10$ ;  $p = .041$ ), and even more positive for the worse-than-expected results ( $\beta = 0.30$ ;  $SE = 0.05$ ;  $t_{(60.35)} = 6.31$ ;  $p < .001$ ). In contrast, there was no statistically significant association between relevance and negative affect for better-than-expected results ( $\beta = -0.08$ ;  $SE = 0.05$ ;  $t_{(62.73)} = -1.70$ ;  $p = .093$ ) (see Appendix 8 for the pairwise comparisons between the conditions).

There was a significant main effect of congruence on negative affect (see Table 7). Additionally, there was a statistically significant interaction between condition and congruence for negative affect. As shown in Figure 9B, even though the association between congruence and negative affect was negative across all conditions, it increased in strength from the worse-than-expected results ( $\beta = -0.46$ ;  $SE = 0.06$ ;  $t_{(105.4)} = -8.18$ ;  $p < .001$ ), to expected results ( $\beta = -0.62$ ;  $SE = 0.05$ ,  $t_{(60.09)} = -12.89$ ;  $p < .001$ ), and was the strongest for the better-than-expected results ( $\beta = -0.70$ ;  $SE = 0.060$ ;  $t_{(126.7)} = -11.72$ ;  $p < .001$ ). Pairwise comparisons indicated that the association differed significantly between the expected and worse-than-expected results ( $p = .001$ ), and between the better-than-expected and worse-than-expected results ( $p < .001$ ), whereas the difference between the better-than-expected and expected results was not statistically significant ( $p = .079$ ). Full pairwise comparisons are reported in Appendix 8.

There was a significant main effect of fairness on negative affect (see Table 7), indicating that greater fairness was overall associated with less negative affect. Additionally, there was a statistically significant interaction between condition and fairness for negative affect. As shown in Figure 9C, the association between fairness and negative affect increased in strength from the worse-than-expected results ( $\beta = -0.23$ ,  $SE = 0.05$ ,  $t_{(47.78)} = -4.49$ ,  $p < .001$ ), to better-than-expected results ( $\beta = -0.36$ ,  $SE = 0.07$ ,  $t_{(148.8)} = -5.26$ ,  $p < .001$ ), and was the strongest for the expected results ( $\beta = -0.59$ ,  $SE = 0.06$ ,  $t_{(75.67)} = -10.12$ ,  $p < .001$ ) (see Appendix 8 for the pairwise comparisons between the conditions).

There was a significant main effect of self-accountability on negative affect but no significant interaction between condition and self-accountability (see Table 7). This indicates that increased self-accountability was overall associated with negative affect, regardless of the hypothetical result outcome. There was no statistically significant main effect of other-accountability on negative affect (see Table 7). The interaction between condition and other-accountability was also not statistically significant.

There was a significant main effect of control on negative affect (see Table 7). Additionally, there was a statistically significant interaction between condition and control for negative affect. As shown in Figure 9D, the association between control and negative affect was negative for the expected ( $\beta = -0.28$ ,  $SE = 0.07$ ,  $t_{(84.66)} = -4.06$ ,  $p < .001$ ), and even more negative for worse-than-expected results ( $\beta = -0.14$ ,  $SE = 0.06$ ,  $t_{(37.72)} = -2.39$ ,  $p = .022$ ). In contrast, there was no statistically significant association between control and negative affect

for better-than-expected results ( $\beta = -0.13$ ,  $SE = 0.08$ ,  $t_{(120.4)} = -1.70$ ,  $p = .092$ ). Pairwise comparisons between conditions were not statistically significant (see Appendix 8).

There was a significant main effect of urgency on negative affect (see Table 7). Additionally, there was a statistically significant interaction between condition and urgency for negative affect. As shown in Figure 9E, even though the association between urgency and negative affect was positive across all conditions, it increased in strength from the worse-than-expected results ( $\beta = 0.20$ ,  $SE = 0.04$ ,  $t_{(25.66)} = 5.56$ ,  $p < .001$ ), to the expected results ( $\beta = 0.62$ ,  $SE = 0.12$ ,  $t_{(23.97)} = 5.11$ ,  $p < .001$ ), and being the strongest for the better-than-expected results ( $\beta = 0.73$ ,  $SE = 0.15$ ,  $t_{(16.43)} = 5.01$ ,  $p < .001$ ). Pairwise comparisons indicated that the association differed significantly between the expected and worse-than-expected conditions ( $p = .004$ ), and between the better-than-expected and worse-than-expected conditions ( $p = .004$ ), whereas the difference between the better-than-expected and expected conditions was not statistically significant ( $p = .268$ ). Full pairwise comparisons are reported in Appendix 8.

There was a significant main effect of emotional coping on negative affect (see Table 7). Additionally, there was a statistically significant interaction between condition and emotional coping for negative affect. As shown in Figure 9F, even though the association between emotional coping and negative affect was negative across all conditions, it increased in strength from the worse-than-expected results ( $\beta = -0.39$ ,  $SE = 0.07$ ,  $t_{(31.70)} = -5.29$ ,  $p < .001$ ), to the better-than-expected results ( $\beta = -0.66$ ,  $SE = 0.10$ ,  $t_{(107.0)} = -6.57$ ,  $p < .001$ ), and was the strongest for the expected results ( $\beta = -1.10$ ,  $SE = 0.08$ ,  $t_{(49.19)} = -13.19$ ,  $p < .001$ ) (see Appendix 8 for the pairwise comparisons between the conditions).

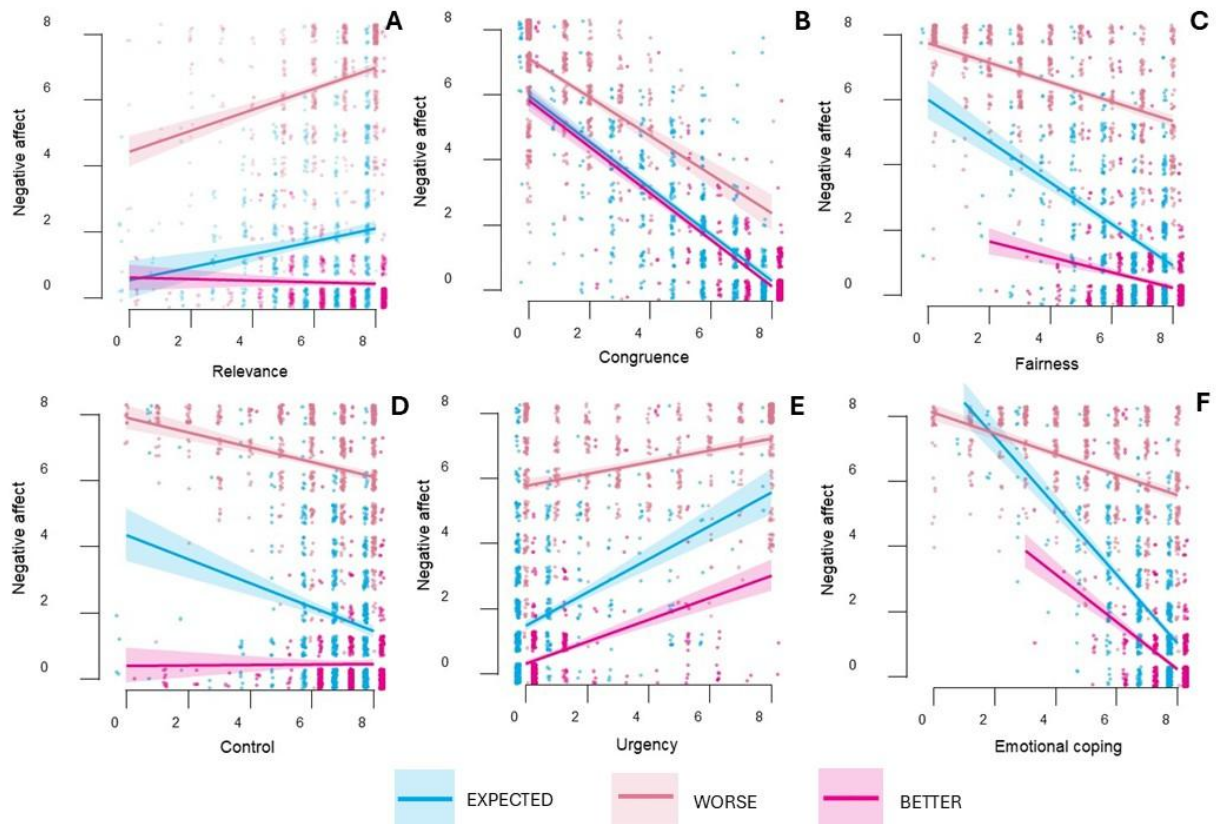
**Table 7***Summary of LMMs predicting subjective negative affect according to appraisal dimension incorporated in the model*

	Condition main effect				Appraisal dimension main effect				Condition by appraisal dimension interaction			
	df1	df2	<i>F</i>	<i>p</i>	df1	df2	<i>F</i>	<i>p</i>	df1	df2	<i>F</i>	<i>P</i>
Relevance	2	337.56	51.16	<.001	1	25.71	7.80	.010	2	1703.21	29.65	<.001
Congruence	2	118.40	12.67	<.001	1	52.92	163.5	<.001	2	1096.40	9.33	<.001
Self-Accountability	2	672.72	96.51	<.001	1	1588.45	5.32	.021	2	1475.86	2.19	.112
Other-Accountability	2	43.51	425.2	<.001	1	18.39	1.19	.290	2	15.26	1.47	.260
Fairness	2	315.86	48.03	<.001	1	39.35	65.29	<.001	2	1284.77	25.13	<.001
Control	2	492.94	65.99	<.001	1	33.92	11.33	.002	2	1024.06	3.26	.039
Urgency	2	48.45	250.7	<.001	1	30.15	34.69	<.001	2	11.95	8.03	.006
Emotional Coping	2	513.44	20.78	<.001	1	32.53	92.71	<.001	2	1173.60	71.21	<.001

*Notes.* df1 ja df2 – degrees of freedom, *F* – F-test statistic, *p* – probability value. Each row represents a separately conducted LMM.

**Figure 9.**

*Interaction between condition and appraisal in predicting subjective negative affect*



*Notes.* Points represent individual observations. Lines represent linear fits of negative affect on appraisal for each condition, and shaded areas indicate standard errors. Only appraisal dimensions with statistically significant interaction effects are presented. Negative subjective affect is measured on a scale of 0 (not negative at all) to 8 (very negative), appraisals are measured on a scale of 0 (completely disagree) to 8 (completely agree). A – the interaction between condition and relevance for negative affect, B – the interaction between condition and congruence for negative affect, C – the interaction between condition and fairness for negative affect, D – the interaction between condition and control for negative affect, E – the interaction between condition and urgency for negative affect, F – the interaction between condition and emotional coping for negative affect

### ***The Moderating Role of Appraisals on Zygomaticus Major Activity***

There was a significant main effect of relevance on mean post-stimulus *zygomaticus major* activity (see Table 8). Additionally, there was a statistically significant interaction between condition and relevance for *zygomaticus major* activity. As shown in Figure 10A, the association between relevance and *zygomaticus major* activity was positive for the expected ( $\beta = 0.04$ ,  $SE = 0.01$ ,  $t_{(437.8)} = 2.96$ ,  $p = .003$ ), and even more so for better-than-expected results ( $\beta = 0.05$ ,  $SE = 0.02$ ,  $t_{(1124)} = 3.11$ ,  $p = .002$ ). In contrast, the association was not

statistically significant for the worse-than-expected results ( $\beta < -0.001$ ,  $SE = 0.01$ ,  $t_{(217.5)} = -0.05$ ,  $p = .964$ ) (see Appendix 9 for the pairwise comparisons between the conditions).

There was a significant main effect of congruence on mean post-stimulus *zygomaticus major* activity (see Table 8). Additionally, there was a statistically significant interaction between condition and congruence for *zygomaticus major* activity. As shown in Figure 10B, the association between congruence and *zygomaticus major* activity was positive for the expected ( $\beta = 0.03$ ,  $SE = 0.01$ ,  $t_{(284.1)} = 2.42$ ,  $p = .016$ ), and even more so for better-than-expected results ( $\beta = 0.08$ ,  $SE = 0.02$ ,  $t_{(726.0)} = 3.92$ ,  $p < .001$ ). In contrast, the association was not statistically significant for the worse-than-expected results ( $\beta = 0.01$ ,  $SE = 0.02$ ,  $t_{(501.5)} = 0.46$ ,  $p = .646$ ) (see Appendix 9 for the pairwise comparisons between the conditions).

There was a significant main effect of self-accountability on mean post-stimulus *zygomaticus major* activity (see Table 8), but no significant interaction between condition and self-accountability. This indicates that increased self-accountability was overall associated with higher *zygomaticus major* activity ( $\beta = 0.05$ ,  $SE = 0.02$ ,  $t_{(1790)} = 2.30$ ,  $p = .021$ ), regardless of the hypothetical result outcome. There was no statistically significant main effect of other-accountability on mean post-stimulus *zygomaticus major* activity (see Table 8). The interaction between condition and other-accountability was also not statistically significant. There was no statistically significant main effect of fairness on mean post-stimulus *zygomaticus major* activity (see Table 8). The interaction between condition and fairness was also not statistically significant. There was no statistically significant main effect of control on mean post-stimulus *zygomaticus major* activity (see Table 8). The interaction between condition and control was also not statistically significant. There was no statistically significant main effect of urgency on mean post-stimulus *zygomaticus major* activity (see Table 8). The interaction between condition and urgency was also not statistically significant. There was a significant main effect of emotional coping on *zygomaticus major* activity, but no significant interaction between condition and emotional coping (see Table 8). This indicates that increased emotional coping was overall associated with *zygomaticus major* activity, regardless of the hypothetical result outcome.

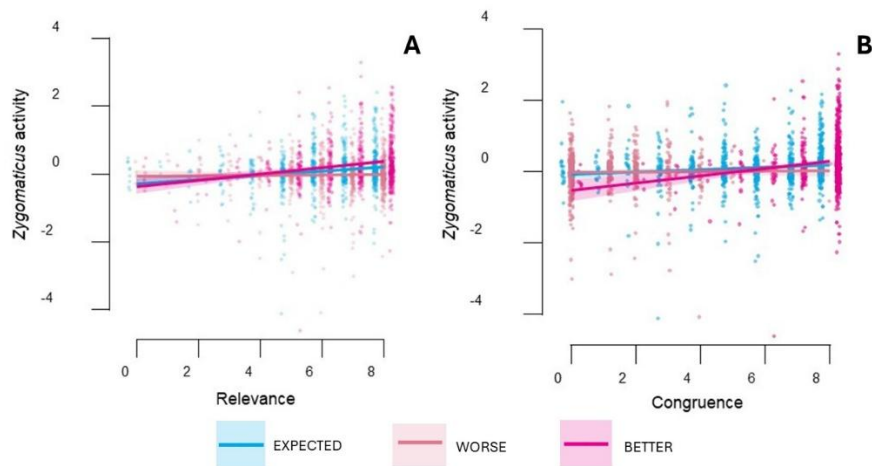
**Table 8***Summary of LMMs predicting zygomaticus major activity according to appraisal dimension incorporated in the model*

	Condition main effect				Appraisal dimension main effect				Condition by appraisal dimension interaction			
	df1	df2	<i>F</i>	<i>p</i>	df1	df2	<i>F</i>	<i>p</i>	df1	df2	<i>F</i>	<i>p</i>
Relevance	2	333.64	0.61	.542	1	509.98	10.86	.001	2	445.72	4.14	.016
Congruence	2	1683.93	2.46	.086	1	182.52	11.39	<.001	2	1323.73	4.02	.018
Self-Accountability	2	2088.78	2.14	.118	1	1083.09	4.32	.038	2	2087.58	1.08	.341
Other-Accountability	2	61.90	9.18	<.001	1	426.45	0.22	.638	2	269.02	0.36	.702
Fairness	2	422.52	0.56	.572	1	1443.78	2.36	.125	2	451.81	1.34	.264
Control	2	167.22	1.28	.280	1	89.29	2.55	.114	2	194.27	0.59	.553
Urgency	2	71.17	6.29	.003	1	1155.88	0.42	.519	2	517.08	0.68	.509
Emotional Coping	2	525.94	0.73	.482	1	1491.11	5.72	.017	2	533.52	2.48	.085

*Notes.* df1 ja df2 – degrees of freedom, *F* – F-test statistic, *p* – probability value. Each row represents a separately conducted LMM.

**Figure 10.**

*Interaction between condition and appraisal in predicting zygomaticus major activity.*



**Notes.** Points represent individual observations. Lines represent linear fits of *zygomaticus major* activity on appraisal for each condition, and shaded areas indicate standard errors. Only appraisal dimensions with statistically significant interaction effects are presented. ***Zygomaticus major* activity is measured with the unit of microvolts, appraisals are measured on a scale of 0 (completely disagree) to 8 (completely agree).** **A – the interaction between condition and relevance for *zygomaticus major* activity, B – the interaction between condition and congruence for *zygomaticus major* activity.** ***The Moderating Role of Appraisals on Corrugator Supercilii Activity***

There was no statistically significant main effect of relevance on mean post-stimulus *corrugator supercilii* activity (see Table 9). However, a statistically significant interaction between condition and relevance was observed. As shown in Figure 11A, the association between relevance and *corrugator supercilii* activity was negative for the better-than-expected results ( $\beta = -0.05$ ,  $SE = 0.02$ ,  $t_{(219.8)} = -2.30$ ,  $p = .022$ ), indicating that higher relevance was associated with lower *corrugator supercilii* activity for better-than-expected results. The association was not statistically significant for the expected ( $\beta = -0.03$ ,  $SE = 0.02$ ,  $t_{(329.6)} = -1.58$ ,  $p = .116$ ), and worse-than-expected results ( $\beta = 0.03$ ,  $SE = 0.02$ ,  $t_{(226.8)} = 1.48$ ,  $p = .140$ ). Pairwise comparisons between the conditions are presented in Appendix 10.

There was a significant main effect of congruence on mean post-stimulus *corrugator supercilii* activity (see Table 9). Additionally, there was a statistically significant interaction between condition and relevance for *zygomaticus major* activity. As shown in Figure 11B, the association between congruence and *corrugator supercilii* activity was negative for the expected ( $\beta = -0.03$ ,  $SE = 0.02$ ,  $t_{(100.5)} = -2.18$ ,  $p = .031$ ), and even more negative for better-than-expected results ( $\beta = -0.13$ ,  $SE = 0.03$ ,  $t_{(264.5)} = -5.04$ ,  $p < .001$ ). In contrast, the

association was positive for worse-than-expected results ( $\beta = 0.06$ ,  $SE = 0.03$ ,  $t_{(507.8)} = 2.55$ ,  $p = .011$ ) (see Appendix 10 for the pairwise comparisons between the conditions).

There was no statistically significant main effect of fairness on mean post-stimulus *corrugator supercilii* activity (see Table 9). However, a statistically significant interaction between condition and fairness was observed. As shown in Figure 11C, the association between fairness and *corrugator supercilii* activity was negative for the better-than-expected results ( $\beta = -0.07$ ,  $SE = 0.03$ ,  $t_{(818.5)} = -2.00$ ,  $p = .046$ ), indicating that higher fairness was associated with lower *corrugator supercilii* activity in this condition. The association was not statistically significant for the expected ( $\beta = -0.04$ ,  $SE = 0.02$ ,  $t_{(377.7)} = -1.87$ ,  $p = .063$ ), and worse-than-expected results ( $\beta = 0.03$ ,  $SE = 0.02$ ,  $t_{(245.8)} = 1.76$ ,  $p = .079$ ). Pairwise comparisons between the conditions are presented in Appendix 10.

There was no statistically significant main effect of self-accountability on mean post-stimulus *corrugator supercilii* activity (see Table 9). The interaction between condition and self-accountability was also not statistically significant. There was no statistically significant main effect of other-accountability on mean post-stimulus *corrugator supercilii* activity (see Table 9). The interaction between condition and other-accountability was also not statistically significant. There was no statistically significant main effect of control on mean post-stimulus *corrugator supercilii* activity (see Table 9). The interaction between condition and control was also not statistically significant. There was no statistically significant main effect of urgency on mean post-stimulus *corrugator supercilii* activity (see Table 9). The interaction between condition and urgency was also not statistically significant. There was no statistically significant main effect of emotional coping on mean post-stimulus *corrugator supercilii* activity (see Table 9). The interaction between condition and emotional coping was also not statistically significant.

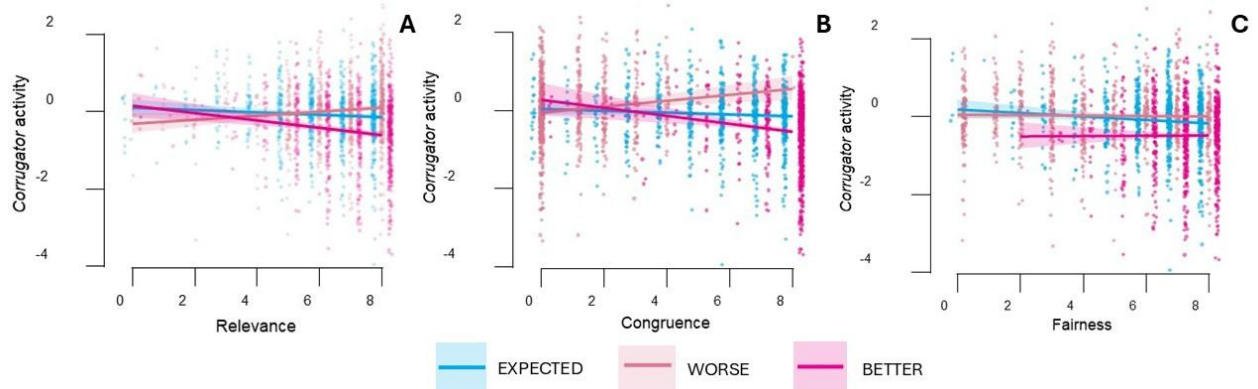
**Table 9***Summary of LMMs predicting corrugator supercilii activity according to appraisal dimension incorporated in the model*

	Condition main effect				Appraisal dimension main effect				Condition by appraisal dimension interaction			
	df1	df2	<i>F</i>	<i>p</i>	df1	df2	<i>F</i>	<i>p</i>	df1	df2	<i>F</i>	<i>P</i>
Relevance	2	355.09	1.39	.250	1	118.45	1.45	.231	2	505.68	4.35	.013
Congruence	2	98.04	3.67	.029	1	157.71	5.67	.018	2	411.14	14.77	<.001
Self-Accountability	2	257.24	1.37	.256	1	1172.74	0.24	.628	2	293.29	1.66	.192
Other-Accountability	2	61.90	26.06	<.001	1	455.82	0.42	.518	2	289.66	2.20	.112
Fairness	2	343.86	1.23	.294	1	1489.35	2.63	.105	2	427.94	5.18	.006
Control	2	165.72	2.63	.075	1	144.11	0.25	.621	2	187.66	0.42	.656
Urgency	2	68.73	27.16	<.001	1	1049.21	0.35	.554	2	458.23	1.46	.235
Emotional Coping	2	227.15	0.37	.690	1	43.85	1.47	.232	2	274.99	2.41	.092

*Notes.* df1 ja df2 – degrees of freedom, *F* – F-test statistic, *p* – probability value. Each row represents a separately conducted LMM.

**Figure 11.**

*Interaction between condition and appraisal in predicting corrugator supercilii activity.*



*Notes.* Points represent individual observations. Lines represent linear fits of *corrugator supercilii* activity on appraisal for each condition, and shaded areas indicate standard errors. Only appraisal dimensions with statistically significant interaction effects are presented. *Corrugator supercilii* activity is measured with the unit of microvolts, appraisals are measured on a scale of 0 (completely disagree) to 8 (completely agree). A – the interaction between condition and relevance for *corrugator supercilii* activity, B – the interaction between condition and congruence for *corrugator supercilii* activity, C – the interaction between condition and fairness for *corrugator supercilii* activity.

## Discussion

The aim of the present study was to investigate the relationship between emotions and appraisals in a personalized experiment. In accordance with this, the first aim of the current study was to develop a personalized experimental paradigm to investigate, how expectations and their violations influence emotional responses and to evaluate, whether the developed paradigm successfully elicited differentiated subjective and physiological emotional reactions. The second aim was to explore how the appraisals change depending on the types of results presented (expected, better-than-expected and worse-than-expected). The third aim was to investigate whether some appraisal dimensions, mainly relevance and self-accountability, moderate these effects. For this, an experiment was conducted in which the participants were shown hypothetical results in three conditions (expected, better-than-expected and worse-than-expected results) for courses that they were enrolled in. During the experiment, the participants were asked to imagine receiving the displayed results as realistically as possible and to rate their subjective positive and negative affect. Additionally, the activity of facial muscles *zygomaticus major* and *corrugator supercilii* was recorded using EMG. The participants also described how they appraise the hypothetical results using eight appraisal dimensions.

In line with two of the hypotheses, the results show that receiving a better-than-expected result led to higher subjective positive affect and higher *zygomaticus major* activity, as well as lower negative subjective affect and lower *corrugator supercilii* activity as opposed to an expected result. In contrast, receiving a worse-than-expected result led to lower subjective positive affect and lower *zygomaticus major* activity as well as higher negative subjective affect and higher *corrugator supercilii* activity as opposed to an expected result. These findings are in line with previous research suggesting that coping with the expectation violations depends upon the valence of the expectation, meaning that individuals respond differently whether they initially expected something more positive or negative. Similarly, it has been shown that outcomes that are better-than-expected tend to elicit positive emotions, whereas outcomes that are worse-than-expected are associated with negative emotional responses (Villano et al., 2020). Previous research has also suggested that people may be more flexible to adjusting to positive expectations than negative ones due to avoidance of testing negative expectations (Pinquart et al., 2021). Together, these findings support the tendency that expectancy violations in personally meaningful academic contexts elicit different subjective and physiological emotional responses depending on whether the outcome is better or worse than expected.

The results showed that *zygomaticus major* activity was consistent with subjective positive affect and *corrugator supercilii* activity was consistent with subjective negative affect. This is in line with previous finds that *zygomaticus major* activity is an objective marker for positive affect and *corrugator supercilii* is an objective marker for negative affect (Davidson & Irwin, 1999; Kreibig et al., 2023; Larsen et al., 2003; Mauss et al., 2005). Additionally, mass-univariate analyses revealed statistically significant differences in *zygomaticus* reactivity between conditions from 720ms to 1350ms as well as from 1480ms to 6000ms, as well as in *corrugator* reactivity from 510ms to 6000ms, showing a fast and lasting difference throughout the presentation of stimuli. The consistency of both subjective and physiological emotional responses shows that there was no noted response bias for subjective responses and therefore supports the validity of created paradigm.

Additional analyzes of EEG responses, specifically late positive potential (LPP), were conducted using data from the same study as part of another thesis (Armulik, 2026). LPP is an event related potential (ERP) component associated with affective arousal and motivated attention (Cuthbert et al., 2000; Hajcak et al., 2010; Olofsson et al., 2008). Contrary to expectations, no significant differences in LPP amplitudes were observed between the

experimental conditions (Armulik, 2026). Even though it has been repeatedly shown, that both pleasant and unpleasant images evoke larger LPP amplitudes than neutral images (e.g. Bradley, 2000; Hamm et al., 2003), it has been also shown that the LPP amplitude level depends on the content displayed (Schupp et al., 2010). Specifically, it has been shown that viewing pictures related to primary motivational imperatives, such as survival of individual and species, are more likely to drive attention and therefore elicit higher LPPs (Schupp et al., 2010). Therefore, it is possible that the hypothetical results were not perceived as a threat or a success enough to require motivational attention. Additionally, viewing similar results multiple times could also decrease the motivational relevance. Future studies could therefore examine whether other EEG components may be more sensitive to emotional responses elicited by personally relevant academic outcomes. Importantly, despite the absence of LPP effects, the significant findings in both facial EMG responses and subjective affect suggest that the paradigm was nevertheless successful in eliciting meaningful emotional reactions.

There were statistically significant differences observed in all examined appraisal dimensions for expected, better-than-expected, and worse-than-expected results. It was found that when receiving a worse-than-expected result, the result was assessed as more relevant and urgent and less congruent, self-accountable, fair and controllable, and harder to emotionally cope with, as opposed to receiving an expected result. Meanwhile when receiving a better-than-expected result, the result was assessed as more relevant, congruent, fair and easier to emotionally cope with, as opposed to receiving an expected result. Additionally, the appraisals were more different for worse-than-expected results compared to expected results. One model that helps to explain the individuals' responses to expectation violations is the ViolEx model which describes expectations as "if-X-then-Y" predictions about the future that can either change or stay the same when reality does not match them (Rief et al., 2015). According to the model, one way of coping with the violation of expectancies is through immunization, thorough which individuals protect their expectations by downplaying or reinterpreting information that contradicts them (Greve & Wentura, 2010). This might include refining their beliefs or appraisals, so the contradiction no longer seems relevant. Students could feel more threatened by the violation of their expectations for worse-than-expected results and therefore have to find ways to interpret it in a different way, such as think that receiving the grade was less fair or out of their control. These differences of appraisals in conditions may therefore help explain why expectancy violations were associated with different emotional responses.

As the created paradigm worked as intended and successfully elicited meaningful subjective and physiological emotional responses, as well as showed significant differences in appraisals between conditions, it was possible to further investigate the relationship between appraisals and emotions with moderator analyses. Based on the moderating effects analyses, the proposed hypothesis for relevance as a moderator of condition on subjective affect was confirmed. The more relevant participants evaluated their result, the more subjectively positive and less subjectively negative they felt for better-than-expected results. As well as the more relevant they evaluated their results the less subjectively positive and more subjectively negative they felt for worse-than-expected results. For expected results, the more relevant participants evaluated their results, the more subjectively positive as well as negative they felt. These patterns were partly confirmed by facial muscle activity. The more relevant participants evaluated their results, the higher was *zygomaticus major* activity for expected results and better-than-expected results and the lower was *corrugator supercilii* activity for better-than-expected results. However, there was no statistical significance of EMG activity for worse-than-expected and expected results. According to Lazarus & Folkman (1984), the personal relevance of an event intensifies emotional responses because it determines how strongly the situation is appraised as significant for one's well-being. The results of the present study are in line with this as higher relevance amplified both positive and negative subjective affect depending on whether the outcome was better or worse than expected. Additionally, Festinger (1962) proposed that the subjective importance of cognitions determines the intensity of psychological discomfort when inconsistencies arise. When results are highly relevant, discrepancies between expectations and outcomes should therefore evoke stronger emotional reactions.

The proposed second hypothesis for self-accountability as a moderator of condition on subjective affect and EMG activity was not confirmed. Specifically, there were no statistically significant interaction effects between self-accountability and outcome expectancy on subjective affect ratings or EMG activity. However, there was a self-accountability main effect on subjective positive and negative affect, as well as *zygomaticus major* activity, indicating that taking more responsibility for the result was associated with higher positive subjective affect and *zygomaticus major* activity. Additionally, taking more self-responsibility for the result was also associated with higher negative subjective affect. One possible explanation for this can be derived from attribution theory, according to which emotional reactions are influenced by how individuals explain the causes of outcomes

(Seligman et al., 1979). Similarly, Control-Value Theory proposes that successes and failures perceived as self-caused may elicit self-conscious emotions, such as pride and shame (Pekrun et al., 2007). Therefore, academic outcomes that are attributed internally may become more personally meaningful and self-relevant, thereby intensifying emotional responses regardless of whether the outcome is positive or negative. However, previous research has suggested that individuals with elevated depressive symptoms may maintain negative expectations by discounting positive outcomes and attributing them to external causes rather than to their own effort or ability (Kube et al., 2020). In contrast, the present study was conducted in a non-clinical student sample, in which participants may have been more likely to internalize positive academic outcomes and attribute them to their own effort or ability. This may partly explain why greater self-accountability was associated with stronger positive emotional responses in the current study

In addition to proposed hypothesis, additional moderator effects of appraisals of experimental conditions on subjective emotional experience and EMG activity were found. There were found similar patterns for appraisal dimensions congruence, fairness, control, and emotional coping. The higher the congruence, fairness, control and emotional coping evaluations, the higher participants evaluated their subjective positive affect for expected and worse-than-expected results. Additionally, the higher the congruence, fairness and emotional coping evaluations, the higher subjects evaluated their subjective positive affect and the lower they evaluated their subjective negative affect for better-than-expected results. This was partly confirmed by facial muscle activity. The more congruent participants evaluated their results the higher was *zygomaticus major* activity for expected results and better-than-expected results and the lower was *corrugator supercilii* activity for expected results and better-than-expected results, however the higher *corrugator supercilii* activity was for worse-than-expected. Additionally, the more urgent participants evaluated their result, the less subjectively positive and more subjectively negative they felt for expected results, better-than-expected results and worse-than-expected results.

It has been shown that emotional responses are created by not only the valence of stimuli but also by how individuals evaluate situations in relation to their goals, coping resources, and perceived control (Scherer, 2001). More specifically, Control-Value Theory proposes that subjective control over achievement outcomes plays a central role in academic emotions, as students' emotional experiences depend partly on whether they perceive academic success and failure as controllable through their own actions and efforts (Pekrun,

2006). From this perspective, higher control and emotional coping evaluations may have contributed to more positive emotional reactions because students perceived the situation as more manageable and less threatening. Similarly, greater congruence and fairness may have reflected the perception that the outcome aligned with personal goals and expectations, thereby promoting more positive emotional experiences. Additionally, the results are in line with previous findings that positive stimuli that are goal congruent elicit more positive emotional facial expressions, such as increased *zygomaticus major* activity and decreased *corrugator supercilii* activity, as well as heightened physiological engagement such as increased heart rate (Aue & Scherer, 2008, 2011). In contrast, goal-incongruent stimuli regardless of their valence trigger stronger physiological mobilization, meaning that the body is ready to respond to the situation (Aue & Scherer, 2008, 2011). This suggests that goal congruence indeed plays a moderator role in emotion. Furthermore, higher urgency evaluations were consistently associated with lower positive affect and higher negative affect, suggesting that perceiving the outcome as requiring immediate attention or action may intensify emotional distress. Lower perceived control may similarly increase uncertainty regarding whether one's preparation efforts adequately matched the demands of the academic situation (Kondo, 1997), thereby contributing to stronger negative emotional reactions.

The present study contributes to the growing literature on emotions and appraisals in academic contexts by introducing a personalized experimental paradigm that combines personally meaningful academic stimuli with experimental control. The findings suggest that expectation violations in academic context can evoke difference subjective, physiological, and appraisal-related responses, therefore making it possible to study emotional reactions and processes as well as appraisals in achievement contexts.

### **Limitations and further research**

Even though the developed experimental paradigm worked as intended, there are some limitations that should be considered. Firstly, the results shown in the experiment were hypothetical academic outcomes, not real grades. Even though the stimuli were personalized, using participants' own courses and expectations, then repeatedly viewing similar results for each condition might lessen the emotional weight of the result compared to real-life academic outcomes. Future studies could address this limitation by examining emotional responses to actual academic outcomes or by increasing the realism and variability of the presented stimuli.

Secondly, the hypothetical result creation system relied on relatively broad grade ranges rather than precise prediction error magnitudes. Previous research has suggested that the size of expectancy violations may influence emotional and coping responses (Afifi & Burgoon, 2000; Roese & Sherman, 2007). Additionally, it has been shown that nearly missing the goal typically drives negative affective processes such as regret (Bell, 1982; Loomes & Sugden, 1982) and disappointment (Bell, 1985; Loomes & Sugden, 1986). Future studies could therefore manipulate prediction error magnitude more systematically, in order to examine how different degrees of expectancy violation influence emotional and appraisal-related responses.

Third, the participants were recruited using a convenience sampling. This resulted in a sample containing mainly psychology bachelor's students (73.5%), female students (88%), and fairly young students ( $M = 25.90$ ,  $SD = 8.47$ ), which might have biased the results. For example, many studies have found that women are more emotionally responsive than men on self-reported emotional experience scales (Bradley et al., 2001; Fujita et al., 1991; Seidlitz & Diener, 1998). Additionally, there are mixed findings regarding physiological responses with some studies supporting the notion that women are more emotionally reactive (e.g. Bradley et al., 2001; Kring & Gordon, 1998; Labouvie-Vief et al., 2003), as well as studies that have not found any differences between men and women (Katkin & Hoffman, 1976; Kelly et al., 2008; Vrana & Rollock, 2002). Therefore, future studies could benefit from more demographically and academically diverse samples in order to better examine potential individual differences in emotional and appraisal processes.

Additionally, participants evaluated outcomes related to different courses, which may have varied in their structure, grading systems, and perceived controllability. For example, some courses may rely on a single final exam, whereas others include multiple assignments or group work, potentially influencing appraisals, such as control or self-accountability independently of the grade itself. Future research could reduce such variability by focusing on more standardized academic contexts, such as students enrolled in the same course (such as psychology bachelor's final exam) or academic program (such as first year economics students).

Another potential limitation for laboratory experiments concerns response bias. Multiple measures were taken to avoid this. Firstly, the participants were informed as little as possible about the aim of the current study. Secondly, to raise the validity of the experiment and minimize the possible response bias for subjective positive and negative affect, the EMG

was also measured which is proven to be an objective positive and negative affect marker. Additionally, to avoid participants knowingly controlling their facial muscle activity, the EMG measuring was not mentioned to the participants. Even though the risks were attempted to be minimized with conscious measure, it remains possible that some participants guessed the aim of the study. Future studies may benefit from including additional implicit or behavioral measures of emotional responding.

Finally, although the paradigm successfully elicited significant subjective and physiological emotional responses, some moderator effects were more consistently observed for subjective affect than for EMG activity. This may partly reflect limited statistical power as well as the generally modest associations between facial muscle activity and subjective emotional experience reported in previous research (e.g. Brown & Schwartz, 1980; Cacioppo et al., 1988; Lang et al., 1993). Additionally, as previously discussed, there were no significant differences in LPP amplitudes observed between the experimental conditions (Armulik, 2026). Future studies with larger samples may help clarify the relationship between appraisal processes, subjective emotional experience, and physiological responses, as well as analyze different ERP components.

Overall, the present study demonstrates the potential of personalized experimental paradigms for investigating emotional responses to expectancy violations in academic contexts. The paradigm may provide a useful framework for examining how individual differences influence emotional and appraisal-related processes in achievement settings. Future research could apply this approach to populations with elevated vulnerability to emotional difficulties, such as students with depressive symptoms or heightened anxiety, as well as to individual difference factors such as perfectionism or neuroticism. More broadly, the paradigm may also be adapted to other performance-related domains, including sports, music, or military contexts. By enabling the experimental investigation of personally meaningful expectancy violations, this approach may help advance the understanding of emotional adjustment and coping processes across different achievement environments.

## **Conclusion**

Based on the results, the created paradigm successfully elicited positive subjective emotional responses for results that were better than participants had expected and negative subjective emotional responses for results that were worse than participants had expected. This pattern was validated by facial muscle activity, specifically *zygomaticus major* activity was raised for better-than-expected results and *corrugator supercilii* activity was raised for

worse-than-expected results. Additionally, specific appraisal patterns were found which differed depending on whether the participants were appraising expected, better-than-expected or worse-than-expected results, which were broadly consistent with theoretical appraisal models. Specifically, worse-than-expected outcomes were characterized by higher relevance and urgency, as well as by lower congruence, self-accountability, fairness, controllability, and emotional coping, whereas better-than-expected outcomes were associated with more relevant, congruent, fair, and emotionally manageable appraisals. Furthermore, several appraisal dimensions moderated subjective emotional responses depending on the type of expectancy outcome, suggesting that emotional reactions to academic results are influenced not only by the outcomes themselves but also by how students interpret and evaluate them.

Overall, the findings support the usefulness of combining personally meaningful academic stimuli with experimental control in the study of emotions and appraisals. The study highlights the importance of understanding how students interpret expectancy violations in academic settings, as these interpretive processes may shape emotional adjustment and potentially influence well-being and academic functioning.

#### **Acknowledgements**

The author would like to sincerely thank the supervisor Helen Uusberg for the continuous advice, support, and encouragement during the process of designing the study, conducting the experiments, analyzing the results, and writing the thesis. The author thanks sincerely supervisor Maria Krajuškina for the advice, support, and encouragement during the process of designing the study, conducting the experiments, and writing the thesis. The author thanks sincerely Richard Naar for the role in software and validation. Additionally, the author thanks Hermann Armulik and Laura Kuusik for the help in creating the instructions and with data collection, as well as all the participants who participated in the experiment and piloting of the study.

### References

- Afifi, W., & Burgoon, J. (2000). The impact of violations on uncertainty and the consequences for attractiveness. *Human Communication Research*, 26(2), 203–233. <https://doi.org/10.1111/j.1468-2958.2000.tb00756.x>
- Allik, J., & Realo, A. (1997). Emotional experience and its relation to the five-factor model in Estonian. *Journal of Personality*, 65(3), 625–647. <https://doi.org/10.1111/j.1467-6494.1997.tb00329.x>
- Aluoja, A., Shlik, J., Vasar, V., Luuk, K., & Leinsalu, M. (1999). Development and psychometric properties of the Emotional State Questionnaire, a self-report questionnaire for depression and anxiety. *Nordic Journal of Psychiatry*, 53(6), 443–449. <https://doi.org/10.1080/080394899427692>
- Armulik, H. (2026). *Ootuspärasest erinevad eksamitulemused: Seos afekti, tõlgenduste ja LPP-ga*. Tartu Ülikool, Sotsiaal- ja haridusteaduskond, psühholoogia instituut.
- Aue, T., & Scherer, K. R. (2008). Appraisal-driven somatovisceral response patterning: Effects of intrinsic pleasantness and goal conduciveness. *Biological Psychology*, 79(2), 158–164. <https://doi.org/10.1016/j.biopsycho.2008.04.004>
- Aue, T., & Scherer, K. R. (2011). Effects of intrinsic pleasantness and goal conduciveness appraisals on somatovisceral responding: Somewhat similar, but not identical. *Biological Psychology*, 86(1), 65–73. <https://doi.org/10.1016/j.biopsycho.2010.10.008>
- Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment*, 13(1), 27–45. <https://doi.org/10.1177/1073191105283504>
- Bandura, A. (1978). Self-efficacy: Toward a unifying theory of behavioral change. *Advances in Behaviour Research and Therapy, Perceived Self-Efficacy: Analyses of Bandura's Theory of Behavioural Change*, 1(4), 139–161. [https://doi.org/10.1016/0146-6402\(78\)90002-4](https://doi.org/10.1016/0146-6402(78)90002-4)
- Beauregard, M., Lévesque, J., & Bourgoin, P. (2001). Neural correlates of conscious self-regulation of emotion. *The Journal of Neuroscience: The Official Journal of the Society for Neuroscience*, 21(18), RC165. <https://doi.org/10.1523/JNEUROSCI.21-18-j0001.2001>
- Bell, D. E. (1982). Regret in Decision Making under Uncertainty. *Operations Research*, 30(5), 961–981. <https://doi.org/10.1287/opre.30.5.961>

- Bell, D. E. (1985). Disappointment in Decision Making Under Uncertainty. *Operations Research*, 33(1), 1–27. <https://doi.org/10.1287/opre.33.1.1>
- Benjamini, Y., & Yekutieli, D. (2001). The control of the false discovery rate in multiple testing under dependency. *The Annals of Statistics*, 29(4), 1165–1188. <https://doi.org/10.1214/aos/1013699998>
- Bhatia, S., Mellers, B., & Walasek, L. (2019). Affective responses to uncertain real-world outcomes: Sentiment change on Twitter. *PLOS ONE*, 14(2), e0212489. <https://doi.org/10.1371/journal.pone.0212489>
- Bögemann, S. A., Puhmann, L. M. C., Wackerhagen, C., Zerban, M., Riepenhausen, A., Köber, G., Yuen, K. S. L., Pooseh, S., Marciniak, M. A., Reppmann, Z., Uściłko, A., Weermeijer, J., Lenferink, D. B., Mituniewicz, J., Robak, N., Donner, N. C., Mestdagh, M., Verdonck, S., van Dick, R., ... Kalisch, R. (2023). Psychological Resilience Factors and Their Association With Weekly Stressor Reactivity During the COVID-19 Outbreak in Europe: Prospective Longitudinal Study. *JMIR Mental Health*, 10, e46518. <https://doi.org/10.2196/46518>
- Bradley, M. M. (2000). Emotion and motivation. In *Handbook of psychophysiology*, 2nd ed (pp. 602–642). Cambridge University Press.
- Bradley, M. M., Codispoti, M., Sabatinelli, D., & Lang, P. J. (2001). Emotion and motivation II: Sex differences in picture processing. *Emotion*, 1(3), 300–319.
- Brown, S.-L., & Schwartz, G. E. (1980). Relationships between facial electromyography and subjective experience during affective imagery. *Biological Psychology*, 11(1), 49–62. [https://doi.org/10.1016/0301-0511\(80\)90026-5](https://doi.org/10.1016/0301-0511(80)90026-5)
- Buhle, J. T., Silvers, J. A., Wager, T. D., Lopez, R., Onyemekwu, C., Kober, H., Weber, J., & Ochsner, K. N. (2014). Cognitive reappraisal of emotion: A meta-analysis of human neuroimaging studies. *Cerebral Cortex*, 24(11), 2981–2990. <https://doi.org/10.1093/cercor/bht154>
- Cacioppo, J. T., Martzke, J. S., Petty, R. E., & Tassinary, L. G. (1988). Specific forms of facial EMG response index emotions during an interview: From Darwin to the continuous flow hypothesis affect-laden information processing. *Journal of Personality and Social Psychology*, 54(4), 592–604. <https://doi.org/10.1037//0022-3514.54.4.592>
- Carver, C. S., & Scheier, M. F. (2001). *On the Self-Regulation of Behavior*. Cambridge University Press.

- Clore, G. L., & Ortony, A. (2000). Cognition in emotion: Always, sometimes, or never? In *Cognitive neuroscience of emotion* (pp. 24–61). Oxford University Press.
- Cuthbert, B. N., Schupp, H. T., Bradley, M. M., Birbaumer, N., & Lang, P. J. (2000). Brain potentials in affective picture processing: Covariation with autonomic arousal and affective report. *Biological Psychology*, *52*(2), 95–111. [https://doi.org/10.1016/s0301-0511\(99\)00044-7](https://doi.org/10.1016/s0301-0511(99)00044-7)
- Davidson, R. J., & Irwin, W. (1999). The functional neuroanatomy of emotion and affective style. *Trends in Cognitive Sciences*, *3*(1), 11–21. [https://doi.org/10.1016/s1364-6613\(98\)01265-0](https://doi.org/10.1016/s1364-6613(98)01265-0)
- Davis, H. A., DiStefano, C., & Schutz, P. A. (2008). Identifying patterns of appraising tests in first-year college students: Implications for anxiety and emotion regulation during test taking. *Journal of Educational Psychology*, *100*(4), 942–960. <https://doi.org/10.1037/a0013096>
- Duffy, A., Keown-Stoneman, C., Goodday, S., Horrocks, J., Lowe, M., King, N., Pickett, W., McNevin, S. H., Cunningham, S., Rivera, D., Bisdounis, L., Bowie, C. R., Harkness, K., & Saunders, K. E. A. (2020). Predictors of mental health and academic outcomes in first-year university students: Identifying prevention and early-intervention targets. *BJPsych Open*, *6*(3), e46. <https://doi.org/10.1192/bjo.2020.24>
- Eldar, E., & Niv, Y. (2015). Interaction between emotional state and learning underlies mood instability. *Nature Communications*, *6*, 6149. <https://doi.org/10.1038/ncomms7149>
- Eldar, E., Rutledge, R. B., Dolan, R. J., & Niv, Y. (2016). Mood as Representation of Momentum. *Trends in Cognitive Sciences*, *20*(1), 15–24. <https://doi.org/10.1016/j.tics.2015.07.010>
- Ellsworth, P., & Scherer, K. (2003). Appraisal Processes in Emotion. *Book Chapters*. [https://repository.law.umich.edu/book\\_chapters/228](https://repository.law.umich.edu/book_chapters/228)
- Enguíanos, D., Aroztegui, J., Iglesias-Soilán, M., Sánchez-San-José, I., & Fernández, J. (2023). Academic Emotions and Regulation Strategies: Interaction with Higher Education Dropout Ideation. *Education Sciences*, *13*(11), 1152. <https://doi.org/10.3390/educsci13111152>
- Fast, N. J., & Chen, S. (2009). When the boss feels inadequate: Power, incompetence, and aggression. *Psychological Science*, *20*(11), 1406–1413. <https://doi.org/10.1111/j.1467-9280.2009.02452.x>

- Feather, N. T. (1967). Valence of outcome and expectation of success in relation to task difficulty and perceived locus of control. *Journal of Personality and Social Psychology*, 7(4), 372–386. <https://doi.org/10.1037/h0025184>
- Festinger, L. (1962). *A Theory of Cognitive Dissonance*. Stanford University Press.
- Frijda, N. H. (1986). *The emotions* (pp. xii, 544). Editions de la Maison des Sciences de l'Homme.
- Frijda, N. H. (2007). *The laws of emotion* (pp. xiv, 352). Lawrence Erlbaum Associates Publishers.
- Fujita, F., Diener, E., & Sandvik, E. (1991). Gender differences in negative affect and well-being: The case for emotional intensity. *Journal of Personality and Social Psychology*, 61(3), 427–434. <https://doi.org/10.1037//0022-3514.61.3.427>
- Gadbois, S. A., & Sturgeon, R. D. (2011). Academic self-handicapping: Relationships with learning specific and general self-perceptions and academic performance over time. *British Journal of Educational Psychology*, 81(2), 207–222. <https://doi.org/10.1348/000709910X522186>
- Garnefski, N., & Kraaij, V. (2006). Cognitive emotion regulation questionnaire – development of a short 18-item version (CERQ-short). *Personality and Individual Differences*, 41(6), 1045–1053. <https://doi.org/10.1016/j.paid.2006.04.010>
- Goldin, P. R., McRae, K., Ramel, W., & Gross, J. J. (2008). The Neural Bases of Emotion Regulation: Reappraisal and Suppression of Negative Emotion. *Biological Psychiatry*, 63(6), 577–586. <https://doi.org/10.1016/j.biopsych.2007.05.031>
- Gollwitzer, M., Thorwart, A., & Meissner, K. (2017). Editorial: Psychological Responses to Violations of Expectations. *Frontiers in Psychology*, 8, 2357. <https://doi.org/10.3389/fpsyg.2017.02357>
- Gratz, K. L., & Roemer, L. (2004). Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and initial validation of the difficulties in emotion regulation scale. *Journal of Psychopathology and Behavioral Assessment*, 26(1), 41–54. <https://doi.org/10.1023/B:JOBA.0000007455.08539.94>
- Greve, W., & Wentura, D. (2010). True lies: Self-stabilization without self-deception. *Consciousness and Cognition, Self, Other and Memory*, 19(3), 721–730. <https://doi.org/10.1016/j.concog.2010.05.016>

- Groppe, D. M., Urbach, T. P., & Kutas, M. (2011). Mass univariate analysis of event-related brain potentials/fields I: A critical tutorial review. *Psychophysiology*, *48*(12), 1711–1725. <https://doi.org/10.1111/j.1469-8986.2011.01273.x>
- 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>
- Hacker, D. J., Bol, L., Horgan, D. D., & Rakow, E. A. (2000). Test prediction and performance in a classroom context. *Journal of Educational Psychology*, *92*(1), 160–170. <https://doi.org/10.1037/0022-0663.92.1.160>
- Hajcak, G., MacNamara, A., & Olvet, D. M. (2010). Event-related potentials, emotion, and emotion regulation: An integrative review. *Developmental Neuropsychology*, *35*(2), 129–155. <https://doi.org/10.1080/87565640903526504>
- Hamm, A., Schupp, H., & Weike, A. (2003). Motivational organization of emotions: Autonomic changes, cortical responses, and reflex modulation. In: R.J. Davidson et al. (Hrsg) *Handbook of Affective Sciences*. Oxford: Oxford University Press 2003, 187–211.
- Hankin, B. L., & Abramson, L. Y. (2001). Development of gender differences in depression: An elaborated cognitive vulnerability–transactional stress theory. *Psychological Bulletin*, *127*(6), 773–796. <https://doi.org/10.1037/0033-2909.127.6.773>
- Hoorens, V. (2012). Expectations. In V. Ramachandran (Ed.). *Encyclopedia of Human Behavior*, 142–149. <https://doi.org/10.1016/B978-0-12-375000-6.00163-4>
- Houston, D. M. (1994). Gloomy but smarter: The academic consequences of attributional style. *British Journal of Social Psychology*, *33*(4), 433–441. <https://doi.org/10.1111/j.2044-8309.1994.tb01039.x>
- Katkin, E. S., & Hoffman, L. S. (1976). Sex differences and self-report of fear: A psychophysiological assessment. *Journal of Abnormal Psychology*, *85*(6), 607–610. <https://doi.org/10.1037//0021-843x.85.6.607>
- Kelly, M. M., Tyrka, A. R., Anderson, G. M., Price, L. H., & Carpenter, L. L. (2008). Sex differences in emotional and physiological responses to the Trier Social Stress Test. *Journal of Behavior Therapy and Experimental Psychiatry*, *39*(1), 87–98. <https://doi.org/10.1016/j.jbtep.2007.02.003>
- Kondo, D. S. (1997). Strategies for coping with test anxiety. *Anxiety, Stress & Coping: An International Journal*, *10*(2), 203–215. <https://doi.org/10.1080/10615809708249301>

- Konstabel, K., Lönnqvist, J., Walkowitz, G., Konstabel, K., & Verkasalo, M. (2012). The 'Short Five' (S5): Measuring personality traits using comprehensive single items. *European Journal of Personality, 26*(1), 13–29. <https://doi.org/10.1002/per.813>
- Krajuškina, M., Naar, R., Uusberg, A., Gross, J. J., & Uusberg, H. (2025). Not just for tough times: The efficacy and mechanisms of positive goal reappraisal in negative, neutral, and positive contexts. *Emotion*. <https://doi.org/10.1037/emo0001613>
- Kreibig, S. D., Brown, A. S., & Gross, J. J. (2023). Quantitative versus qualitative emotion regulation goals: Differential effects on emotional responses. *Psychophysiology, 60*(12), e14387. <https://doi.org/10.1111/psyp.14387>
- Kring, A. M., & Gordon, A. H. (1998). Sex differences in emotion: Expression, experience, and physiology. *Journal of Personality and Social Psychology, 74*(3), 686–703. <https://doi.org/10.1037/0022-3514.74.3.686>
- Kube, T., Schwarting, R., Rozenkrantz, L., Glombiewski, J. A., & Rief, W. (2020). Distorted Cognitive Processes in Major Depression: A Predictive Processing Perspective. *Biological Psychiatry, 87*(5), 388–398. <https://doi.org/10.1016/j.biopsych.2019.07.017>
- Kuppens, P., Dejonckheere, E., Kalokerinos, E. K., & Koval, P. (2022). Some Recommendations on the Use of Daily Life Methods in Affective Science. *Affective Science, 3*(2), 505–515. <https://doi.org/10.1007/s42761-022-00101-0>
- Kuppens, P., & Tong, E. M. W. (2010). An Appraisal Account of Individual Differences in Emotional Experience. *Social and Personality Psychology Compass, 4*(12), 1138–1150. <https://doi.org/10.1111/j.1751-9004.2010.00324.x>
- Labouvie-Vief, G., Lumley, M. A., Jain, E., & Heinze, H. (2003). Age and gender differences in cardiac reactivity and subjective emotion responses to emotional autobiographical memories. *Emotion, 3*(2), 115–126. <https://doi.org/10.1037/1528-3542.3.2.115>
- Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1997). Motivated attention: Affect, activation, and action. In *Attention and orienting: Sensory and motivational processes* (pp. 97–135). Lawrence Erlbaum Associates Publishers.
- Lang, P. J., Greenwald, M. K., Bradley, M. M., & Hamm, A. O. (1993). Looking at pictures: Affective, facial, visceral, and behavioral reactions. *Psychophysiology, 30*(3), 261–273. <https://doi.org/10.1111/j.1469-8986.1993.tb03352.x>
- Larsen, J. T., McGraw, A. P., & Cacioppo, J. T. (2001). Can people feel happy and sad at the same time? *Journal of Personality and Social Psychology, 81*(4), 684–696. <https://doi.org/10.1037/0022-3514.81.4.684>

- Larsen, J. T., Norris, C. J., & Cacioppo, J. T. (2003). Effects of positive and negative affect on electromyographic activity over zygomaticus major and corrugator supercilii. *Psychophysiology*, *40*(5), 776–785. <https://doi.org/10.1111/1469-8986.00078>
- Larsen, J. T., & Norris, J. I. (2009). A facial electromyographic investigation of affective contrast. *Psychophysiology*, *46*(4), 831–842. <https://doi.org/10.1111/j.1469-8986.2009.00820.x>
- Lazarus, R. S. (1991). *Emotion and Adaptation*. Oxford University Press.
- Lazarus, R. S., & Folkman, S. (1984). *Stress, Appraisal, and Coping*. Springer Publishing Company.
- Leow, T., Li, W. W., Miller, D. J., & McDermott, B. (2025). Prevalence of university non-continuation and mental health conditions, and effect of mental health conditions on non-continuation: A systematic review and meta-analysis. *Journal of Mental Health*, *34*(2), 222–237. <https://doi.org/10.1080/09638237.2024.2332812>
- Levi, U., Einav, M., Ziv, O., Raskind, I., & Margalit, M. (2014). Academic expectations and actual achievements: The roles of hope and effort. *European Journal of Psychology of Education*, *29*(3), 367–386. <https://doi.org/10.1007/s10212-013-0203-4>
- Loomes, G., & Sugden, R. (1982). Regret Theory: An Alternative Theory of Rational Choice Under Uncertainty. *The Economic Journal*, *92*(368), 805–824. <https://doi.org/10.2307/2232669>
- Loomes, G., & Sugden, R. (1986). Disappointment and Dynamic Consistency in Choice under Uncertainty. *The Review of Economic Studies*, *53*(2), 271–282. <https://doi.org/10.2307/2297651>
- MacNamara, A. (2018). In the mind's eye: The late positive potential to negative and neutral mental imagery and intolerance of uncertainty. *Psychophysiology*, *55*(5), e13024. <https://doi.org/10.1111/psyp.13024>
- Marsh, H. W. (1990). The structure of academic self-concept: The Marsh/Shavelson model. *Journal of Educational Psychology*, *82*(4), 623–636. <https://doi.org/10.1037/0022-0663.82.4.623>
- Mauss, I. B., Levenson, R. W., McCarter, L., Wilhelm, F. H., & Gross, J. J. (2005). The tie that binds? Coherence among emotion experience, behavior, and physiology. *Emotion*, *5*(2), 175–190. <https://doi.org/10.1037/1528-3542.5.2.175>
- Mauss, I. B., & Robinson, M. D. (2009). Measures of emotion: A review. *Cognition and Emotion*, *23*(2), 209–237. <https://doi.org/10.1080/02699930802204677>

- Medvec, V. H., Madey, S. F., & Gilovich, T. (1995). When less is more: Counterfactual thinking and satisfaction among Olympic medalists. *Journal of Personality and Social Psychology, 69*(4), 603–610. <https://doi.org/10.1037/0022-3514.69.4.603>
- Mellers, B. A. (2000). Choice and the relative pleasure of consequences. *Psychological Bulletin, 126*(6), 910–924. <https://doi.org/10.1037/0033-2909.126.6.910>
- Mobbs, D., Trimmer, P. C., Blumstein, D. T., & Dayan, P. (2018). Foraging for foundations in decision neuroscience: Insights from ethology. *Nature Reviews. Neuroscience, 19*(7), 419–427. <https://doi.org/10.1038/s41583-018-0010-7>
- Moors, A., Ellsworth, P. C., Scherer, K. R., & Frijda, N. H. (2013). Appraisal Theories of Emotion: State of the Art and Future Development. *Emotion Review, 5*(2), 119–124. <https://doi.org/10.1177/1754073912468165>
- Myin-Germeys, I., Oorschot, M., Collip, D., Lataster, J., Delespaul, P., & Os, J. van. (2009). Experience sampling research in psychopathology: Opening the black box of daily life. *Psychological Medicine, 39*(9), 1533–1547. <https://doi.org/10.1017/S0033291708004947>
- Öhman, A., & Soares, J. J. F. (1994). “Unconscious anxiety”: Phobic responses to masked stimuli. *Journal of Abnormal Psychology, 103*(2), 231–240. <https://doi.org/10.1037/0021-843X.103.2.231>
- Olofsson, J. K., Nordin, S., Sequeira, H., & Polich, J. (2008). Affective picture processing: An integrative review of ERP findings. *Biological Psychology, 77*(3), 247–265. <https://doi.org/10.1016/j.biopsycho.2007.11.006>
- Otto, A., Fleming, S., & Glimcher, P. (2016). Unexpected but Incidental Positive Outcomes Predict Real-World Gambling. *Psychological Science, 27*. <https://doi.org/10.1177/0956797615618366>
- Otto, A. R., & Eichstaedt, J. C. (2018). Real-world unexpected outcomes predict city-level mood states and risk-taking behavior. *PloS One, 13*(11), e0206923. <https://doi.org/10.1371/journal.pone.0206923>
- Owens, M., Stevenson, J., Hadwin, J. A., & Norgate, R. (2014). When does anxiety help or hinder cognitive test performance? The role of working memory capacity. *British Journal of Psychology, 105*(1), 92–101. <https://doi.org/10.1111/bjop.12009>
- Peirce, J. W. (2007). PsychoPy—Psychophysics software in Python. *Journal of Neuroscience Methods, 162*(1–2), 8–13. <https://doi.org/10.1016/j.jneumeth.2006.11.017>

- 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. (2016). Success and Failure – Achievement-Related Emotions. In K. M. Quinlan (Ed.), *How Higher Education Feels: Commentaries on Poems That Illuminate Emotions in Learning and Teaching* (pp. 215–236). SensePublishers. [https://doi.org/10.1007/978-94-6300-636-1\\_10](https://doi.org/10.1007/978-94-6300-636-1_10)
- Pekrun, R., Frenzel, A. C., Götz, T., & Perry, R. P. (2007). *The control-value theory of achievement emotions: An integrative approach to emotions in education. Emotion in education, 13–36.*
- Pekrun, R., Goetz, T., Perry, R. P., Kramer, K., Hochstadt, M., & Molfenter, S. (2004). Beyond test anxiety: Development and validation of the test emotions questionnaire (TEQ). *Anxiety, Stress & Coping: An International Journal, 17*(3), 287–316. <https://doi.org/10.1080/10615800412331303847>
- Peterson, C., & Barrett, L. C. (1987). Explanatory style and academic performance among university freshman. *Journal of Personality and Social Psychology, 53*(3), 603–607. <https://doi.org/10.1037/0022-3514.53.3.603>
- Pinquart, M., Rothers, A., Gollwitzer, M., Khosrowtaj, Z., Pietzsch, M., & Panitz, C. (2021). Predictors of Coping With Expectation Violation: An Integrative Review. *Review of General Psychology, 25*, 108926802110241. <https://doi.org/10.1177/10892680211024123>
- Pullmann, H., & Allik, J. (2000). The Rosenberg Self-Esteem Scale: Its dimensionality, stability and personality correlates in Estonian. *Personality and Individual Differences, 28*(4), 701–715. [https://doi.org/10.1016/S0191-8869\(99\)00132-4](https://doi.org/10.1016/S0191-8869(99)00132-4)
- Pullmann, H., & Allik, J. (2008). Relations of academic and general self-esteem to school achievement. *Personality and Individual Differences, 45*(6), 559–564. <https://doi.org/10.1016/j.paid.2008.06.017>
- Reinart, L., & Uusberg, A. (2024). *Säilenõtkuse mõõdikute BRS ja PAS8 adapteerimine eesti ja vene keelde. Uuringuraport.* Tartu Ülikool, Sotsiaal- ja haridusteaduskond, psühholoogia instituut.
- Reisenzein, R. (1994). Pleasure-arousal theory and the intensity of emotions. *Journal of Personality and Social Psychology, 67*(3), 525–539. <https://doi.org/10.1037/0022-3514.67.3.525>

- Rief, W., Glombiewski, J. A., Gollwitzer, M., Schubö, A., Schwarting, R., & Thorwart, A. (2015). Expectancies as core features of mental disorders. *Current Opinion in Psychiatry*, 28(5), 378. <https://doi.org/10.1097/YCO.0000000000000184>
- Rimm, H., & Jerusalem, M. (1999). Adaptation and validation of an estonian version of the general self-efficacy scale (ESES). *Anxiety, Stress, & Coping*, 12(3), 329–345. <https://doi.org/10.1080/10615809908250481>
- Robinson, M. D., & Clore, G. L. (2002). Belief and feeling: Evidence for an accessibility model of emotional self-report. *Psychological Bulletin*, 128(6), 934–960. <https://doi.org/10.1037/0033-2909.128.6.934>
- Roese, N. J., & Sherman, J. W. (2007). Expectancy. In *Social Psychology: Handbook of Basic Principles* (pp. 91–115). Guilford.
- Roseman, I., & Kaiser, S. (2001). Applications of appraisal theory to understanding, diagnosis, and treating emotional pathology. In *Appraisal processes in emotion: Theory, methods, research* (pp. 249–267). Oxford University Press.
- Roseman, I., & Smith, C. (2001). *Appraisal Theory Overview, Assumptions, Varieties, Controversies* (pp. 3–19). <https://doi.org/10.1093/oso/9780195130072.003.0001>
- Rosenberg, M. (1965). *Rosenberg Self-Esteem Scale (Rosenberg, 1965)*. <https://doi.org/https://doi.org/10.1037/t01038-000>
- Russell, J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology*, 39(6), 1161–1178. <https://doi.org/10.1037/h0077714>
- Russell, J. A., & Barrett, L. F. (1999). Core affect, prototypical emotional episodes, and other things called emotion: Dissecting the elephant. *Journal of Personality and Social Psychology*, 76(5), 805–819. <https://doi.org/10.1037//0022-3514.76.5.805>
- Rutledge, R. B., Skandali, N., Dayan, P., & Dolan, R. J. (2014). A computational and neural model of momentary subjective well-being. *Proceedings of the National Academy of Sciences of the United States of America*, 111(33), 12252–12257. <https://doi.org/10.1073/pnas.1407535111>
- Saarniit, M. (2000). *Estonian Multidimensional Perfectionism Scale: Psychometric properties and relations to personality measures and general mental abilities. Bachelor Thesis. Tartu Ülikool, Sotsiaal- ja haridusteaduskond, psühholoogia instituut.*
- Scherer, K. R. (1984). On the Nature and Function of Emotion: A Component Process Approach. In *Approaches To Emotion*. Psychology Press.

- Scherer, K. R. (2001). Appraisal considered as a process of multilevel sequential checking. In *Appraisal processes in emotion: Theory, methods, research* (pp. 92–120). Oxford University Press.
- Scherer, K. R. (2015). When and Why Are Emotions Disturbed? Suggestions Based on Theory and Data From Emotion Research. *Emotion Review*, 7(3), 238–249. <https://doi.org/10.1177/1754073915575404>
- Scherer, K. R., & Brosch, T. (2009). Culture-specific appraisal biases contribute to emotion dispositions. *European Journal of Personality*, 23(3), 265–288. <https://doi.org/10.1002/per.714>
- Scherer, K. R., & Moors, A. (2019). The Emotion Process: Event Appraisal and Component Differentiation. *Annual Review of Psychology*, 70(Volume 70, 2019), 719–745. <https://doi.org/10.1146/annurev-psych-122216-011854>
- Schupp, H., Cuthbert, B., Bradley, M., Hillman, C., Hamm, A., & Lang, P. (2010). Brain processes in emotional perception: Motivated attention. *First Publ. in: Cognition and Emotion 18 (2004) - 593-611, 18*. <https://doi.org/10.1080/02699930341000239>
- Schutz, P. A., & Davis, H. A. (2000). Emotions and self-regulation during test taking. *Educational Psychologist*, 35(4), 243–256. [https://doi.org/10.1207/S15326985EP3504\\_03](https://doi.org/10.1207/S15326985EP3504_03)
- Seema, R., T.Quaglia, J., Brown, K., Konstabel, K., & Baltin, A. (2014). The Estonian Mindful Attention Awareness Scale: Assessing Mindfulness Without a Distinct Linguistic Present Tense. *Mindfulness*, 6. <https://doi.org/10.1007/s12671-014-0314-2>
- Seidnitz, L., & Diener, E. (1998). Sex differences in the recall of affective experiences. *Journal of Personality and Social Psychology*, 74(1), 262–271. <https://doi.org/10.1037//0022-3514.74.1.262>
- Seligman, M. E., Abramson, L. Y., Semmel, A., & von Baeyer, C. (1979). Depressive attributional style. *Journal of Abnormal Psychology*, 88(3), 242–247. <https://doi.org/10.1037/0021-843X.88.3.242>
- Smidt, J. (2014). *Akadeemilise motivatsiooni skaala adapteerimine eesti keelde. Seminaritöö. Tartu Ülikool, Sotsiaal- ja haridusteaduskond, psühholoogia instituut.*
- Smith, B. W., Dalen, J., Wiggins, K., Tooley, E., Christopher, P., & Bernard, J. (2008). The brief resilience scale: Assessing the ability to bounce back. *International Journal of Behavioral Medicine*, 15(3), 194–200. <https://doi.org/10.1080/10705500802222972>

- Smith, C., & Lazarus, R. (1990). Emotion and Adaptation. In *Contemporary Sociology* (Vol. 21, pp. 609–637). <https://doi.org/10.2307/2075902>
- Suess, F., & Abdel Rahman, R. (2015). Mental imagery of emotions: Electrophysiological evidence. *NeuroImage*, *114*, 147–157. <https://doi.org/10.1016/j.neuroimage.2015.03.063>
- Talpsep, T. (2015). *Measuring mindfulness and self-compassion: A questionnaire and ERP study*. Tartu Ülikool, Sotsiaal- ja haridusteaduskond, psühholoogia instituut.
- Tamir, M., John, O. P., Srivastava, S., & Gross, J. J. (2007). Implicit theories of emotion: Affective and social outcomes across a major life transition. *Journal of Personality and Social Psychology*, *92*(4), 731–744. <https://doi.org/10.1037/0022-3514.92.4.731>
- Tellegen, A., Watson, D., & Clark, L. A. (1999). On the dimensional and hierarchical structure of affect. *Psychological Science*, *10*(4), 297–303. <https://doi.org/10.1111/1467-9280.00157>
- Üpraus, R. (2009). *Akadeemiline edukus: Akadeemilise enesetõhususe mõõtmine. Seminaritöö*. Tartu Ülikool, Sotsiaal- ja haridusteaduskond, psühholoogia instituut.
- Vachtel, I. (2011). *Emotsioonide Reguleerimise Raskuste Skaala konstrueerimine. Magistritöö*. Tartu Ülikool, Sotsiaal- ja haridusteaduskond, psühholoogia instituut.
- Vallerand, R., Pelletier, L., Blais, M., Brière, N., Senécal, C., & Vallières, E. (1992). The Academic Motivation Scale: A Measure of Intrinsic, Extrinsic, and Amotivation in Education. *Educational and Psychological Measurement*, *52*, 1003–1003. <https://doi.org/10.1177/0013164492052004025>
- Van Reekum, C., & Scherer, K. (1997). Levels of processing in emotion-antecedent appraisal. *Advances in Psychology*, *124*, 259–300.
- Vanman, E. J., Paul, B. Y., Ito, T. A., & Miller, N. (1997). The modern face of prejudice and structural features that moderate the effect of cooperation on affect. *Journal of Personality and Social Psychology*, *73*(5), 941–959. <https://doi.org/10.1037/0022-3514.73.5.941>
- Verinis, J. S., Brandsma, J. M., & Cofer, C. N. (1968). Discrepancy from expectation in relation to affect and motivation: Tests of McClelland's hypothesis. *Journal of Personality and Social Psychology*, *9*(1), 47–58. <https://doi.org/10.1037/h0025672>
- Villano, W. J., Otto, A. R., Ezie, C. E. C., Gillis, R., & Heller, A. S. (2020). Temporal dynamics of real-world emotion are more strongly linked to prediction error than outcome.

- Journal of Experimental Psychology: General*, 149(9), 1755–1766.  
<https://doi.org/10.1037/xge0000740>
- Vrana, S. R., & Rollock, D. (2002). The role of ethnicity, gender, emotional content, and contextual differences in physiological, expressive, and self-reported emotional responses to imagery. *Cognition and Emotion*, 16(1), 165–192.  
<https://doi.org/10.1080/02699930143000185>
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54(6), 1063–1070. <https://doi.org/10.1037/0022-3514.54.6.1063>
- Watson, D., Wiese, D., Vaidya, J., & Tellegen, A. (1999). The two general activation systems of affect: Structural findings, evolutionary considerations, and psychobiological evidence. *Journal of Personality and Social Psychology*, 76(5), 820–838.  
<https://doi.org/10.1037/0022-3514.76.5.820>
- Weiner, B. (1979). A theory of motivation for some classroom experiences. *Journal of Educational Psychology*, 71(1), 3–25. <https://doi.org/10.1037/0022-0663.71.1.3>
- Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological Review*, 92(4), 548–573. <https://doi.org/10.1037/0033-295X.92.4.548>
- Weiner, B. (1986). *An Attributional Theory of Motivation and Emotion*. Springer New York.
- Yeo, G. C., & Ong, D. C. (2024). Associations between cognitive appraisals and emotions: A meta-analytic review. *Psychological Bulletin*, 150(12), 1440–1471.  
<https://doi.org/10.1037/bul0000452>
- Zamora, Á., Suárez, J. M., & Ardura, D. (2018). A model of the role of error detection and self-regulation in academic performance. *The Journal of Educational Research*, 111(5), 595–602. <https://doi.org/10.1080/00220671.2017.1349072>
- Zeelenberg, M., & Beattie, J. (1997). Consequences of regret aversion 2: Additional evidence for effects of feedback on decision making. *Organizational Behavior and Human Decision Processes*, 72(1), 63–78. <https://doi.org/10.1006/obhd.1997.2730>

## Appendices

### Appendix 1

*List of questionnaires that participants completed independently in the Formr.org platform before the laboratory experiment. All questionnaires were presented in Estonian.*

1. Demographic information – gender, age, highest level of education, major and course at university
2. Predicted results of the participants' current courses
3. General self-esteem questionnaire (Pullmann & Allik, 2000; Rosenberg, 1965)
4. Academic self-esteem questionnaire (Marsh, 1990; Pullmann & Allik, 2008)
5. Self-efficacy questionnaire (Rimm & Jerusalem, 1999)
6. Academical self-efficacy questionnaire (Bandura, 1978; Üpraus, 2009)
7. Academic motivation questionnaire (Smidt, 2014; Vallerand et al., 1992)
8. Difficulties in emotion regulation (DERS) (Gratz & Roemer, 2004; Vachtel, 2011)
9. Habitual use of emotion regulation strategies (ERQ) (Gross & John, 2003)
10. Beliefs about emotion regulation (Tamir et al., 2007)
11. Cognitive emotion regulation questionnaire (CERQ) (Garnefski & Kraaij, 2006)
12. Positive appraisal style (PAS8) questionnaire (Bögemann et al., 2023; Reinart & Uusberg, 2024)
13. Brief Resilience scale (BRS) (Reinart & Uusberg, 2024; B. W. Smith et al., 2008)
14. Estonian Multidimensional Perfectionism Scale (Saarniit, 2000)
15. Personality XS5 (Konstabel et al., 2012)
16. The Estonian Mindful Attention Awareness Scale (MAAS) (Seema et al., 2014)
17. The Five Facet Mindfulness Questionnaire (FFMQ) (Baer et al., 2006; Talpsep, 2015)

## **Appendix 2**

*List of questionnaires that participants completed independently in the Formr.org platform after the laboratory experiment.*

1. Positive and negative affect scale (PANAS) (Allik & Realo, 1997; Watson et al., 1988)
2. Symptoms of depression and anxiety (EEK-2) (Aluoja et al., 1999)
3. Questions about the perceived difficulty and success of the experimental task

**Appendix 3**

*List of questionnaires that participants completed independently in the Formr.org platform as the follow-up questionnaire.*

1. Participants' actual course results, related subjective positive and negative affect, and appraisals of the outcome (using items adapted from the dependent variables of the experiment)
2. Positive and negative affect scale (PANAS) (Allik & Realo, 1997; Watson et al., 1988)
3. Symptoms of depression and anxiety (EEK-2) (Aluoja et al., 1999)

**Appendix 4**

*The self-reported scales presented to the participants after each hypothetical result stimulus in Estonian.*

**Subjective emotions scales:**

<b>Kuidas sa end selles olukorras tunneksid?</b>										
<b>Kui negatiivselt sa end tunneksid?</b>										
üldse mitte negatiivselt	0	1	2	3	4	5	6	7	8	väga negatiivselt
<b>Kui positiivselt sa end tunneksid?</b>										
üldse mitte positiivselt	0	1	2	3	4	5	6	7	8	väga positiivselt

**Appraisal dimensions:**

<b>Kui ma oleksin selles olukorras, siis mõtleksin, et...</b>										
<b>...see tulemus on mulle oluline</b>										
ei nõustu üldse	-4	-3	-2	-1	0	1	2	3	4	nõustun täielikult
<b>...see on hea tulemus</b>										
ei nõustu üldse	-4	-3	-2	-1	0	1	2	3	4	nõustun täielikult
<b>...mina vastutan selle tulemuse eest</b>										
ei nõustu üldse	-4	-3	-2	-1	0	1	2	3	4	nõustun täielikult
<b>...keegi teine vastutab selle olukorra eest</b>										
ei nõustu üldse	-4	-3	-2	-1	0	1	2	3	4	nõustun täielikult
<b>...see tulemus on õiglane</b>										
ei nõustu üldse	-4	-3	-2	-1	0	1	2	3	4	nõustun täielikult
<b>...see tulemus oli minu kontrolli all</b>										
ei nõustu üldse	-4	-3	-2	-1	0	1	2	3	4	nõustun täielikult
<b>...pean selle tulemuse osas kohe midagi ette võtma</b>										
ei nõustu üldse	-4	-3	-2	-1	0	1	2	3	4	nõustun täielikult
<b>...tulen toime tunnetega, mida see tulemus minus tekitab</b>										
ei nõustu üldse	-4	-3	-2	-1	0	1	2	3	4	nõustun täielikult

**Appendix 5****Table 5.1***Description of Random Factors Included in LMMs Investigating the Moderator Effects*

The LMM	Course nested within participant			Participant	
	Intercept	Intercept	Condition	Appraisal	Condition*Appraisal
<b>Positive affect</b>					
Relevance	✓	✓	✓	✓	
Congruence	✓	✓	✓	✓	
Self-Accountability	✓	✓	✓	✓	✓
Other-Accountability	✓	✓	✓	✓	✓
Fairness	✓	✓	✓	✓	
Control	✓	✓	✓	✓	✓
Urgency	✓	✓	✓	✓	
Emotional Coping	✓	✓	✓	✓	
<b>Negative affect</b>					
Relevance	✓	✓	✓	✓	
Congruence	✓	✓	✓	✓	
Self-Accountability	✓	✓	✓		
Other-Accountability	✓	✓	✓	✓	✓
Fairness	✓	✓	✓	✓	
Control	✓	✓	✓	✓	
Urgency	✓	✓	✓	✓	✓
Emotional Coping	✓	✓	✓	✓	
<b>Zygomaticus activity</b>					
Relevance	✓	✓	✓		
Congruence	✓	✓		✓	
Self-Accountability	✓	✓			
Other-Accountability	✓	✓	✓		
Fairness	✓	✓	✓		

Control	✓	✓	✓	✓
Urgency	✓	✓	✓	
Emotional Coping	✓	✓	✓	
<b><i>Corrugator activity</i></b>				
Relevance	✓	✓	✓	✓
Congruence	✓	✓	✓	✓
Self-Accountability	✓	✓	✓	
Other-Accountability	✓	✓	✓	
Fairness	✓	✓	✓	
Control	✓	✓	✓	✓
Urgency	✓	✓	✓	
Emotional Coping	✓	✓	✓	✓

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*Notes.* ✓ indicates that the corresponding random effect was included in the model. All models included a random intercept for course nested within participant. Random-effects structures were simplified in cases of singular fit.

## Appendix 6

**Table 6.1**

*The correlation matrix of subjective positive and negative affect, zygomaticus major and corrugator supercilii activity and appraisals*

	Positive affect	Negative affect	Zygomaticus activity	Corrugator activity	Relevance	Congruence	Self-Accountability	Other-Accountability	Fairness	Control	Urgency
Negative affect	-0.87***	—									
Zygomaticus activity	0.21***	-0.17***	—								
Corrugator activity	-0.25***	0.23***	-0.25***	—							
Relevance	0.07**	0.08***	0.14***	-0.5*	—						
Congruence	0.89***	-0.91***	0.21***	-0.20***	0.06**	—					
Self-Accountability	0.24***	-0.22***	0.08***	-0.03	0.13***	0.22***	—				
Other-Accountability	-0.14***	0.06**	-0.02	0.02	-0.07***	-0.05***	-0.51***	—			
Fairness	0.61***	-0.67***	0.15***	-0.13***	0.07**	0.64***	0.48***	-0.23***	—		
Control	0.32***	-0.34***	0.11***	-0.08***	0.13***	0.33***	0.80***	-0.43***	0.59***	—	
Urgency	-0.58***	0.65***	-0.09***	0.09***	0.17***	-0.64***	-0.05*	-0.01	-0.44***	-0.13***	—
Emotional Coping	0.63***	-0.70***	0.11***	-0.12***	-0.11***	0.65***	0.24***	-0.08***	0.64***	0.37***	-0.56***

*Notes.* The table shows the correlation coefficient Pearson r. \*p < .05. \*\*p < .01. \*\*\*p < .001. Sample size: subjects = 49; observations = 2149.

## Appendix 7

Table 7.1

*Pairwise condition comparisons for the associations between appraisals and subjective positive affect*

Measure	Expected vs Worse								Better vs Expected						Better vs Worse						
	Est.	SE	df	95% CI		<i>t</i>	<i>p</i>	Est.	SE	df	95% CI		<i>t</i>	<i>p</i>	Est.	SE	df	95% CI		<i>t</i>	<i>p</i>
				Lower	Upper						Lower	Upper						Lower	Upper		
Relevance	0.34	0.04	1721	0.25	0.43	7.73	< .001	0.13	0.05	1835	0.04	0.22	2.78	.006	0.47	0.05	1689	0.37	0.56	9.82	< .001
Congruence	0.24	0.04	900.6	0.16	0.32	5.69	< .001	0.11	0.05	1156	0.02	0.21	2.32	.021	0.35	0.06	1169	0.24	0.47	6.24	< .001
Fairness	0.40	0.05	733.9	0.30	0.49	8.23	< .001	-0.21	0.07	1783	-0.34	-0.08	-3.25	.002	0.18	0.06	1639	0.06	0.31	2.90	0.004
Control	0.31	0.11	31.13	0.10	0.53	2.93	.019	-0.37	0.16	32.99	-0.70	-0.04	-2.30	.055	-0.06	0.13	22.94	-0.32	0.20	-0.45	.654
Urgency	-0.26	0.05	857.6	-0.36	-0.17	-5.40	< .001	0.15	0.07	1601	0.02	0.29	2.29	.044	-0.11	0.06	1150	-0.23	0.01	-1.83	.067
Emotional coping	0.64	0.06	832.4	0.53	0.75	11.31	< .001	-0.45	0.09	1894	-0.62	-0.28	-5.15	< .001	0.20	0.08	1614	0.03	0.36	2.33	.020

*Notes.* Est. (Estimate) = the difference between two conditions; SE = standard error; CI = 95% confidence interval; df = degrees of freedom; *p*-values are adjusted using the Holm correction. Sample size: subjects = 49; courses = 196 observations = 2149. LMM was conducted using condition as a fixed effects variable and subject and courses as random effects grouping factors. The model terms were tested with Satterthwaite method. Each row represents a separately conducted LMM.

## Appendix 8

Table 8.1

*Pairwise condition comparisons for the associations between appraisals and subjective negative affect*

Measure	Expected vs Worse							Better vs Expected						Better vs Worse							
	Est.	SE	df	95% CI		<i>t</i>	<i>p</i>	Est.	SE	df	95% CI		<i>t</i>	<i>p</i>	Est.	SE	df	95% CI		<i>t</i>	<i>p</i>
				Lower	Upper						Lower	Upper						Lower	Upper		
Relevance	-0.21	0.05	1808	-0.30	-0.11	-4.40	< .001	-0.18	0.05	1615	-0.27	-0.09	-3.77	< .001	-0.38	0.05	1633	-0.48	-0.29	-7.69	< .001
Congruence	-0.16	0.05	1259	-0.25	-0.07	-3.43	.001	-0.08	0.05	518.4	-0.18	0.01	-1.76	.079	-0.24	0.06	1018	-0.36	-0.13	-4.17	< .001
Fairness	-0.36	0.05	845.0	-0.46	-0.26	-7.07	< .001	0.23	0.07	1438	0.10	0.36	3.42	.001	-0.13	0.06	1399	-0.26	-0.01	-2.06	.040
Control	-0.15	0.06	1107	-0.27	-0.02	-2.32	.062	0.15	0.08	845.9	0.01	0.30	2.04	.084	0.01	0.07	1012	-0.13	0.15	0.12	.909
Urgency	0.42	0.12	21.52	0.18	0.66	3.65	.004	0.11	0.10	12.16	-0.10	0.32	1.16	.268	0.54	0.14	15.26	0.24	0.84	3.80	.004
Emotional coping	-0.71	0.06	901.6	-0.82	-0.59	-11.92	< .001	0.44	0.09	1302	0.27	0.60	5.10	< .001	-0.27	0.08	1160	-0.43	-0.11	-3.23	.001

*Notes.* Est. (Estimate) = the difference between two conditions; SE = standard error; CI = 95% confidence interval; df = degrees of freedom; *p*-values are adjusted using the Holm correction. Sample size: subjects = 49; courses = 196 observations = 2149. LMM was conducted using condition as a fixed effects variable and subject and courses as random effects grouping factors. The model terms were tested with Satterthwaite method. Each row represents a separately conducted LMM.

## Appendix 9

Table 9.1

*Pairwise condition comparisons for the associations between appraisals and zygomaticus major activity*

Measure	Expected vs Worse								Better vs Expected						Better vs Worse						
	Est.	SE	df	95% CI		<i>t</i>	<i>p</i>	Est.	SE	df	95% CI		<i>t</i>	<i>p</i>	Est.	SE	df	95% CI		<i>t</i>	<i>p</i>
				Lower	Upper						Lower	Upper						Lower	Upper		
Relevance	0.04	0.02	251.3	0.01	0.08	2.40	.034	0.01	0.02	584.5	-0.03	0.05	0.60	.548	0.06	0.02	1029	0.01	0.10	2.53	.034
Congruence	0.02	0.02	1470	-0.02	0.06	1.18	.237	0.05	0.02	1586	0.01	0.09	2.26	.048	0.07	0.03	1016	0.02	0.12	2.78	.016

*Notes.* Est. (Estimate) = the difference between two conditions; SE = standard error; CI = 95% confidence interval; df = degrees of freedom; *p*-values are adjusted using the Holm correction. Sample size: subjects = 49; courses = 196 observations = 2149. LMM was conducted using condition as a fixed effects variable and subject and courses as random effects grouping factors. The model terms were tested with Satterthwaite method. Each row represents a separately conducted LMM.

**Appendix 10****Table 10.1***Pairwise condition comparisons for the associations between appraisals and corrugator supercilii activity*

Measure	Expected vs Worse								Better vs Expected						Better vs Worse						
	Est.	SE	df	95% CI		<i>t</i>	<i>p</i>	Est.	SE	df	95% CI		<i>t</i>	<i>p</i>	Est.	SE	df	95% CI		<i>t</i>	<i>p</i>
				Lower	Upper						Lower	Upper						Lower	Upper		
Relevance	-0.06	0.03	495.1	-0.11	-0.01	-2.32	.041	-0.02	0.03	431.2	-0.08	0.03	-0.89	.373	-0.08	0.03	876.9	-0.14	-0.03	-2.82	.015
Congruence	-0.10	0.03	262.8	-0.15	-0.04	-3.46	.001	-0.10	0.03	446.2	-0.15	-0.04	-3.41	.001	-0.19	0.04	684.1	-0.26	-0.12	-5.44	<.001
Fairness	-0.07	0.03	278.0	-0.12	-0.02	-2.71	.021	-0.03	0.04	477.4	-0.10	0.04	-0.79	.432	-0.10	0.04	906.4	-0.17	-0.02	-2.59	.021

*Notes.* Est. (Estimate) = the difference between two conditions; SE = standard error; CI = 95% confidence interval; df = degrees of freedom; *p*-values are adjusted using the Holm correction. Sample size: subjects = 49; courses = 196 observations = 2149. LMM was conducted using condition as a fixed effects variable and subject and courses as random effects grouping factors. The model terms were tested with Satterthwaite method. Each row represents a separately conducted LMM.

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