1   Estimating individual subjective values of emotion regulation strategies

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16   Abstract

17   Individuals have a repertoire of emotion regulation (ER) strategies at their disposal, which

18 they can use more or less flexibly. In ER flexibility research, strategies that facilitate goal

19 achievement are considered adaptive and therefore are subjectively valuable. Individuals

20 are motivated to reduce their emotional arousal effectively and to avoid cognitive effort.

21 Perceived costs of ER strategies in the form of effort, however, are highly subjective.

22 Subjective values (SVs) should therefore represent a trade-off between effectiveness and

23 subjectively required cognitive effort. However, SVs of ER strategies have not been

24 determined so far. We present a paradigm that is suitable for determining individual SVs

25 of ER strategies. Using a multilevel modelling approach, it will be investigated whether

26 individual SVs can be explained by effectiveness (subjective arousal, facial muscle activity)

27 and subjective effort. Relations of SVs to personality traits will be explored.

28   *Keywords:* emotion regulation, regulatory effort, effort discounting, registered report,

29 specification curve analysis

30   Word count: 5630

Estimating individual subjective values of emotion regulation strategies

1. Introduction

The ability to modify emotional experiences, expressions, and physiological reactions[1] to regulate emotions is an important cognitive skill. It is therefore not surprising that emotion regulation (ER) has substantial implications for well-being and adaptive functioning[2]. Different strategies can be used to regulate emotions, namely situation selection, situation modification, attentional deployment, cognitive change, and response modification[1], and, following the taxonomy of Powers and LaBar[3], individuals can implement ER strategies by means of different tactics. So called antecedent-focused strategies, e.g., attentional deployment and cognitive change, take effect early in the emotion generation process[1]. In contrast, response modification takes place late in the process and is therefore conceptualized as a response-focused strategy[1]. This postulated temporal sequence of ER strategies influences their effectiveness. Albeit it is meta-analytically proven that all mentioned strategies reduce subjective emotional experience, distraction as a tactic of attentional deployment and (expressive) suppression as a tactic of response modulation showed only small to medium effect sizes (distraction: $d_+ = 0.27$; suppression: $d_+ = 0.27$). In contrast, distancing as tactic of cognitive change showed the highest effectiveness with an effect size of $d_+ = 0.45$[4].

Psychophysiological measures provide further important information on the effectiveness of emotion regulation strategies (for an overview, see Zaehringer et al.[5]). Compared to cardiovascular, electrodermal, and pupillometric autonomic responses, facial electromyography has been reported consistently across studies to be influenced by emotion regulation with even medium effect sizes. For example, studies have shown that reappraisal of negative emotion is associated with reduced activity of the corrugator supercilii

56 (associated with anger, sadness, and fear) with $d_- = 0.32$[5]. In addition, the levator labii

57 superioris (associated with disgust) has also been associated with reduced activity during

58 reappraisal[6]. Similar effects have been reported for suppression[6], distancing[7], and

59 distraction[8]. Importantly, results on electromyographic measures seem to be more

60 consistent compared to other autonomic measures, likely because they are specific to

61 emotional valence and its changes.

62 Similarly to the differences in short term effectiveness, these tactics from three

63 different strategies are also related to different medium and long-term consequences. In

64 particular, strategies that do not change the emotional content of the situation, for

65 instance by taking a neutral perspective (i.e., distraction and suppression) are presumed to

66 be disadvantageous in the longer term. Thus, the self-reported habitual use of suppression

67 is associated with more negative affect and lower general well-being[9]. In addition, a

68 number of ER strategies, e.g., rumination and suppression, have been associated with

69 mental disorders (for meta-analytic review, see Aldao et al.[10]), which led to the postulation

70 of *adaptive* (such as reappraisal, acceptance) and *maladaptive* (such as suppression,

71 rumination) ER strategies. For example, it was shown that maladaptive ER strategies

72 (rumination and suppression) mediate the effect between neuroticism and depressive

73 symptoms[11].

74 The postulation of *adaptive* and *maladaptive* ER strategies has been challenged by

75 the concepts of ER repertoire and ER flexibility. Within this framework, *maladaptive* refers

76 to inflexible ER strategy use or use of strategies that are hindering goal achievement[12].

77 Adaptive flexible ER requires a large repertoire of ER strategies[12]. The term "repertoire"

78 can be defined as the ability to utilize a wide range of regulatory strategies in divergent

79 contextual demands and opportunities[13]. A growing number of studies report findings

80 about the repertoire of emotion regulation strategies and its relationship to

81 psychopathology[14–16]. Additionally, greater ER flexibility is related to reduced negative

82 affect and therefore beneficial in daily life[17].

How do people choose strategies from their repertoire? Similarly to the expectancy-value model of emotion regulation[18] it could be assumed, that people also assign a value to an ER strategy reflecting the usefulness of this strategy for goal achieving. Evidence from other psychological domains (e.g., intertemporal choice[19]) shows that subjective values (SVs) are attributed to the choice options on the basis of which the decision is made. Research on ER choice has identified numerous factors that influence the choice of ER strategies, which can be seen as indirect evidence for factors influencing SVs[20]. For example, a study found that the intensity of a stimulus or situation plays a role in the choice[21]. Higher intensity of the (negative) stimulus lead to a choice of rather disengaging tactics of attentional deployment, like distraction[20,21]. ER choice was further influenced by, among others, extrinsic motivation (e.g., monetary incentives), motivational determinants (i.e., hedonic regulatory goals), and effort[20,22]. Nonetheless, there are only few studies to date that examined the required effort of several strategies in more detail and compared them with each other. Furthermore, the research on ER choice lacks information regarding the strategies that were *not* chosen in each case. It is unclear whether people had clear preferences or whether the choice options were similarly attractive.

We assume that people choose the strategy that has the highest value for them at the moment. The value is determined against the background of goal achievement in the specific situation: A strategy is highly valued if it facilitates goal achievement[12]. One certainly central goal is the regulation of negative affect. The effectiveness of ER strategies should therefore influence the respective SV. A second, intrinsic, and less obvious goal is the avoidance of effort[23]. When given the choice, most individuals prefer tasks that are less effortful[24]. Cognitive effort avoidance has been reported in many contexts, for example in affective context[25], the context of decision making[26], and executive functions[27], and is associated with Need for Cognition (NFC)[28], a stable measure of the individual pursuit and enjoyment of cognitive effort[29,30]. In the area of emotion regulation, too, there are initial indications that people show a tendency towards effort avoidance. Across two studies, we

could show in previous work that the choice for an ER strategy is mainly influenced by the effort required to implement a given strategy[22]. In our studies, participants used the strategies distancing and suppression while inspecting emotional pictures. Afterwards, they choose which strategy they wanted to use again. Participants tended to re-apply the strategy that was subjectively less effortful, even though it was subjectively not the most effective one - in this case: suppression. Moreover, the majority of participants stated afterwards the main reason for their choice was effort. We assume therefore that, although individuals trade off both factors - effectiveness and effort - against each other, effort should be the more important predictor for SVs of ER strategies. In addition, perceived utility should have an impact on SVs. A strategy that is less effortful and can objectively regulate arousal (i.e., is effective), but is not subjectively perceived as useful, should have a low SV. SVs of ER Strategies could therefore be helpful to describe the ER repertoire[12] more comprehensively. Depending on the flexibility of a person, different patterns of SVs could be conceivable: A person with high flexibility would show relatively high SVs for a number of strategies. This would mean that all strategies are a good option for goal achievement. A second person with less flexibility, however, would show high SVs only for one strategy or low SVs for all of the strategies. This in turn would mean that there is only a limited amount of strategies in the repertoire to choose from. Subsequently, the ability to choose an appropriate strategy for a specific situation is also limited.

So far we have not seen any attempt in ER choice research to determine individual SVs of ER strategies. However, this would be useful to describe interindividual differences in the preference of ER strategies and the ER repertoire more comprehensively. To investigate this question, the individual SVs of each strategy available for selection would have to be determined. Promising approaches can be found in studies on difficulty levels of effortful cognitive tasks.

Individual SVs of effortful cognitive tasks have been quantified using the Cognitive Effort Discounting Paradigm (COG-ED)[29].

137   In the original study by Westbrook et al.[29], cognitive load was varied using the

138   *n*-back task, a working memory task that requires fast and accurate responses to

139   sequentially presented stimuli. Participants had to decide in an iterative procedure whether

140   they wanted to repeat a higher *n*-back level for a larger, fixed monetary reward, or a lower

141   level for a smaller, varying reward, with the implicit assumption that the objectively

142   easiest *n*-back level has the highest SV. In the present study, we want to use this paradigm

143   to determine SVs of ER strategies. In doing so, we need to make an important change: We

144   have to adapt the assumption that the easiest *n*-back level has the highest SV. As we have

145   shown in previous studies, there are large inter-individual differences in the preference and

146   perceived subjective effort of ER strategies[22]. Moreover, there is nothing like an objectively

147   easiest ER strategy. Therefore, we have to add an additional step, which precedes the other

148   steps and where the ER option with the higher subjective value is determined. In this step,

149   the same monetary value (i.e., 1 €) is assigned to both options. The assumption is that

150   participants now choose the option that has the higher SV for them. In the next step we

151   return to the original paradigm. The higher monetary value (i.e., 2 €) is assigned to the

152   option that was not chosen in the first step and therefore is assumed to have the lower SV.

153   In the following steps, the lower value is changed in every iteration according to Westbrook

154   et al.[29] until the indifference point is reached. This procedure will be repeated until all

155   strategies have been compared. The SV of each strategy is calculated as the mean of this

156   strategy's SV from all comparisons. In case a participant has a clear preference for one

157   strategy, the SV of this strategy will be 1. But our paradigm can also account for the case

158   that a person does not have a clear preference. Then no SV will be 1, but still, the SVs of

159   all strategies can be interpreted as absolute values and in relation to the other strategy's

160   SVs (see Figure 1). In a separate study, we will test our adapted paradigm together with a

161   *n*-back task and explore whether this paradigm can describe individuals that do not prefer

162   the easiest *n*-back option (see Zerna et al.[31]).

163   The aim of the present study is to evaluate whether this paradigm is suitable for
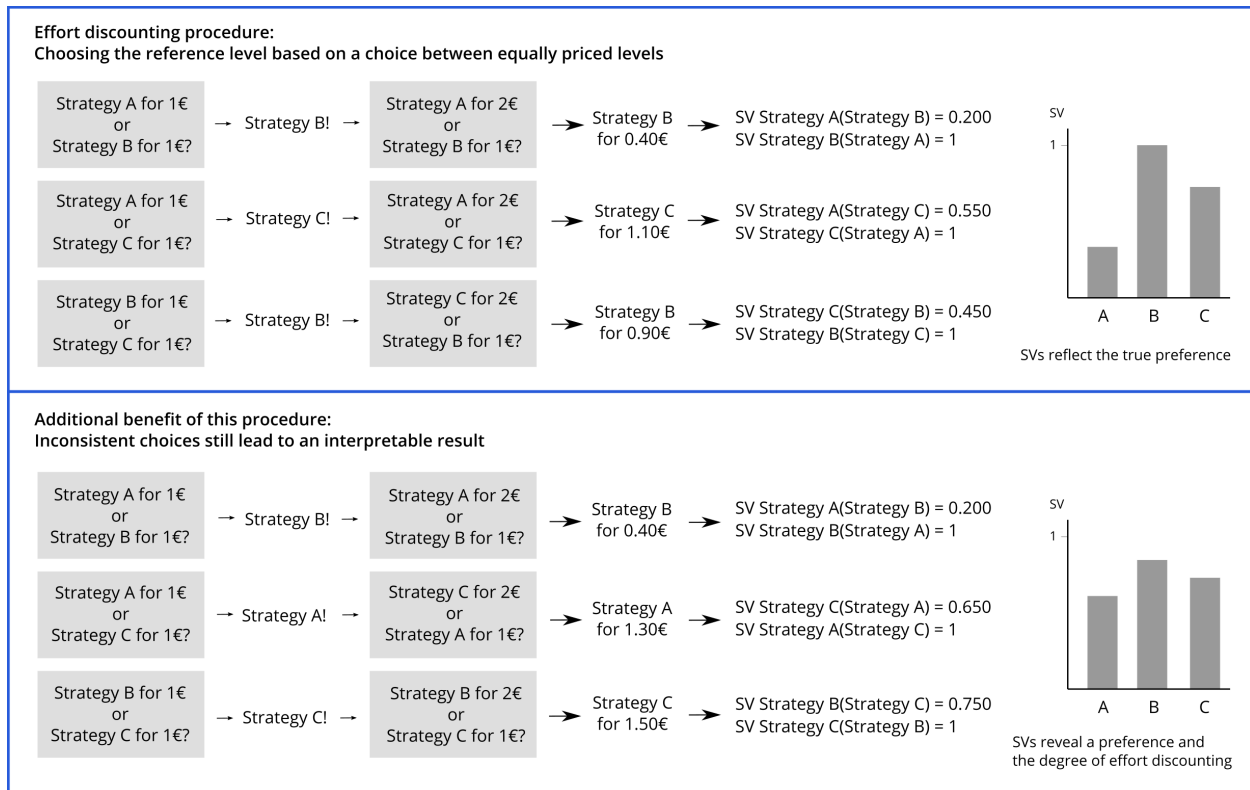
Figure 1. Exemplary visualization of two response patterns. In the top half, the person has a clear preference for one of the three strategies. In the lower half, they have no clear preference and therefore show an inconsistent response pattern. This pattern can be represented by our paradigm.

determining SVs of ER strategies. As a manipulation check, we first want to investigate whether the valence of the pictures is affecting subjective and physiological responding, resulting in lower subjective arousal ratings after and lower EMG activity during neutral compared to negative pictures. Second, we want to check whether the ER strategies distraction, distancing, and suppression effectively reduce subjective arousal and physiological responding compared to the active viewing condition. Third, we want to see whether the strategies subjectively require more cognitive effort than the active viewing condition, and whether participants re-apply the for them least effortful strategy. Furthermore, we want to investigate whether subjective effort, arousal ratings, subjective utility, and EMG activity predict individual subjective values of ER strategies. And lastly, we want to check whether the SV of a strategy is associated with its likelihood of being

175   chosen again, and whether SVs reflect participants' self-reported ER flexibility. All

176   hypotheses are detailed in the design table. Exploratorily, we want to investigate whether

177   individual SVs are related to personality traits and how individual SVs of ER strategies

178   relate to SVs of other tasks with different demand levels, namely n-back.

2. Method

180   We report how we determined our sample size, all data exclusions (if any), all

181   manipulations, and all measures in the study[32]. The paradigm was written and presented

182   using *PsychoPy*[33]. We used *R* with *R Studio*[34,35] with the main packages *afex*[36] and

183   *BayesFactor*[37] for all analyses. The R Markdown file used to analyze the data and write

184   this document, as well as the raw data and the materials are freely available at

185   https://github.com/ChScheffel/CERED. A complete list of all measures assessed in the

186   study can be found at OSF (https://osf.io/vnj8x/) and GitHub

187   (https://github.com/ChScheffel/CERED).

2.1 Ethics information

189   The study protocol complies with all relevant ethical regulations and was approved

190   by the ethics committee of the Technische Universität Dresden (reference number

191   EK50012022). Prior to testing, written informed consent will be obtained. Participants will

192   receive 30 € in total or course credit for participation.

2.2 Pilot data

194   The newly developed ER paradigm was tested in a pilot study with $N = 16$

195   participants (9 female; age: $M = 24.1 \pm SD = 3.6$). Regarding self-reported arousal,

196   results showed significant higher subjective arousal for active viewing of negative compared

197   to neutral pictures. However, ER strategies did not lead to a reduction of subjective

198 arousal compared to active viewing of negative pictures. Regarding physiological responses,

199 ER strategies were associated with reduced facial muscle activity of the *corrugator* and

200 *levator* compared to active viewing of negative pictures. In accordance with our previous

201 study[22], we found that the use of ER strategies compared to active viewing was associated

202 with increased subjective effort. All results are detailed in the Supplementary Material

203 **2.3 Design**

204   Young healthy participants (aged 18 to 30 years) will be recruited using the software

205 *ORSEE*[38] at the Technische Universität Dresden. Participants will be excluded from

206 participation if they do not fluently speak German, have current or a history of

207 psychological disorders or neurological trauma, or report to take medication. Participants

208 will be invited to complete an online survey containing different questionnaires to assess

209 broad and narrow personality traits and measures of well-being. The study consists of two

210 lab sessions, which will take place in a shielded cabin with constant lighting. Before each

211 session, participants will receive information about the respective experimental procedure

212 and provide informed consent. In the first session participants will fill out a demographic

213 questionnaire and complete an n-back task with the levels one to four. Then, they will

214 complete an effort discounting (ED) procedure regarding the n-back levels on screen,

215 followed by a random repetition of one n-back level. The second session will take place

216 exactly one week after session one. Participants will provide informed consent and receive

217 written instructions on the ER paradigm and ER strategies that they should apply. A brief

218 training will ensure that all participants are able to implement the ER strategies. Next,

219 electrodes to measure facial EMG will be attached and the ER paradigm will be conducted,

220 followed by an ED procedure regarding the ER strategies. After that, participants will

221 choose one ER strategy to repeat one more time. Study data will be collected and managed

222 using REDCap electronic data capture tools hosted at Technische Universität Dresden[39,40].

223 **2.3.1 Psychometric measures.** The online survey will contain a number of

224 questionnaires. In the focus of the current project is the Flexible Emotion Regulation Scale

225 (FlexER)[41].

226 It assess flexible use of ER strategies with items such as "If I want to feel less negative

227 emotions, I have several strategies to achieve this.", which we define as ER flexibility. The

228 items are rated on a 4-point scale ranging from "strongly agree" to "strongly disagree".

229 Further psychological constructs will be assessed but have no clear hypothesies in the

230 present work an are therefore investigated only exploratory: General psychological

231 well-being will be assessed using the German version of the WHO-5 scale[42,43]. To measure

232 resilience, the German version 10-item-form of the Connor-Davidson resilience Scale

233 (CD-RISC)[46] will be used. Habitual use of ER will be assessed using the German version of

234 the Emotion Regulation Questionnaire (ERQ)[9,47]. Implicit theories of willpower in emotion

235 control will be assessed using the implicit theories questionnaire from Bernecker and Job[48].

236 To assess Need for Cognition, the German version short form of the Need for Cognition

237 Scale[28,49] will be used. To assess self-control,[50] sum scores of the German versions of the

238 following questionnaires will be used: the Self-Regulation Scale (SRS)[51], the Brief

239 Self-Control Scale (BSCS)[52,53], and the Barratt Impulsiveness Scale (BIS-11)[54,55].

240 Attentional control will be assessed using the Attentional Control Scale (ACS)[56]. For more

241 detailed information on psychometric properties of the questionnaires, please see

242 supplementary material.

243 **2.3.2 Emotion regulation paradigm.** The ER paradigm will consist of three

244 parts that will be described in the following.

245 *Part one: ER task.* Part one will be a standard ER task in a block design (see Figure

246 2), similar to paradigms previously used by our group[22]. Participants will be told to

247 actively view neutral and negative pictures (see 2.3.3) or to regulate all upcoming emotions

248 by means of distraction, distancing, and expressive suppression, respectively. Every

249 participant first will have the condition "active viewing-neutral" that serves as a baseline

condition. During this block, 20 neutral pictures will be presented. Participants will be asked to "actively view all pictures and permit all emotions that may arise." In the second block, participants will actively view negative pictures. During the third, fourth, and fifth block, participants will see negative pictures and will be asked to regulate their emotions using distraction, distancing, and suppression. In order to achieve distraction, participants will be asked to think of a geometric object or an everyday activity, like brushing their teeth. During distancing, participants will be asked to "take the position of a non-involved observer, thinking about the picture in a neutral way." Participants will be told not to re-interpret the situation or attaching a different meaning to the situation. During suppression, participants will be told to "suppress their emotional facial expression." They should imagine being observed by a third person that should not be able to tell by looking at the facial expression whether the person is looking at an emotional picture. Participants will be instructed not to suppress their thoughts or change their facial expression to the opposite[22]. All participants will receive written instruction and complete a training session. After the training session, participants will be asked about their applied ER strategies to avoid misapplication. The order of the three regulation blocks (distraction, distancing, and suppression) will be randomized between participants. Each of the blocks consisted of 20 trials showing neutral (Block 1) and negative (Blocks 2, 3, 4, 5) pictures. Each trial began with a fixation cross that lasted 3 to 5 seconds (random uniform distributed). It was followed by neutral or negative picture for a total of 6 seconds. After each block, participants retrospectively rated their subjective emotional arousal ("not at all aroused" to "very highly aroused"), their subjective effort ("not very exhausting" to "very exhausting"), and - after the ragulation blocks - the utility of the respective strategy ("not useful at all" to "very useful") on a continuous scale using a slider on screen.

Part two: ER effort discounting. In the second part, ER effort discounting will take place. The procedure of the discounting will follow the COG-ED paradigm by Westbrook et al.[29] with a major change. We will use the following adaption that allows the computation

277 of SVs for different strategies without presuming that all individuals would inherently

278 evaluate the same strategy as the easiest one: For each possible pairing (distraction

279 vs. distancing, distraction vs. suppression, and distancing vs. suppression), each of the two

280 strategies will be presented with a monetary reward. The order of the pairings will be

281 randomized. Because there is no strategy that is objectively more difficult, we will add an

282 initial comparison that begins with the option "1 € for strategy A or 1 € for strategy B".

283 The participants decide by clicking the on-screen button of the respective option. The

284 strategy that is not chosen will be assigned the fixed value of 2 €, the chosen strategy will

285 be assigned a starting value of 1 €. From this point on, comparisons between strategies will

286 follow the original COG-ED paradigm[29]. Each pairing is presented six consecutive times,

287 and with each decision the reward of the strategy with the starting value of 1 € is either

288 lowered (if this strategy was chosen) or raised (if the strategy with the fixed 2 € reward was

289 chosen). The adjustment starts at 0.50 € and each is half the adjustment of the previous

290 step, rounded to two digits after the decimal point. If a participant always chooses the

291 strategy with the fixed 2 € reward, the other strategy's last value on display will be 1.97 €,

292 if they always choose the lower strategy, its last value will be 0.03 €. The sixth adjustment

293 of 0.02 € will be done during data analysis, based on the participants' decision in the last

294 display of the pairing. Participants will be instructed to decide as realistically as possible

295 by imagining that the monetary reward is actually available for choice.

296   *Part three: ER choice.* After the discounting part, participants will choose which one

297 of the three ER strategies (distraction, distancing or suppression) they want to re-apply.

298 Importantly, there will be no further instruction on what basis they should make their

299 decision. Participants should make their decision freely, according to criteria they consider

300 important for themselves. However, participants will be asked to state the reasons for the

301 decision afterwards. As soon as they have decided, they will see the respective instruction

302 and the block with another 20 negative pictures starts.

Block 1
Active viewing of neutral pictures

subjective arousal and rating

Block 2 - *Active viewing*
Active viewing of negative pictures

subjective arousal and rating

Block 3 - *Distraction*
Distraction of negative pictures

subjective arousal, effort and utility rating

Block 4 - *Distancing*
Distancing from negative pictures

subjective arousal, effort and utility rating

Block 5 - *Expressive suppression*
Expressive suppression of negative pictures

subjective arousal, effort and utility rating

randomized order

Effort Discounting Procedure
Pairwise comparison of the strategies *Distraction*, *Distancing*, and *Expressive suppression*

Block 6 - *Choice*
Reapply *Distraction*, *Distancing*, or *Expressive suppression*

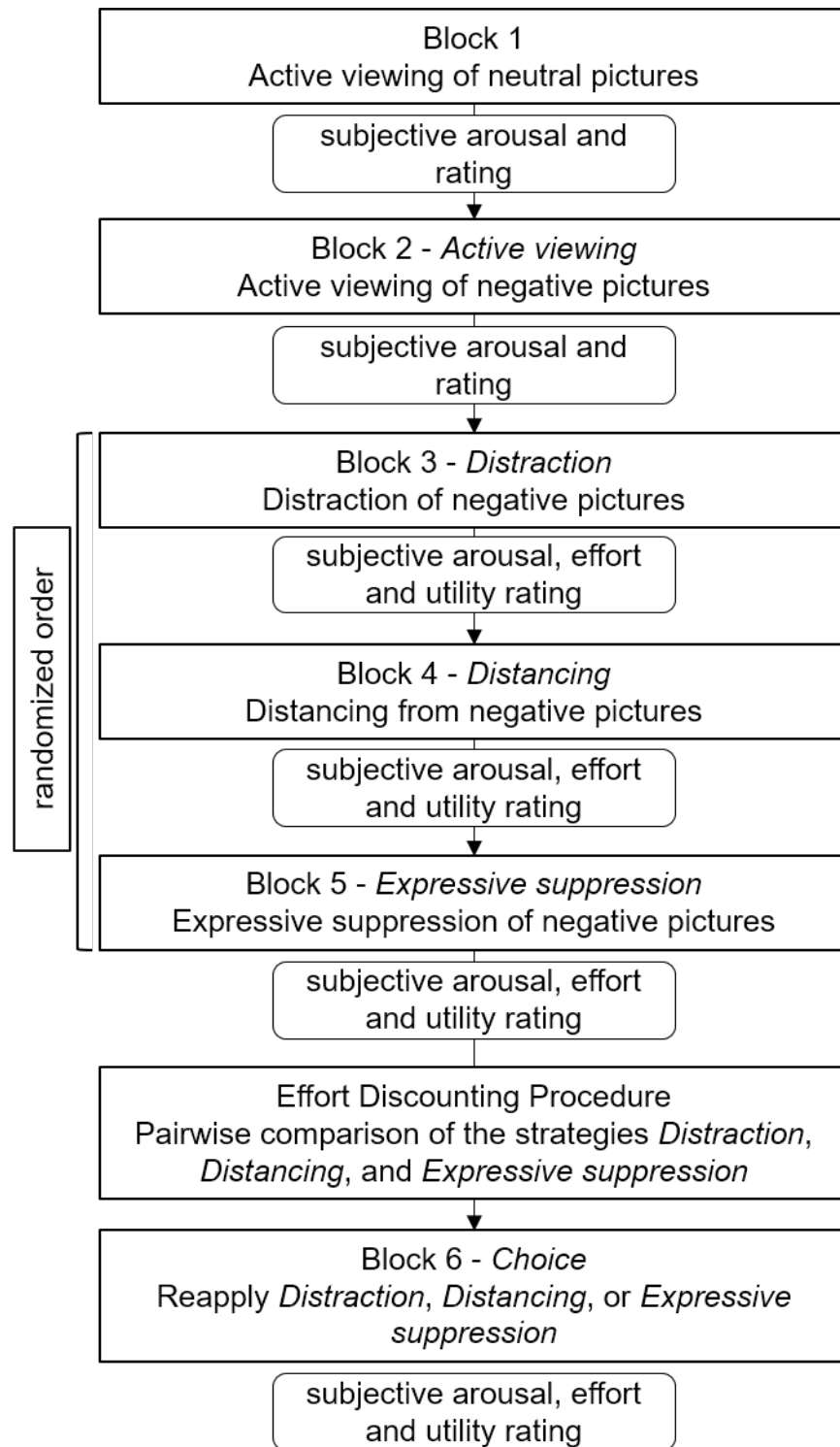subjective arousal, effort and utility rating

Figure 2. Block design of the paradigm. Every participant starts with two "active viewing" blocks continaing neutral (Block 1) and negative (Block 2) pictures. Order of the regulation blocks (Blocks 3, 4, and 5) is randomized between participants. After, the discounting procedure takes place. All three regulation strategies are pairwise compared. Before the last block, participants can decide which regulation strategy they want to reapply. Subjective arousal and effort ratings are assessed after each block using a slider on screen with a continuous scale.

303   **2.3.3 Stimuli.**   Pictures that will be used in the paradigm are selected from the

304   Emotional Picture Set (EmoPicS)[57] and the International Affective Picture System

305   (IAPS)[58]. The 20 neutral pictures (Valence (V): $M \pm SD = 4.81 \pm 0.51$; Arousal (A): M

306    $\pm SD = 3 \pm 0.65$) depicted content related to the categories persons, objects, and scenes.

307   Further, 100 negative pictures, featuring categories animals, body, disaster, disgust, injury,

308   suffering, violence, and weapons, will be used. An evolutionary algorithm[59] is used to

309   cluster these pictures into five sets with comparable valence and arousal values (set one: V:

310    $M \pm SD = 2.84 \pm 0.57$, A: $M \pm SD = 5.62 \pm 0.34$; set two: V: $M \pm SD = 2.64 \pm 0.46$, A:

311    $M \pm SD = 5.58 \pm 0.35$; set three: V: $M \pm SD = 2.82 \pm 0.62$, A: $M \pm SD = 5.60 \pm 0.39$;

312   set four: V: $M \pm SD = 2.65 \pm 0.75$, A: $M \pm SD = 5.61 \pm 0.41$; set five: V: $M \pm SD =$

313   2.74 ± 0.70, A: $M \pm SD = 5.63 \pm 0.37$). A complete list of all pictures and their

314   classification into sets can be found in supplementary material 1. The five sets of negative

315   pictures will be assigned randomly to the blocks.

316   **2.3.4 Facial electromyography.**   Bipolar facial electromyography (EMG) will be

317   measured for *corrugator supercilii* and *levator labii* as indices of affective valence[60], similar

318   to previous work by our group[7]. Two passive surface Ag/AgCl electrodes (8 mm inner

319   diameter, 10 mm distance between electrodes) will be placed over each left muscle

320   according to the guidelines of.[61] The ground electrode will be placed over the left *Mastoid*.

321   Before electrode placement, the skin will be abraded with Every abrasive paste, cleaned

322   with alcohol, and filled with Lectron III electrolyte gel. Raw signals will be amplified by a

323   BrainAmp amplifier (Brain Products Inc., Gilching, Germany). Impedance level will be

324   kept below 10 $k\Omega$. Data will be sampled at 1000 Hz, filtered, rectified and integrated. A 20

325   Hz high pass (order 8), a 300 Hz low pass (order 8), and a 50 Hz notch filter will be applied

326   to both signals. Corrugator and Levator EMG will be analyzed during the 6 s of picture

327   presentation. EMG data will be baseline-corrected using a time window of 2 s prior to

328   stimulus onset.[60] Last, the sampling rate will be changed to 100 Hz, and EMG data will be

329   averaged for each condition and each participant.

2.4 Sampling plan

Sample size calculation is done using G^*Power[62,63]. In a meta-analysis of Zaehringer and colleagues[5], effect sizes of ER on peripheral-physiological measures were reported: To find an effect of $d = -0.32$ of ER on *corrugator* muscle activity with $\alpha = .05$ and $\beta = .95$, data of at least $N = 85$ have to be analyzed. Power analyses of all other hypotheses yielded smaller sample sizes. However, if participants withdraw from study participation, technical failures occur, or experimenter considers the participant for not suitable for study participation (e.g., because the participant does not follow instructions or shows great fatigue), respective data will also be excluded from further analyses. Therefore, we aim to collect data of $N = 120$ participants, about 50 more data sets, than necessary. Detailed information on power calculation for each hypothesis can be found in the design table.

2.5 Analysis plan

Data collection and analysis will not be performed blind to the conditions of the experiments. Data of whole participants will be excluded from analysis if participants withdraw their consent or they state that they did not follow experimental instructions. EMG data of subjects will be excluded from analysis if errors occured during recording. No further data exclusions are planned. The level of significance will be set to $\alpha = .05$. For hypotheses H1-4, repeated measures analysis of variance (rmANOVA) will be conducted and estimated marginal means will be computed using the *afex* package[36]. Greenhouse-Geisser-corrected degrees of freedom and associated p-values and will be reported when the assumption of sphericity is violated. If the within-subjects factor of interest is significant, pairwise contrasts will be calculated using Bonferroni adjustment for multiple testing. Proportion of explained variance η_p^2 will be reported as a measure of effect size.

Effect of valence on arousal and facial EMG. To examine the impact of valence of

355 emotional pictures on subjective arousal ratings (H1a), a rmANOVA with the factor

356 valence (neutral and negative) for the strategy active viewing will be conducted. To

357 examine the impact of valence on physiolocigal responding (H1b and H1c), a rmANOVA

358 with the factor valence (neutral and negative) for the strategy active viewing will be

359 conducted for EMG *corrugator* and *levator* activity.

360   *Effects of emotion regulation on arousal, facial EMG and effort.* To investigate the

361 effects of the three ER strategies on subjective arousal (H2a), another rmANOVA with the

362 factor strategy (active viewing - negative, distraction, distancing, and suppression) for

363 subjective arousal ratings will be conducted. To examine the effects of the three ER

364 strategies on physiological responding (H3a and H3b), another rmANOVA with the factor

365 strategy (active viewing - negative, distraction, distancing, and suppression) for EMG

366 *corrugator* and *levator* activity will be conducted. To examine the effect of ER strategies

367 on subjective effort (H4a), a rmANOVA with the factor strategy (active viewing,

368 distraction, distancing, and suppression) for subjective effort ratings will be conducted.

369   *Subjective values of emotion regulation strategies.* For each ER strategy, SVs will be

370 calculated as follows: first, the value 0.02 € will be added to or subtracted from the last

371 monetary value of the flexible strategy, depending on the participant's last choice. Second,

372 the resulting monetary value will be divided by 2.00 € to arrive at the SV of the opposite

373 strategy in each pairing. Therefore, the SVs of the flexible strategies are 1, because they

374 were chosen in the initial comparison of each pairing in which the same value was offered

375 for both strategies, so they are the preferred strategy of each pairing. The SVs of the fixed

376 strategies lay between 0 and 1, with lower values indicating that the participant would

377 need a much higher monetary incentive to choose this strategy over the other one in the

378 pairing. The final SV per strategy for each participant will be computed by averaging the

379 SVs of each strategy across pairings.

380   To explore the association between subjective effort (H5a), subjective arousal (H5b),

381 subjective utility (H5c), and physiological responding (H5d,e) on SVs, a multilevel model

382 (MLM) will be specified using the *lmerTest* package[64]. First, ER strategies will be recoded

383 and centered for each subject according to their individual SVs: The strategy with the

384 highest SV will be coded as -1, the strategy with the second highest SV 0, and the strategy

385 with the lowest SV will be coded as 1. Restricted maximum likelihood (REML) will be

386 applied to fit the model. A random slopes model of SVs including subjective effort (effort

387 ratings), subjective arousal (arousal ratings), and physiological responses (*corrugator* and

388 *levator* activity) as level-1-predictors will be specified.

$SV \sim strategy + \text{effort rating} + \text{arousal rating} + \text{utility} + corrugator \text{ activity} + levator \text{ activity} + (strategy|su$

389 Level-1-predictors will be centered within cluster[65]. Residuals of the final model will be

390 inspected visually. Intraclass correlation coefficient (ICC), ρ, will be reported for each

391 model (null model, as well as full model).

392   To investigate whether individual SVs predict ER choice (H7a), a Chi-squared test

393 with predicted choice (highest SV of each participant) and actual choice will be computed.

394 Furthermore, an ordinal logistic regression with the dependent variable choice and

395 independent variables SVs of each strategy will be computed.

396   The association between flexible ER and SVs of ER strategies (H7b) will be

397 investigated with a linear regression using the individual *intercept* and *slope* of each

398 participants' SVs to predict their FlexER score. To this end, for each participant, SVs will

399 be sorted by magnitude in descending order and entered as dependent variable in a linear

400 model, with strategy (centered, i.e., -1, 0, 1) as independent variable. The resulting

401 *intercept* informs about the extent to which an individual considers any or all of the ER

402 strategies as useful for regulation their emotion, while the *slope* informs about the

403 flexibility in the use of emotion regulation strategies. The individual intercepts and slopes

404 will then be entered as predictors in a regression model with the FlexER score as

dependent variable. A positive association with the predictor *intercept* would indicate that overall higher SVs attached to ER strategies predicts higher scores on the FlexER scale. A positive association with the predictor *slope* would indicate that less negative slopes, i.e., a smaller preference for a given ER strategy, would be associated with a higher score of the FlexER scale.

The influence of personality traits on SVs will be investigated exploratorily. Therefore, the MLM specified above will be extended by the level-2-predictors NFC and self-control.

For each result of the analyses, both *p*-values and Bayes factors $BF10$, calculated using the *BayesFactor* package[37], will be reported. Bayes factors are calculated using the default prior widths of the functions *anovaBF*, *lmBF* and *regressionBF*.

Data availability

The data of this study can be downloaded from osf.io/vnj8x/.

Code availability

The paradigm code, as well as the R Markdown file used to analyze the data and write this document is available at our Github repository.

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Competing Interests

The authors declare no competing interests.

636 **Figures and figure captions**

Effort discounting procedure:
Choosing the reference level based on a choice between equally priced levels

Strategy A for 1€ or Strategy B for 1€?	→ Strategy B! →	Strategy A for 2€ or Strategy B for 1€?	→ Strategy B for 0.40€	→ SV Strategy A(Strategy B) = 0.200 SV Strategy B(Strategy A) = 1
Strategy A for 1€ or Strategy C for 1€?	→ Strategy C! →	Strategy A for 2€ or Strategy C for 1€?	→ Strategy C for 1.10€	→ SV Strategy A(Strategy C) = 0.550 SV Strategy C(Strategy A) = 1
Strategy B for 1€ or Strategy C for 1€?	→ Strategy B! →	Strategy C for 2€ or Strategy B for 1€?	→ Strategy B for 0.90€	→ SV Strategy C(Strategy B) = 0.450 SV Strategy B(Strategy C) = 1

SV

1

A B C

SVs reflect the true preference

Additional benefit of this procedure:
Inconsistent choices still lead to an interpretable result

Strategy A for 1€ or Strategy B for 1€?	→ Strategy B! →	Strategy A for 2€ or Strategy B for 1€?	→ Strategy B for 0.40€	→ SV Strategy A(Strategy B) = 0.200 SV Strategy B(Strategy A) = 1
Strategy A for 1€ or Strategy C for 1€?	→ Strategy A! →	Strategy C for 2€ or Strategy A for 1€?	→ Strategy A for 1.30€	→ SV Strategy C(Strategy A) = 0.650 SV Strategy A(Strategy C) = 1
Strategy B for 1€ or Strategy C for 1€?	→ Strategy C! →	Strategy B for 2€ or Strategy C for 1€?	→ Strategy C for 1.50€	→ SV Strategy B(Strategy C) = 0.750 SV Strategy C(Strategy B) = 1

SV

1

A B C

SVs reveal a preference and the degree of effort discounting

Figure 1

637   *Figure 1.* Exemplary visualization of two response patterns. In the top half, the

638 person has a clear preference for one of the three strategies. In the lower half, they have no

639 clear preference and therefore show an inconsistent response pattern. This pattern can also
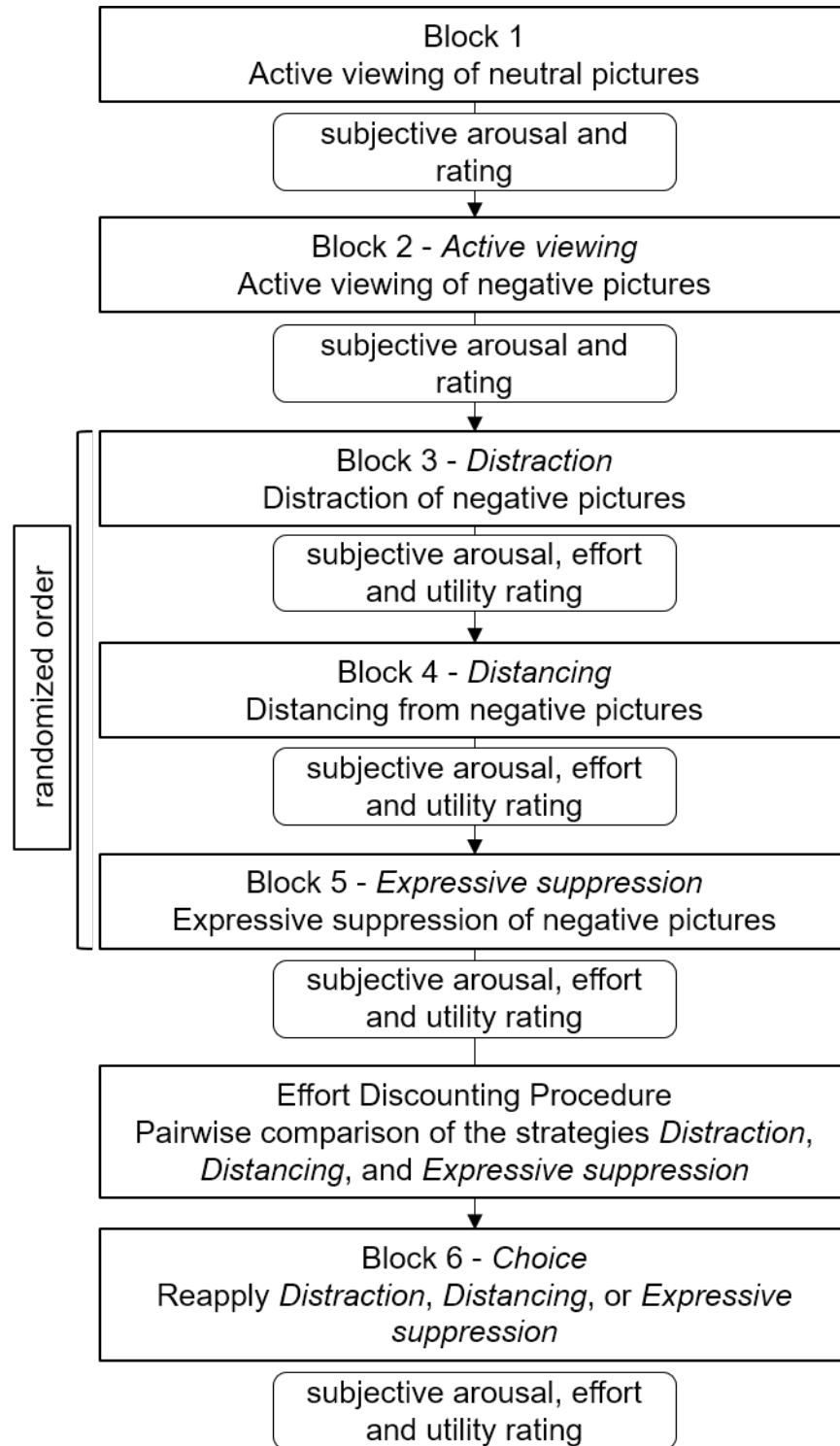
640 be represented by our paradigm.

Figure 2

641   *Figure 2.* Block design of the paradigm. Every participant starts with two "active

642   viewing" blocks continaing neutral (Block 1) and negative (Block 2) pictures. Order of the

643   regulation blocks (Blocks 3, 4, and 5) is randomized between participants. After, the

644   discounting procedure takes place. All three regulation strategies are pairwise compared.

645   Before the last block, participants can decide which regulation strategy they want to

646   reapply. Subjective arousal and effort ratings are assessed after each block using a slider on

647   screen with a continuous scale.

648   **Design Table**

Question	Hypothesis	Sampling plan (e.g. power analysis)	Analysis Plan	Interpretation given to different outcomes
1.) Do negative pictures (compared to neutral pictures) evoke subjective arousal and physiological responding? (Manipulation check)	1a) Subjective arousal (arousal rating) is lower after actively viewing neutral pictures compared to actively viewing negative pictures.	F tests - ANOVA: Repeated measures, within factors Analysis: A priori: Compute required sample size Input: Effect size f = 1.59 (η_p^2 = 0.716) (Scheffel et al., 2021) α err prob = 0.05 Power (1-β err prob) = 0.95 Number of groups = 1 Number of measurements = 2 Corr among rep measures = 0.5 Nonsphericity correction ε = 1 Output: Noncentrality parameter λ = 40.3380260 Critical F = 10.1279645 Numerator df = 1.0 Denominator df = 3.0 Total sample size = 4 Actual power = 0.9789865	Repeated measures ANOVA with two linear contrasts, comparing the subjective arousal ratings of two blocks (active viewing – neutral and active viewing - negative). ANOVA is calculated using aov_ez() function of the afex-package, estimated marginal means are calculated using emmeans() function from the emmeans-package: if the factor Block is significant, pairwise contrasts are calculated using pairs() with Bonferroni adjustment for multiple testing. Bayes factors are computed for the ANOVA and each contrast using the BayesFactor-package.	ANOVA yields $p < .05$ is interpreted as subjective arousal (arousal ratings) changing significantly with blocks. Values of arousal ratings are interpreted as equal between blocks if $p > .05$. Each contrast yielding $p < .05$ is interpreted as arousal ratings being different between those two blocks, magnitude and direction are inferred from the respective estimate. Values of arousal ratings are interpreted as equal between blocks if $p > .05$. The Bayes factor $BF10$ is reported alongside every p-value to assess the strength of evidence.
	1b) Physiological responding (EMG *corrugator* activity) is lower while actively viewing neutral pictures compared to actively viewing negative pictures.	F tests - ANOVA: Repeated measures, within factors Analysis: A priori: Compute required sample size Input: Effect size f = 0.5573293 (η_p^2 = 0.237) (Pilot Study) α err prob = 0.05 Power (1-β err prob) = 0.95 Number of groups = 1 Number of measurements = 2	Repeated measures ANOVA with two linear contrasts, comparing the EMG *corrugator* activity of two blocks (active viewing – neutral and active viewing - negative). ANOVA is calculated using aov_ez() function of the afex-package, estimated marginal means are calculated using	ANOVA yields $p < .05$ is interpreted as physiological responding (EMG *corrugator* activity) changing significantly with blocks. Values of arousal ratings are interpreted as equal between blocks if $p > .05$. Each contrast yielding $p < .05$ is interpreted as EMG *corrugator* activity being different between those two blocks, magnitude and direction are

		Corr among rep measures = 0.5 Nonsphericity correction ε = 1 Output: Noncentrality parameter λ = 16.1520293 Critical F = 4.7472253 Numerator df = 1.0 Denominator df = 12.0 Total sample size = 13 Actual power = 0.9573615	emmeans() function from the emmeans-package: if the factor Block is significant, pairwise contrasts are calculated using pairs() with Bonferroni adjustment for multiple testing. Bayes factors are computed for the ANOVA and each contrast using the BayesFactor-package.	inferred from the respective estimate. Values of EMG *corrugator* activity are interpreted as equal between blocks if $p > .05$. The Bayes factor *BF10* is reported alongside every *p*-value to assess the strength of evidence.
	1c) Physiological responding (EMG *levator* activity) is lower while actively viewing neutral pictures compared to actively viewing negative pictures.	F tests - ANOVA: Repeated measures, within factors Analysis: A priori: Compute required sample size Input: Effect size f = 0.4396788 (η_p^2 = 0.162) (Pilot Study) α err prob = 0.05 Power (1-β err prob) = 0.95 Number of groups = 1 Number of measurements = 2 Corr among rep measures = 0.5 Nonsphericity correction ε = 1 Output: Noncentrality parameter λ = 14.6921260 Critical F = 4.4138734 Numerator df = 1.0 Denominator df = 18.0 Total sample size = 19 Actual power = 0.9517060	Repeated measures ANOVA with two linear contrasts, comparing the EMG *levator* activity of two blocks (active viewing – neutral and active viewing - negative). ANOVA is calculated using aov_ez() function of the afex-package, estimated marginal means are calculated using emmeans() function from the emmeans-package: if the factor Block is significant, pairwise contrasts are calculated using pairs() with Bonferroni adjustment for multiple testing. Bayes factors are computed for the ANOVA and each contrast using the BayesFactor-package.	ANOVA yields $p < .05$ is interpreted as physiological responding (EMG *levator* activity) changing significantly with blocks. Values of arousal ratings are interpreted as equal between blocks if $p > .05$. Each contrast yielding $p < .05$ is interpreted as EMG *levator* activity being different between those two blocks, magnitude and direction are inferred from the respective estimate. Values of EMG *levator* activity are interpreted as equal between blocks if $p > .05$. The Bayes factor *BF10* is reported alongside every *p*-value to assess the strength of evidence.

| 2.) Do ER strategies reduce emotional arousal? (Manipulation check) | 2a) Subjective arousal (arousal rating) is lower after using an emotion regulation strategy (distraction, distancing, suppression) compared to active viewing. | F tests - ANOVA: Repeated measures, within factors
Analysis: A priori: Compute required sample size
<u>Input:</u>
Effect size f = 0.50 (η_p^2 = 0.20) (Scheffel et al., 2021)
α err prob = 0.05
Power (1-β err prob) = 0.95
Number of groups = 1
Number of measurements = 4
Corr among rep measures = 0.5
Nonsphericity correction ε = 1

<u>Output:</u>
Noncentrality parameter λ = 20.0
Critical F = 2.9603513
Numerator df = 3.0
Denominator df = 27.0
Total sample size = 10
Actual power = 0.95210128 | Repeated measures ANOVA comparing the subjective arousal ratings of four blocks (active viewing, distraction, distancing, suppression).

ANOVA is calculated using aov_ez() function of the afex-package, estimated marginal means are calculated using emmeans() function from the emmeans-package: if the factor Block is significant, pairwise contrasts are calculated using pairs() with Bonferroni adjustment for multiple testing.

Bayes factors are computed for the ANOVA and each contrast using the BayesFactor-package. | ANOVA yields $p < .05$ is interpreted as arousal ratings changing significantly with blocks. Values of arousal ratings are interpreted as equal between blocks if $p > .05$.

Each contrast yielding $p < .05$ is interpreted as arousal ratings being different between those two blocks, magnitude and direction are inferred from the respective estimate. Values of arousal ratings are interpreted as equal between blocks if $p > .05$.

The Bayes factor *BF10* is reported alongside every *p*-value to assess the strength of evidence. |
| 3.) Do ER strategies reduce physiological responding? (Manipulation check) | 3a) Physiological responding (EMG *corrugator* activity) is lower after using an emotion regulation strategy (distraction, distancing, suppression) compared to active viewing. | F tests - ANOVA: Repeated measures, within factors
Analysis: A priori: Compute required sample size
<u>Input:</u>
Effect size f = 0.1605 (Zaehringer et al., 2020)
α err prob = 0.05
Power (1-β err prob) = 0.95
Number of groups = 1
Number of measurements = 4
Corr among rep measures = 0.5
Nonsphericity correction ε = 1 | Repeated measures ANOVA comparing the *corrugator* muscle activity of four blocks (active viewing, distraction, distancing, suppression).

ANOVA is calculated using aov_ez() function of the afex-package, estimated marginal means are calculated using emmeans() function from the emmeans-package: if the factor Block is significant, pairwise contrasts are calculated using | ANOVA yields $p < .05$ is interpreted as *corrugator* muscle activity changing significantly with blocks. Values of *corrugator* muscle activity are interpreted as equal between blocks if $p > .05$.

Each contrast yielding $p < .05$ is interpreted as *corrugator* muscle activity being different between those two blocks, magnitude and direction are inferred from the respective estimate. Values of *corrugator* muscle activity |

		Output: Noncentrality parameter λ = 17.5169700 Critical F = 2.6404222 Numerator df = 3.0 Denominator df = 252 Total sample size = 85 Actual power = 0.9509128	pairs() with Bonferroni adjustment for multiple testing. Bayes factors are computed for the ANOVA and each contrast using the BayesFactor-package.	are interpreted as equal between blocks if $p > .05$. The Bayes factor $BF10$ is reported alongside every p-value to assess the strength of evidence.
	3b) Physiological responding (EMG *levator* activity) is lower after using an emotion regulation strategy (distraction, distancing, suppression) compared to active viewing.	F tests - ANOVA: Repeated measures, within factors Analysis: A priori: Compute required sample size Input: Effect size f = 0.1605 (Zaehringer et al., 2020) α err prob = 0.05 Power (1-β err prob) = 0.95 Number of groups = 1 Number of measurements = 4 Corr among rep measures = 0.5 Nonsphericity correction ε = 1 Output: Noncentrality parameter λ = 17.5169700 Critical F = 2.6404222 Numerator df = 3.0 Denominator df = 252 Total sample size = 85 Actual power = 0.9509128	Repeated measures ANOVA comparing the *levator* muscle activity of four blocks (active viewing, distraction, distancing, suppression). ANOVA is calculated using aov_ez() function of the afex-package, estimated marginal means are calculated using emmeans() function from the emmeans-package: if the factor Block is significant, pairwise contrasts are calculated using pairs() with Bonferroni adjustment for multiple testing. Bayes factors are computed for the ANOVA and each contrast using the BayesFactor-package.	ANOVA yields $p < .05$ is interpreted as *levator* muscle activity changing significantly with blocks. Values of *levator* muscle activity are interpreted as equal between blocks if $p > .05$. Each contrast yielding $p < .05$ is interpreted as *levator* muscle activity being different between those two blocks, magnitude and direction are inferred from the respective estimate. Values of *levator* muscle activity are interpreted as equal between blocks if $p > .05$. The Bayes factor $BF10$ is reported alongside every p-value to assess the strength of evidence.
4.) Do ER strategies require cognitive effort? (Manipulation check)	4a) Subjective effort (effort rating) is greater after using an emotion regulation strategy (distraction,	F tests - ANOVA: Repeated measures, within factors Analysis: A priori: Compute required sample size Input:	Repeated measures ANOVA comparing the subjective effort ratings of four blocks (active viewing, distraction, distancing, suppression).	ANOVA yields $p < .05$ is interpreted as effort ratings changing significantly with blocks. Values of effort ratings are interpreted as equal between blocks if $p > .05$.

	distancing, suppression) compared to active viewing.	Effect size f = 0.2041241 ($\eta_p{}^2$ = 0.04) (Scheffel et al., 2021) α err prob = 0.05 Power (1-β err prob) = 0.95 Number of groups = 1 Number of measurements = 4 Corr among rep measures = 0.5 Nonsphericity correction ε = 1 Output: Noncentrality parameter λ = 17.6666588 Critical F = 2.6625685 Numerator df = 3.0 Denominator df = 156.0 Total sample size = 53 Actual power = 0.95206921	ANOVA is calculated using aov_ez() function of the afex-package, estimated marginal means are calculated using emmeans() function from the emmeans-package: if the factor Block is significant, pairwise contrasts are calculated using pairs() with Bonferroni adjustment for multiple testing. Bayes factors are computed for the ANOVA and each contrast using the BayesFactor-package.	Each contrast yielding $p < .05$ is interpreted as effort ratings being different between those two blocks, magnitude and direction are inferred from the respective estimate. Values of effort ratings are interpreted as equal between blocks if $p > .05$. The Bayes factor *BF10* is reported alongside every *p*-value to assess the strength of evidence.
	4b) Majority of participants reuse the strategy that was least effortful for them.	-	Subjects are asked about the reasons for their choice in the follow-up survey. These answers are classified into categories and counted.	The percentage choice of strategies is described descriptively.
5.) Which variables can predict individual subjective values of ER strategies?	5a) Subjective effort (effort ratings) negatively predict subjective values of ER strategies.	t tests - Linear multiple regression: Fixed model, single regression coefficient Analysis: A priori: Compute required sample size Input: Tail(s) = One Effect size f² = 0.34 (Since there are no findings in this respect yet,	Multilevel model of SVs with level-1-predictors subjective effort, subjective arousal, subjective utility, *corrugator*, and *levator* muscle activity using subject specific intercepts and allowing random slopes for ER strategies.	Fixed effects yield $p < .05$ are interpreted as subjective values are related to subjective effort. Subjective values are interpreted as not being related to subjective effort if $p > .05$. The Bayes factor *BF10* is reported alongside every *p*-value to assess the strength of evidence.

5b) Subjective arousal (arousal ratings) negatively predict subjective values of ER strategies.	we have inferred from the effect size in the closest-similar model: Westbrook et al., 2013) α err prob = 0.05 Power (1-β err prob) = 0.95 Number of predictors = 4 Output: Noncentrality parameter δ = 3.4 Critical t = 1.6991270 Df = 29 Total sample size = 34 Actual power = 0.9529571	The null model and the random slopes model are calculated using lmer() of the lmerTest-package. Bayes factors are computed for the MLM using the BayesFactor-package.	Fixed effects yield $p < .05$ are interpreted as subjective values are related to subjective arousal. Subjective values are interpreted as not being related to subjective arousal if $p > .05$. The Bayes factor *BF10* is reported alongside every *p*-value to assess the strength of evidence.
5c) Subjective utility (utility ratings) positively predict subjective values of ER strategies.			Fixed effects yield $p < .05$ are interpreted as subjective values are related to subjective utility. Subjective values are interpreted as not being related to subjective utility if $p > .05$. The Bayes factor *BF10* is reported alongside every *p*-value to assess the strength of evidence.
5d) Physiological responding (EMG *corrugator* activity) negatively predict subjective values of ER strategies.			Fixed effects yield $p < .05$ are interpreted as subjective values are related to *corrugator* activity. Subjective values are interpreted as not being related to *corrugator* activity if $p > .05$. The Bayes factor *BF10* is reported alongside every *p*-value to assess the strength of evidence.
5e) Physiological responding (EMG *levator* activity) negatively predict subjective values of ER strategies.			Fixed effects yield $p < .05$ are interpreted as subjective values are related to *levator* activity. Subjective values are interpreted as not being related to *levator* activity if $p > .05$.

				The Bayes factor *BF10* is reported alongside every *p*-value to assess the strength of evidence.
6.) Is the effort required for an ER strategy the best predictor for subjective values of ER strategies?	6a) Subjective values decline with increasing effort, even after controlling for task performance (subjective arousal ratings), utility (subjective utility ratings), and physiological responding (EMG *corrugator* and *levator* activity).	t tests - Linear multiple regression: Fixed model, single regression coefficient Analysis: A priori: Compute required sample size Input: Tail(s) = One Effect size f² = 0.34 (Since there are no findings in this respect yet, we have inferred from the effect size in the closest-similar model: Westbrook et al., 2013) α err prob = 0.05 Power (1-β err prob) = 0.95 Number of predictors = 4 Output: Noncentrality parameter δ = 3.4 Critical t = 1.6991270 Df = 29 Total sample size = 34 Actual power = 0.9529571		Fixed effects yield $p < .05$ are interpreted as subjective values changing significantly with ER strategy. Subjective values are interpreted as equal between ER strategies if $p > .05$. The Bayes factor *BF10* is reported alongside every *p*-value to assess the strength of evidence.
7.) Are subjective values related to flexible emotion regulation?	7a) The higher the subjective value, the more likely the respective strategy is chosen.	1) χ² tests – Goodness-of-fit tests_ Contingency tables Analysis: A priori: Compute required sample size Input: Effect size ω = 0.5 (Based on our theoretical considerations, we assume a large effect) α err prob = 0.05	1) Chi-squared test with the variables "predicted choice" (= highest SV of each participant) and "choice" (Strategy 1, 2, or 3) 2) Ordinal regression with dependent variable "Choice" (Strategy 1, 2, or 3) and independent variables "SV	1) χ² yields $p < .05$ is interpreted as predicted choice (highest SV of each participant) and actual choice show significant consistency. Predicted choice and actual choice are interpreted as independent if $p > .05$.

| | | Power (1-β err prob) = 0.95
Df = 1
Output:
Noncentrality parameter λ = 19.8
Critical χ² = 11.0704977
Total sample size = 52
Actual power = 0.9500756

2) z tests –Logistic regression
Analysis: A priori: Compute required sample size
Input:
Tails: One
Pr(Y=1\|X=1) H1 = 0.80 (Based on our theoretical considerations, that a higher SVs should lead almost certainly to the choice of the respective strategy)
Pr(Y=1\|X=1) H0 = 0.333 (Based on theoretical considerations: if all SVs are equal, choice is on chance level)
α err prob = 0.05
Power (1-β err prob) = 0.95
R² other X = 0
X distribution: normal
X param μ = 0
X param σ = 1
Output:
Critical z = 1.6448536
Total sample size = 25
Actual power = 0.9528726 | strategy 1", "SV strategy 2" and "SV strategy 3". | The Bayes factor *BF10* is reported alongside every *p*-value to assess the strength of evidence.

2) Ordinal logistic regression yields *p* < .05 is interpreted as the respective subjective value has a significant influence on the OR of the choice of a strategy.
Respective SV is interpreted as not related to choice if *p* > .05.

The Bayes factor *BF10* is reported alongside every *p*-value to assess the strength of evidence. |

	7b) Subjective values are lower and decline stronger when ER flexibility is lower.	t tests – Linear multiple regression: Fixed model, single regression coefficient Analysis: A priori: compute required sample size Input: Tail(s) = One Effect size f^2 = 0.15 (as there is no evidence in the literature, we assume a medium sized effect) α err prob = 0.05 Power (1-β err prob) = 0.95 Number of predictors = 2 Output: Noncentrality parameter δ = 3.316662 Critical t = 1.69665997 Df = 71 Total sample size = 74 Actual power = 0.95101851	SVs will be sorted by magnitude in descending order. Values will be fitted in a linear model to estimate the individual intercept (i.e., the extent to which an individual considers any of the ER strategies useful) and slope (i.e., the extent to which one strategy is preferred over others, indicating less flexibility). A linear regression will be computed with individual intercepts and slopes as predictors and FlexER score as criterion.	β yield $p < .05$ are interpreted as significant association between predictor (intercept, slope) and ER flexibility. The direction of effect is interpreted according to sign (negative or positive). p – values $> .05$ are interpreted as no association between predictor and ER flexibility. The Bayes factor *BF10* is reported alongside every p-value to assess the strength of evidence.

| Exploratory: Are individual subjective values of ER strategies related to personality traits? | | | Multilevel model of SVs with level-1-predictors subjective effort, subjective arousal, *corrugator*, and *levator* muscle activity and level-2-predictors NFC and self-control using subject specific intercepts and allowing random slopes for ER strategies.

The null model and the random slopes model are calculated using lmer() of the lmerTest-package.

Bayes factors are computed for the MLM using the BayesFactor-package. | Fixed effects yield $p < .05$ are interpreted as subjective values are related to NFC and self-control. Subjective values are interpreted as not being related to subjective effort if $p > .05$.

The Bayes factor *BF10* is reported alongside every p-value to assess the strength of evidence. |

659

Supplementary Material

Supplementary Material 1

Table S1

List of IAPS (Lang, Bradley, and Cuthbert, 2008) and EmoPicS (Wessa et al., 2010) used in the ER paradigm.

	Neutral	Negative 1	Negative 2	Negative 3	Negative 4	Negative 5
	083[†]	225[†]	210[†]	208[†]	227[†]	223[†]
	107[†]	230[†]	218[†]	219[†]	252[†]	238[†]
	124[†]	255[†]	222[†]	226[†]	1051*	245[†]
	140[†]	327[†]	228[†]	253[†]	2800*	2981*
	143[†]	1111*	246[†]	254[†]	3061*	3016*
	7000*	3017*	251[†]	326[†]	3230*	3101*
	7002*	3022*	2703*	1301*	6561*	3181*
	7004*	3180*	3051*	3350*	6838*	3215*
	7006*	3280*	3160*	6242*	9120*	3220*
	7009*	6190*	3185*	6410*	9181*	3225*
	7021*	6244*	3301*	6555*	9185*	6020*
	7025*	6836*	6562*	6825*	9230*	6571*
	7041*	9180*	9031*	6940*	9254*	6831*
	7100*	9182*	9040*	8230*	9295*	8231*
	7150*	9253*	9042*	9041*	9332*	9373*
	7185*	9300*	9043*	9140*	9411*	9400*
	7211*	9326*	9145*	9340*	9420*	9402*
	7224*	9424*	9160*	9409*	9421*	9403*
	7233*	9425*	9184*	9570*	9599*	9405*
	7235*	9920*	9904*	9800*	9905*	9423*
Valence	4.86 ± 0.49	2.84 ± 0.57	2.64 ± 0.46	2.82 ± 0.62	2.65 ± 0.75	2.74 ± 0.70
Arousal	3.01 ± 0.61	5.62 ± 0.34	5.58 ± 0.38	5.60 ± 0.39	5.61 ± 0.41	5.63 ± 0.37

Note. * Pictures taken from the IAPS (Lang, Bradley, and Cuthbert, 2008); [†] Pictures taken from the EmoPicS (Wessa et al., 2010).

Detailed information on psychometric measures

WHO-5. General psychological well-being is assessed using the WHO-5 scale[42,43]. 5 Items such as "Over the past 2 weeks I have felt calm and relaxed." are rated on a 6-point Likert scale raning from 0 (at no time) to 5 (all of the time). The german version of the scale showed a high internal consistency (Cronbach's $\alpha = .92$)[43].

Connor-Davidson Resilience Scale. Resilience is assessed using the Connor-Davidson Resilience Scale (CD-RISC)[44–46]. 10 items such as "I am able to adapt to change." are rated on a scale from 0 (not true at all) to 4 (true nearly all the time). The 10-item version showed a high internal consistency (Cronbach's $\alpha = .84$) and a satisfactory retest-reliability of $r_{tt} = .81$ across 6 month[45].

Emotion Regulation Questionnaire. Habitual use of reappraisal and suppression is measured using the 10-item Emotion Regulation Questionnaire (ERQ)[9,47]. The scale has items such as "I keep my emotions to myself" (ERQ-suppression - 4 items) and "When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm" (ERQ-reappraisal - 6 items), which are answered on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree), and has acceptable to high internal consistency (Cronbach's $\alpha > .75$).[66]

FlexER Scale. Flexible use of ER strategies is assessed using the FlexER Scale[41] with items such as "If I want to feel less negative emotions, I have several strategies to achieve this.", which are answered on a 4-point scale ranging from "strongly agree" to "strongly disagree". Psychometric properties are currently under investigation.

Implicit Theories Questionnaire. Implicit theories of willpower in emotional control are assessed using the Implicit Theories Questionnaire of.[48] 4 items such as "Having to control a strong emotion makes you exhausted and you are less able to manage your feelings right afterwards." are rated on a 6-point scale ranging from 1 (fully agree) to 6 (do not agree at all). The questionnaire showed an internal consistency of Cronbach's $\alpha = .87$[48].

687   *Need for Cognition Scale.* Need for Cognition (NFC) is assessed with the 16-item

688 short version of the German NFC scale.[49] Responses to each item (e.g., "Thinking is not

689 my idea of fun", recoded) are recorded on a 7-point Likert scale ranging from -3

690 (completely disagree) to +3 (completely agree) and are summed to the total NFC score.

691 The scale shows comparably high internal consistency (Cronbach's α > .80)[49,67] and a

692 retest reliability of r_{tt} = .83 across 8 to 18 weeks.[68]

693   *Self-Regulation Scale.* As one measure of self-control, the Self-Regulation Scale

694 (SRS)[51] is used. The scale has 10 items (e.g., "It is difficult for me to suppress thoughts

695 that interfere with what I need to do.", recoded) on a 4-point scale ranging from 1 (not at

696 all true) to 4 (exactly true). It has high internal consistency [Cronbach's α > .80;].[51]

697   *Brief Self-Control Scale.* As a second measure of self-control, the Brief Self-Control

698 Scale (BSCS)[52,53] is used. It comprises 13 items (e.g., "I am good at resisting

699 temptations") with a 5-point rating scale ranging from 1 (not at all like me) to 5 (very

700 much like me). The scale shows acceptable internal consistency (Cronbach's α = .81)[53] .

701   *Barratt Impulsiveness Scale.* As a third measure of self-control, the Barratt

702 Impulsiveness Scale (BIS-11)[54,55] is used. Responses to each item (e.g., "I am

703 self-controlled.", recoded) are assessed on a 4-point scale ranging from 1 (never/rarely) to 4

704 (almost always/always). An internal consistency of Cronbach's α = .74 and a retest

705 reliability of r_{tt} = .56 for General Impulsiveness and r_{tt} = .66 for Total Score across 6

706 month were reported.[55]

707   *Attentional Control Scale.* Attentional control is measured using the Attentional

708 Control Scale (ACS)[56] with items such as "My concentration is good even if there is music

709 in the room around me". The 20 items are rated on a 4-point scale ranging from 1 (almost

710 never) to 4 (always). An internal consistency of Cronbach's α = .88 was reported.[56]

711 **Pilot study: Subjective arousal in the conditions "Active viewing - neutral"**

712 **and "Active viewing - negative"**

713 ANOVA:

Effect	df	MSE	F	ges	p.value
block	1, 15	3895.91	34.32 ***	.475	<.001

715 $BF10 = 1,244.99$

716 Paired contrasts:

Table 1
Paired contrasts for the rmANOVA comparing subjective arousal of negative and neutral pictures in the condition "active viewing".

Contrast	Estimate	SE	df	t	p	$BF10$	η_p^2	$95\%CI$
$View_{neutral} - View_{negative}$	-129.28	22.07	15.00	-5.86	0.00	794.78	0.70	[0.43, 1.00]

Note. SE = standard error, df = degrees of freedom, t = t-statistic, p = p-value, CI = confidence interval.
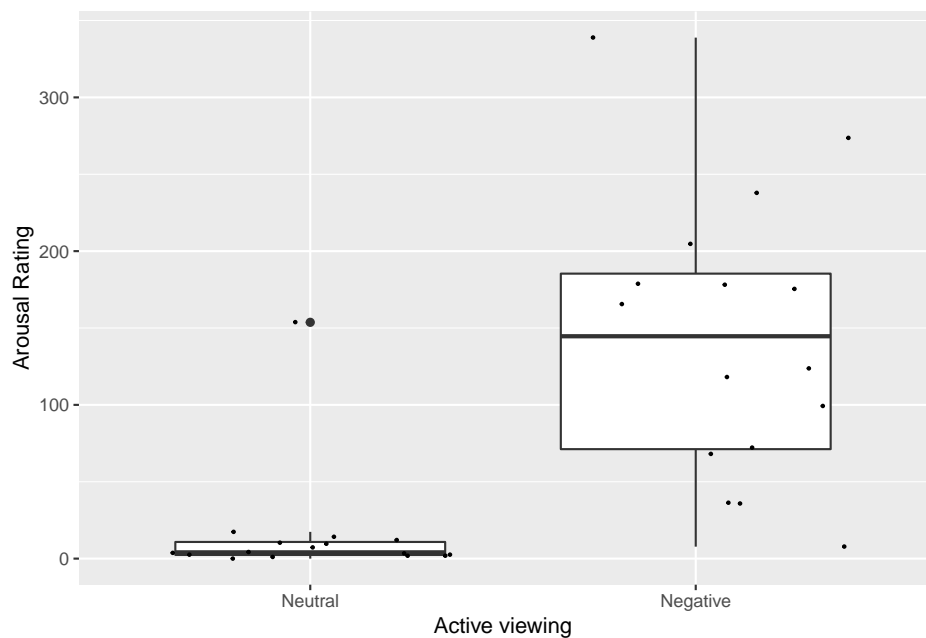
717 Figure:

Figure 3. Subjective arousal ratings for the conditions "Active viewing - neutral" and "Active viewing - negative" visualized as boxplots. Each dot represents the effort rating of a single subject. Bold dots represent outliers.

Pilot study: Subjective arousal in the conditions "Active viewing - negative", "Distraction", "Distancing", and "Suppression"

ANOVA:

Effect	df	MSE	F	ges	p.value
block	2.79, 41.89	2238.27	1.17	.011	.332

$BF10 = 0.11$

Paired contrasts:

Table 2

Paired contrasts for the rmANOVA comparing subjective arousal of conditions "Active viewing - negative", "Distraction", "Distancing", and "Suppression".

Contrast	Estimate	SE	df	t	p	$BF10$	η_p^2	$95\%CI$
$View_{negative} - Distraction$	-0.74	16.14	45.00	-0.05	1.00	0.26	4.68e-05	[0.00, 1.00]
$View_{negative} - Distancing$	-5.35	16.14	45.00	-0.33	1.00	0.27	2.43e-03	[0.00, 1.00]
$View_{negative} - Suppression$	-26.23	16.14	45.00	-1.63	0.67	1.25	0.06	[0.00, 1.00]
$Distraction - Distancing$	-4.61	16.14	45.00	-0.29	1.00	0.26	1.81e-03	[0.00, 1.00]
$Distraction - Suppression$	-25.49	16.14	45.00	-1.58	0.73	0.77	0.05	[0.00, 1.00]
$Distancing - Suppression$	-20.88	16.14	45.00	-1.29	1.00	0.52	0.04	[0.00, 1.00]

Note. SE = standard error, *df* = degrees of freedom, *t* = *t*-statistic, *p* = *p*-value, CI = confidence interval.
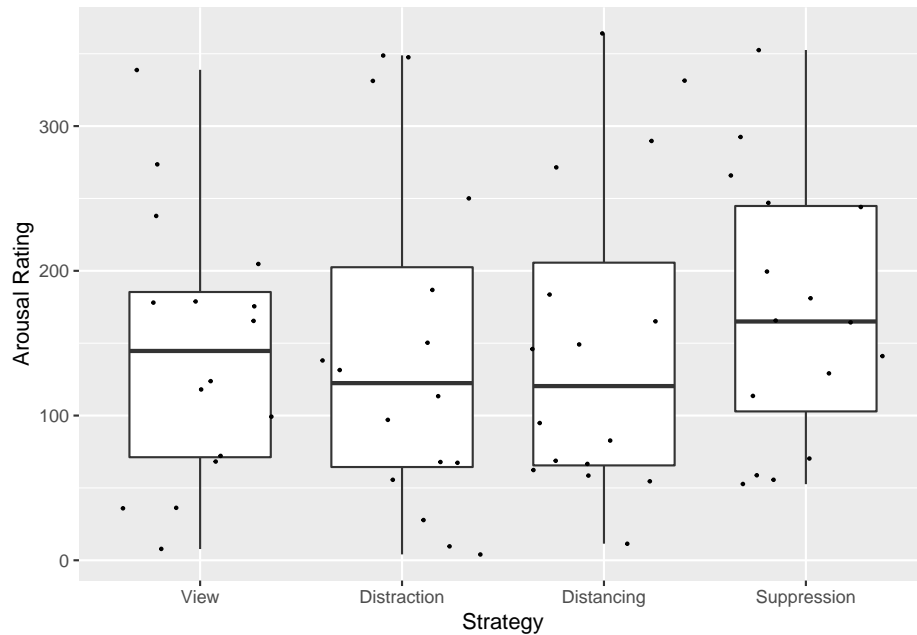
724   Figure:

Figure 4. Subjective arousal ratings for the conditions "Active viewing - negative", "Distraction", "Distancing", and "Suppression" visualized as boxplots. Each dot represents the effort rating of a single subject. Bold dots represent outliers.

725 **Pilot study: Physiological responding (*Corrugator* and *Levator* activity) in the**

726 **conditions "Active viewing - neutral" and "Active viewing - negative"**

727 *Corrugator*: ANOVA:

Effect	df	MSE	F	ges	p.value
block	1, 15	1.01	9.70 **	.237	.007

729 $BF10 = 6{,}690{,}401.91$

730 Paired contrasts:

Table 3
Paired contrasts for the rmANOVA comparing physiological responding (Corrugator activity) of negative and neutral pictures in the condition "active viewing".

Contrast	Estimate	SE	df	t	p	$BF10$	η_p^2	$95\%CI$
$View_{neutral} - View_{negative}$	-1.11	0.36	15.00	-3.11	0.01	5,019,313.20	0.39	[0.09, 1.00]

Note. SE = standard error, df = degrees of freedom, t = t-statistic, p = p-value, CI = confidence interval.

731 *Levator*: ANOVA:

Effect	df	MSE	F	ges	p.value
block	1, 15	0.17	7.72 *	.162	.014

733 $BF10 = 48.44$

734 Paired contrasts:

Table 4
Paired contrasts for the rmANOVA comparing physiological responding (Levator activity) of negative and neutral pictures in the condition "active viewing".

Contrast	Estimate	SE	df	t	p	$BF10$	η_p^2	$95\%CI$
$View_{neutral} - View_{negative}$	-0.40	0.14	15.00	-2.78	0.01	41.02	0.34	[0.05, 1.00]

Note. SE = standard error, df = degrees of freedom, t = t-statistic, p = p-value, CI = confidence interval.
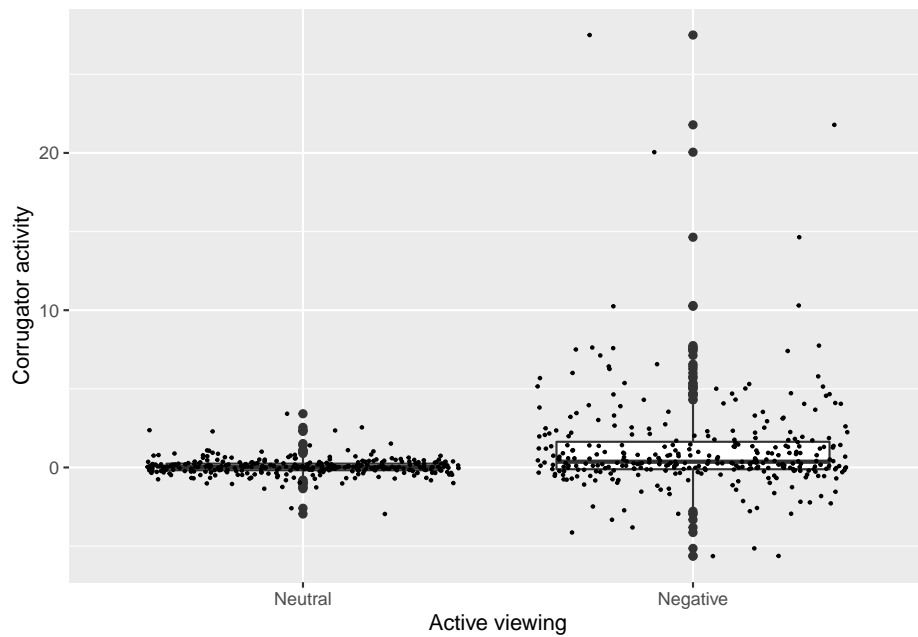
735   Figures:

Figure 5. Corrugator activity for the conditions "Active viewing - neutral" and "Active viewing - negative" visualized as boxplots. Each dot represents the corrugator activity of a single trial. Bold dots represent outliers.
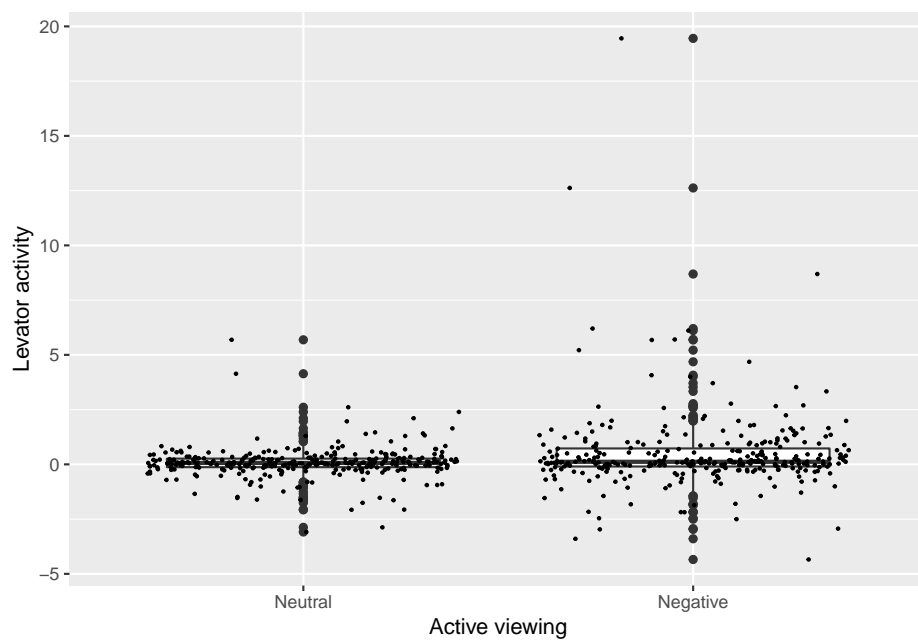

Figure 6. Levator activity for the conditions "Active viewing - neutral" and "Active viewing - negative" visualized as boxplots. Each dot represents the levator activity of a single trial. Bold dots represent outliers.

736 **Pilot study: Physiological responding (*Corrugator* and *Levator* activity) in the**

737 **conditions"Active viewing - negative", "Distraction", "Distancing", and**

738 **"Suppression"**

739 *Corrugator*: ANOVA:

Effect	df	MSE	F	ges	p.value
block	1.53, 22.98	1.16	5.71 *	.189	.015

741 $BF10 = 5{,}257{,}689.54$

742 Paired contrasts:

Table 5
Paired contrasts for the rmANOVA comparing physiological responding (Corrugator activity) of conditions "Active viewing - negative", "Distraction", "Distancing", and "Suppression".

Contrast	Estimate	SE	df	t	p	$BF10$	η_p^2	$95\%CI$
$View_{negative} - Distraction$	0.88	0.27	45.00	3.22	0.01	4,962.89	0.19	[0.05, 1.00]
$View_{negative} - Distancing$	0.95	0.27	45.00	3.50	0.01	616.63	0.21	[0.06, 1.00]
$View_{negative} - Suppression$	0.92	0.27	45.00	3.40	0.01	11,678.82	0.20	[0.06, 1.00]
$Distraction - Distancing$	0.08	0.27	45.00	0.28	1.00	0.07	1.78e-03	[0.00, 1.00]
$Distraction - Suppression$	0.05	0.27	45.00	0.18	1.00	0.08	7.22e-04	[0.00, 1.00]
$Distancing - Suppression$	-0.03	0.27	45.00	-0.10	1.00	0.06	2.36e-04	[0.00, 1.00]

Note. SE = standard error, df = degrees of freedom, t = t-statistic, p = p-value, CI = confidence interval.

743 *Levator*: ANOVA:

Effect	df	MSE	F	ges	p.value
block	2.07, 31.00	0.20	8.27 **	.225	.001

745 $BF10 = 672{,}341.29$

746 Paired contrasts:

Table 6

Paired contrasts for the rmANOVA comparing physiological respodning (Levator activity) of conditions "Active viewing - negative", "Distraction", "Distancing", and "Suppression".

Contrast	Estimate	SE	df	t	p	$BF10$	η_p^2	$95\%CI$
$View_{negative} - Distraction$	0.42	0.13	45.00	3.24	0.01	58.02	0.19	[0.05, 1.00]
$View_{negative} - Distancing$	0.45	0.13	45.00	3.46	0.01	93.49	0.21	[0.06, 1.00]
$View_{negative} - Suppression$	0.62	0.13	45.00	4.79	0.00	6,253.91	0.34	[0.16, 1.00]
$Distraction - Distancing$	0.03	0.13	45.00	0.22	1.00	0.07	1.06e-03	[0.00, 1.00]
$Distraction - Suppression$	0.20	0.13	45.00	1.54	0.78	1.52	0.05	[0.00, 1.00]
$Distancing - Suppression$	0.17	0.13	45.00	1.32	1.00	0.52	0.04	[0.00, 1.00]

Note. SE = standard error, df = degrees of freedom, t = t-statistic, p = p-value, CI = confidence interval.
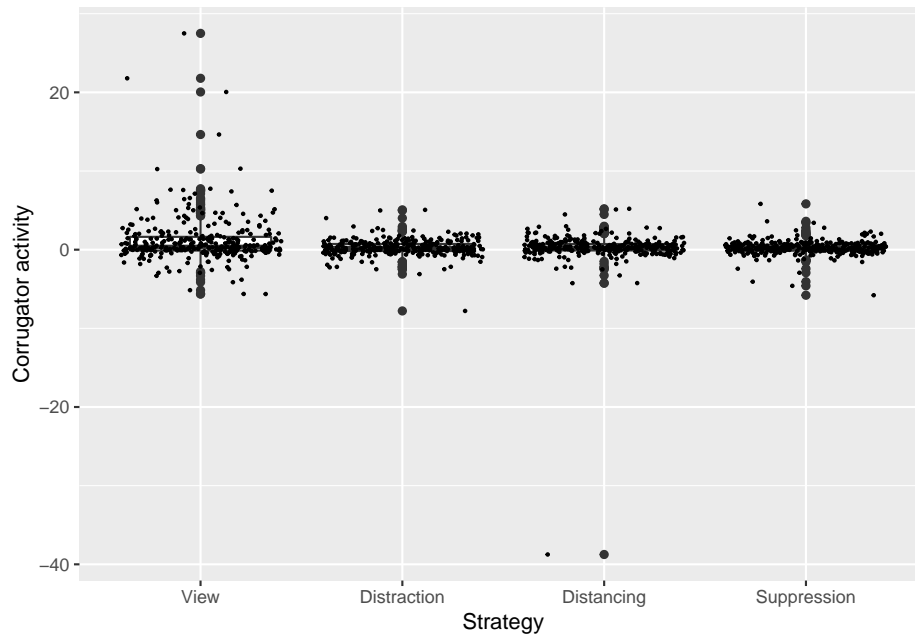
747   Figures:

Figure 7. Corrugator activity for the conditions "Active viewing - negative", "Distraction", "Distancing", and "Suppression" visualized as boxplots. Each dot represents the corrugator activity of a single trial. Bold dots represent outliers.
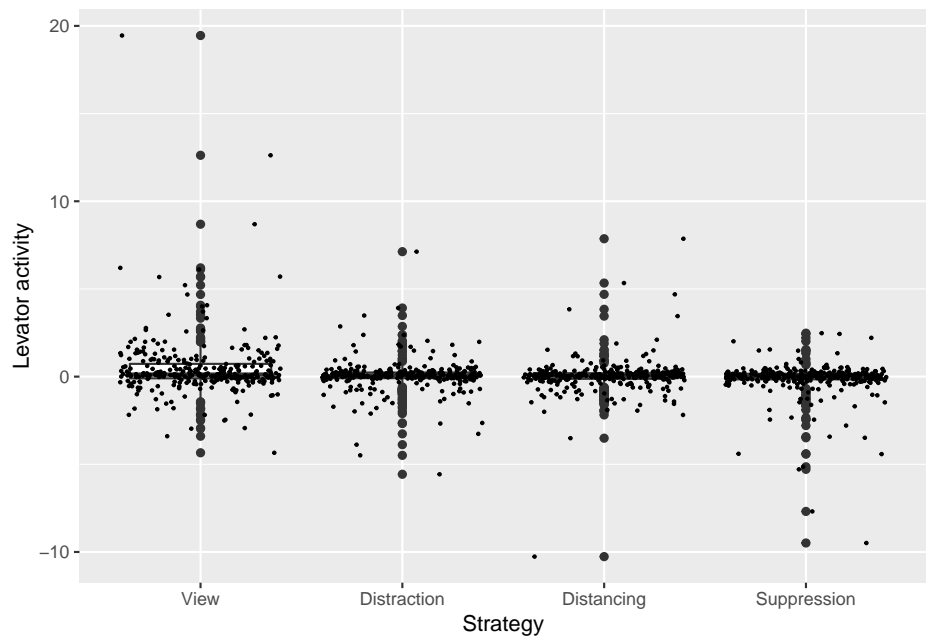
Figure 8. Levator activity for the conditions "Active viewing - negative", "Distraction", "Distancing", and "Suppression" visualized as boxplots. Each dot represents the levator activity of a single trial. Bold dots represent outliers.

Pilot study: Subjective effort in the conditions "Active viewing - negative", "Distraction", "Distancing", and "Suppression"

ANOVA:

Effect	df	MSE	F	ges	p.value
block	2.38, 35.66	4388.19	11.13 ***	.185	<.001

$BF10 = 7.40$

Paired contrasts:

Table 7

Paired contrasts for the rmANOVA comparing subjective effort of conditions "Active viewing - negative", "Distraction", "Distancing", and "Suppression".

Contrast	Estimate	SE	df	t	p	$BF10$	η_p^2	$95\%CI$
$View_{negative} - Distancing$	-110.72	20.85	45.00	-5.31	0.00	59.77	0.39	[0.20, 1.00]
$View_{negative} - Distraction$	-89.72	20.85	45.00	-4.30	0.00	20.49	0.29	[0.12, 1.00]
$View_{negative} - Suppression$	-88.15	20.85	45.00	-4.23	0.00	33.13	0.28	[0.11, 1.00]
$Distraction - Distancing$	21.00	20.85	45.00	1.01	1.00	0.50	0.02	[0.00, 1.00]
$Distraction - Suppression$	22.57	20.85	45.00	1.08	1.00	0.57	0.03	[0.00, 1.00]
$Distancing - Suppression$	1.57	20.85	45.00	0.08	1.00	0.26	1.27e-04	[0.00, 1.00]

Note. SE = standard error, df = degrees of freedom, t = t-statistic, p = p-value, CI = confidence interval.
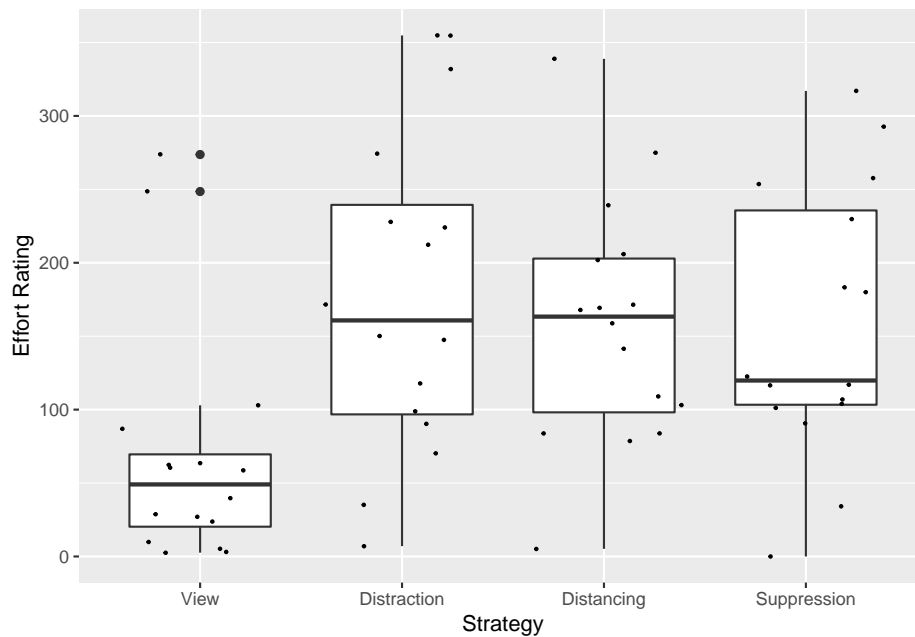
754   Figure:

Figure 9. Subjective effort ratings for the conditions "Active viewing - negative", "Distraction", "Distancing", and "Suppression" visualized as boxplots. Each dot represents the effort rating of a single subject. Bold dots represent outliers.