1   Estimating individual subjective values of emotion regulation strategies

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Abstract

Individuals have a repertoire of emotion regulation (ER) strategies at their disposal, which they can use more or less flexibly. In ER flexibility research, strategies that facilitate goal achievement are considered adaptive and therefore are subjectively valuable. Individuals are motivated to reduce their emotional arousal effectively and to avoid cognitive effort. Perceived costs of ER strategies in the form of effort, however, are highly subjective. Subjective values (SVs) should therefore represent a trade-off between effectiveness and subjectively required cognitive effort. However, SVs of ER strategies have not been determined so far. We present a paradigm that is suitable for determining individual SVs of ER strategies. Using a multilevel modelling approach, it will be investigated whether individual SVs can be explained by effectiveness (subjective arousal, facial muscle activity) and subjective effort. Relations of SVs to personality traits will be explored.

Keywords: emotion regulation, regulatory effort, effort discounting, registered report, specification curve analysis

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. It could be assumed, that the antecedent-focused strategies,

148 i.e. attentional deployment and cognitive change, require less effort, because according to

149 Gross[1] these strategies apply when the emotional reaction has not fully developed, yet. In

150 contrast, suppression would need ongoing effort, because it takes effect late in the emotion

151 generating process and does not alter the emotion itself. A similar assumption has been

152 made by Mesmer-Magnus et al.[31], who state that Surface Acting (the equivalent to

153 expressive suppression in emotional labor research) is supposed to continuously require

154 high levels of energy (hence effort). Deep Acting (which refers to reappraisal), in turn, only

155 initially needs the use of energy. This would be in conflict with findings in our previous

156 studies, that showed that many people choose expressive suppression because they

157 evaluated it as less effortful, hence easy[22]. Others define emotion regulation on a continuum

158 from explicit, conscious, and effortful to implicit, unconscious, automatic and effortless[32].

159 This would mean, that all explicit strategies that have been proposed by the process model

160 of emotion regulation are similarly effortful[1]. Similarly, the flexibility approach of emotion

161 regulation also states, that there is no "best" strategy[33]. An emotion regulation attempt is

162 adaptive, when the intended, individual goal is reached. Those attempts could also consist

163 of sequences of regulatory efforts using different strategies, which might be effective and

164 effortless only in this specific context. Therefore, we have to add an additional step, which

165 precedes the other steps and where the ER option with the higher subjective value is

166 determined. In this step, the same monetary value (i.e., 1 €) is assigned to both options.

167 The assumption is that participants now choose the option that has the higher SV for

168 them. In the next step we return to the original paradigm. The higher monetary value (i.e.,

169 2 €) is assigned to the option that was not chosen in the first step and therefore is assumed

170 to have the lower SV. In the following steps, the lower value is changed in every iteration

171 according to Westbrook et al.[29] until the indifference point is reached. This procedure will

172 be repeated until all strategies have been compared. The SV of each strategy is calculated

173 as the mean of this strategy's SV from all comparisons. In case a participant has a clear

174 preference for one strategy, the SV of this strategy will be 1. But our paradigm can also

175 account for the case that a person does not have a clear preference. Then no SV will be 1,

176 but still, the SVs of all strategies can be interpreted as absolute values and in relation to

177 the other strategy's SVs (see Figure 1). In a separate study, we will test our adapted

178 paradigm together with a *n*-back task and explore whether this paradigm can describe

179 individuals that do not prefer the easiest *n*-back option (see Zerna et al.[34]).

180   The aim of the present study is to evaluate whether this paradigm is suitable for

181 determining SVs of ER strategies. As a manipulation check, we first want to investigate

182 whether the valence of the pictures is affecting subjective and physiological responding,

183 resulting in lower subjective arousal ratings after and lower EMG activity during neutral

184 compared to negative pictures. Second, we want to check whether the ER strategies

185 distraction, distancing, and suppression effectively reduce subjective arousal and

186 physiological responding compared to the active viewing condition. Third, we want to see

187 whether the strategies subjectively require more cognitive effort than the active viewing

188 condition, and whether participants re-apply the for them least effortful strategy.

189 Furthermore, we want to investigate whether subjective effort, arousal ratings, subjective

190 utility, and EMG activity predict individual subjective values of ER strategies. And lastly,
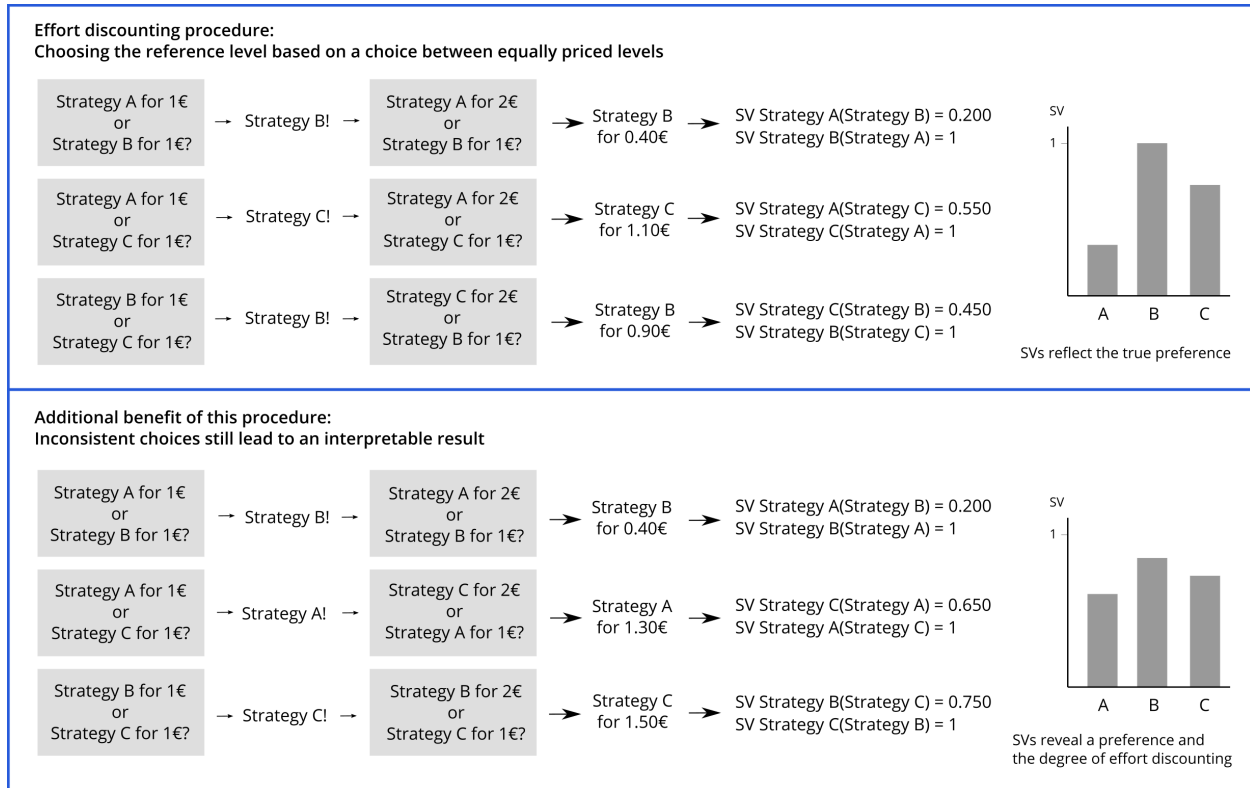
Figure 1. Exemplary visualization of two response patterns. In the top half, the person has a clear preference for one of the three strategies. In the lower half, they have no clear preference and therefore show an inconsistent response pattern. This pattern can be represented by our paradigm.

191 we want to check whether the SV of a strategy is associated with its likelihood of being

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

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

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

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

2. Method

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

198 manipulations, and all measures in the study[35]. The paradigm was written and presented

199 using *PsychoPy*[36]. We used *R* with *R Studio*[37,38] with the main packages *afex*[39] and

200 *BayesFactor*[40] for all analyses. The R Markdown file used to analyze the data and write

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

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

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

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

2.1 Ethics information

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

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

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

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

2.2 Pilot data

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

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

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

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

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

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

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

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

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

2.3 Design

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

222 *ORSEE*[41] at the Technische Universität Dresden. Participants will be excluded from

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

239 using REDCap electronic data capture tools hosted at Technische Universität Dresden[42,43].

240 **2.3.1 Psychometric measures.**   The online survey will contain a number of

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

242 (FlexER)[44].

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

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

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

246 Further psychological constructs will be assessed but have no clear hypotheses in the

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

248 well-being will be assessed using the German version of the WHO-5 scale[45,46]. To measure

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

250 (CD-RISC)[49] will be used. Habitual use of ER will be assessed using the German version of

251 the Emotion Regulation Questionnaire (ERQ)[9,50]. Implicit theories of willpower in emotion

252 control will be assessed using the implicit theories questionnaire from Bernecker and Job[51].

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

254 Scale[28,52] will be used. To assess self-control,[53] sum scores of the German versions of the

255 following questionnaires will be used: the Self-Regulation Scale (SRS)[54], the Brief

256 Self-Control Scale (BSCS)[55,56], and the Barratt Impulsiveness Scale (BIS-11)[57,58].

257 Attentional control will be assessed using the Attentional Control Scale (ACS)[59]. For more

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

259 supplementary material.

260 **2.3.2 Emotion regulation paradigm.** The ER paradigm will consist of three

261 parts that will be described in the following.

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

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

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

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

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

267 condition. During this block, 20 neutral pictures will be presented. Participants will be

268 asked to "actively view all pictures and permit all emotions that may arise." In the second

269 block, participants will actively view negative pictures. During the third, fourth, and fifth

270 block, participants will see negative pictures and will be asked to regulate their emotions

271 using distraction, distancing, and suppression. In order to achieve distraction, participants

272 will be asked to think of a geometric object or an everyday activity, like brushing their

273 teeth. During distancing, participants will be asked to "take the position of a non-involved

274 observer, thinking about the picture in a neutral way." Participants will be told not to

275 re-interpret the situation or attaching a different meaning to the situation. During

276 suppression, participants will be told to "suppress their emotional facial expression." They

277 should imagine being observed by a third person that should not be able to tell by looking

278 at the facial expression whether the person is looking at an emotional picture. Participants

279 will be instructed not to suppress their thoughts or change their facial expression to the

280 opposite[22]. All participants will receive written instruction and complete a training session.

281 After the training session, participants will be asked about their applied ER strategies to

282 avoid misapplication. The order of the three regulation blocks (distraction, distancing, and

283 suppression) will be randomized between participants. Each of the blocks consists of 20

284 trials showing neutral (Block 1) and negative (Blocks 2, 3, 4, 5) pictures. Each trial begins

285 with a fixation cross that lasts 3 to 5 seconds (random uniform distributed). It is followed

286 by neutral or negative pictures for a total of 6 seconds. After each block, participants

287 retrospectively will rate their subjective emotional arousal ("not at all aroused" to "very

288 highly aroused"), their subjective effort ("not very exhausting" to "very exhausting"), and

289 - after the ragulation blocks - the utility of the respective strategy ("not useful at all" to

290 "very useful") on a continuous scale using a slider on screen.

291   *Part two: ER effort discounting.* In the second part, ER effort discounting will take

292 place. The procedure of the discounting will follow the COG-ED paradigm by Westbrook et

293 al.[29] with a major change. We will use the following adaption that allows the computation

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

318 decision afterwards in RedCap using a free text field. As soon as they have decided, they

319 will see the respective instruction and the block with another 20 negative pictures starts.

320 **2.3.3 Stimuli.** Pictures that will be used in the paradigm are selected from the

321 Emotional Picture Set (EmoPicS)[60] and the International Affective Picture System

322 (IAPS)[61]. The 20 neutral pictures (Valence (V): $M \pm SD = 4.81 \pm 0.51$; Arousal (A): M

323 $\pm SD = 3 \pm 0.65$) depicted content related to the categories persons, objects, and scenes.

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

325 suffering, violence, and weapons, will be used. An evolutionary algorithm[62] is used to

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

327 $M \pm SD = 2.84 \pm 0.57$, A: $M \pm SD = 5.62 \pm 0.34$; set two: V: $M \pm SD = 2.64 \pm 0.46$, A:

328 $M \pm SD = 5.58 \pm 0.35$; set three: V: $M \pm SD = 2.82 \pm 0.62$, A: $M \pm SD = 5.60 \pm 0.39$;

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

330 2.74 ± 0.70, A: $M \pm SD = 5.63 \pm 0.37$). A complete list of all pictures and their

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

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┌────────────────────────────────────────────┐
│                  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│
└────────────────────────────────────────────┘
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(randomized order — applies to Blocks 3, 4, 5)

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         ╭──────────────────────────╮
         │   subjective arousal, effort│
         │      and utility rating     │
         ╰──────────────────────────╯
┌────────────────────────────────────────────┐
│          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     │
         ╰──────────────────────────╯
```
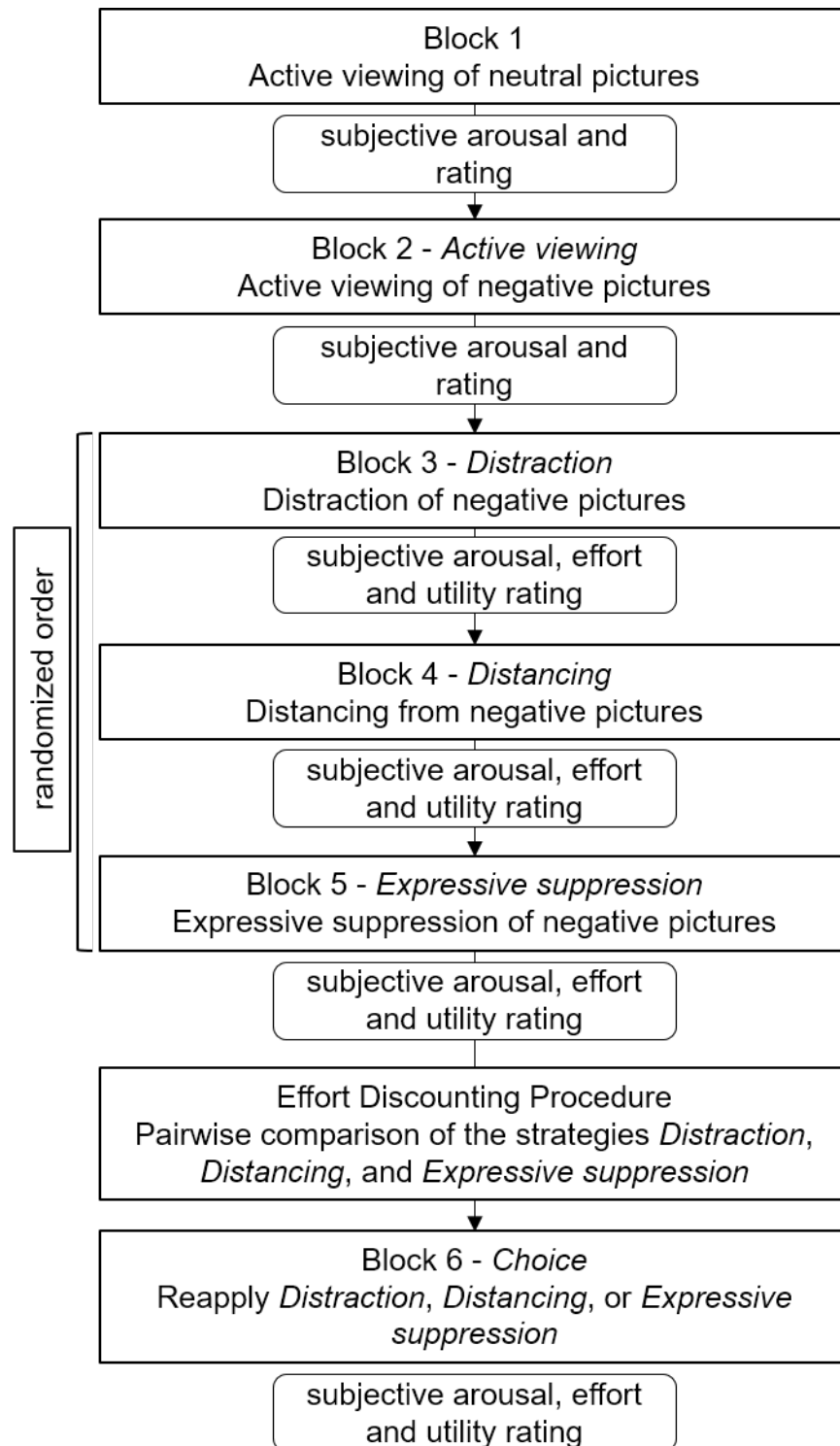
Figure 2. Block design of the paradigm. Every participant starts with two "active viewing" blocks continaing neutral (Block 1) and negative (Block 2) pictures. Order of the regulation blocks (Blocks 3, 4, and 5) is randomized between participants. After, the discounting procedure takes place. All three 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.

332 pictures will be assigned randomly to the blocks.

333   **2.3.4 Facial electromyography.** Bipolar facial electromyography (EMG) will be

334 measured for *corrugator supercilii* and *levator labii* as indices of affective valence[63], similar

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

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

337 according to the guidelines of.[64] The ground electrode will be placed over the left *Mastoid.*

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

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

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

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

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

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

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

345 stimulus onset.[63] Last, the sampling rate will be changed to 100 Hz, and EMG data will be

346 averaged for each condition and each participant.

347 **2.4 Sampling plan**

348   Sample size calculation is done using *G*Power*[65,66]. In a meta-analysis of Zaehringer

349 and colleagues[5], effect sizes of ER on peripheral-physiological measures were reported: To

350 find an effect of $d = -0.32$ of ER on *corrugator* muscle activity with $\alpha = .05$ and $\beta = .95$,

351 data of at least $N = 85$ have to be analyzed. Power analyses of all other hypotheses yielded

352 smaller sample sizes. However, if participants withdraw from study participation, technical

353 failures occur, or experimenter considers the participant for not suitable for study

354 participation (e.g., because the participant does not follow instructions or shows great

355 fatigue), respective data will also be excluded from further analyses. Therefore, we aim to

356 collect data of $N = 120$ participants, about 50 more data sets, than necessary. Detailed

357 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[39]. 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 emotional pictures on subjective arousal ratings (H1a), a rmANOVA with the factor valence (neutral and negative) for the strategy active viewing will be conducted. To examine the impact of valence on physiolocigal responding (H1b and H1c), a rmANOVA with the factor valence (neutral and negative) for the strategy active viewing will be conducted for EMG *corrugator* and *levator* activity.

Effects of emotion regulation on arousal, facial EMG and effort. To investigate the effects of the three ER strategies on subjective arousal (H2a), another rmANOVA with the factor strategy (active viewing - negative, distraction, distancing, and suppression) for subjective arousal ratings will be conducted. To examine the effects of the three ER strategies on physiological responding (H3a and H3b), another rmANOVA with the factor strategy (active viewing - negative, distraction, distancing, and suppression) for EMG *corrugator* and *levator* activity will be conducted. To examine the effect of ER strategies

384 on subjective effort (H4a), a rmANOVA with the factor strategy (active viewing - negative,

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

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

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

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

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

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

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

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

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

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

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

396 SVs of each strategy across pairings.

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

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

399 (MLM) will be specified using the *lmerTest* package[67]. First, ER strategies will be recoded

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

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

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

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

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

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

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

406 Level-1-predictors will be centered within cluster[68]. Residuals of the final model will be

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

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

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

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

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

412 independent variables SVs of each strategy will be computed.

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

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

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

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

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

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

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

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

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

422 dependent variable. A positive association with the predictor *intercept* would indicate that

423 overall higher SVs attached to ER strategies predicts higher scores on the FlexER scale. A

424 positive association with the predictor *slope* would indicate that less negative slopes, i.e., a

425 smaller preference for a given ER strategy, would be associated with a higher score of the

426 FlexER scale.

427   The influence of personality traits on SVs will be investigated exploratorily.

428 Therefore, the MLM specified above will be extended by the level-2-predictors NFC and

429 self-control.

430   For each result of the analyses, both *p*-values and Bayes factors $BF10$, calculated

431 using the *BayesFactor* package[40], will be reported. Bayes factors are calculated using the

432 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.
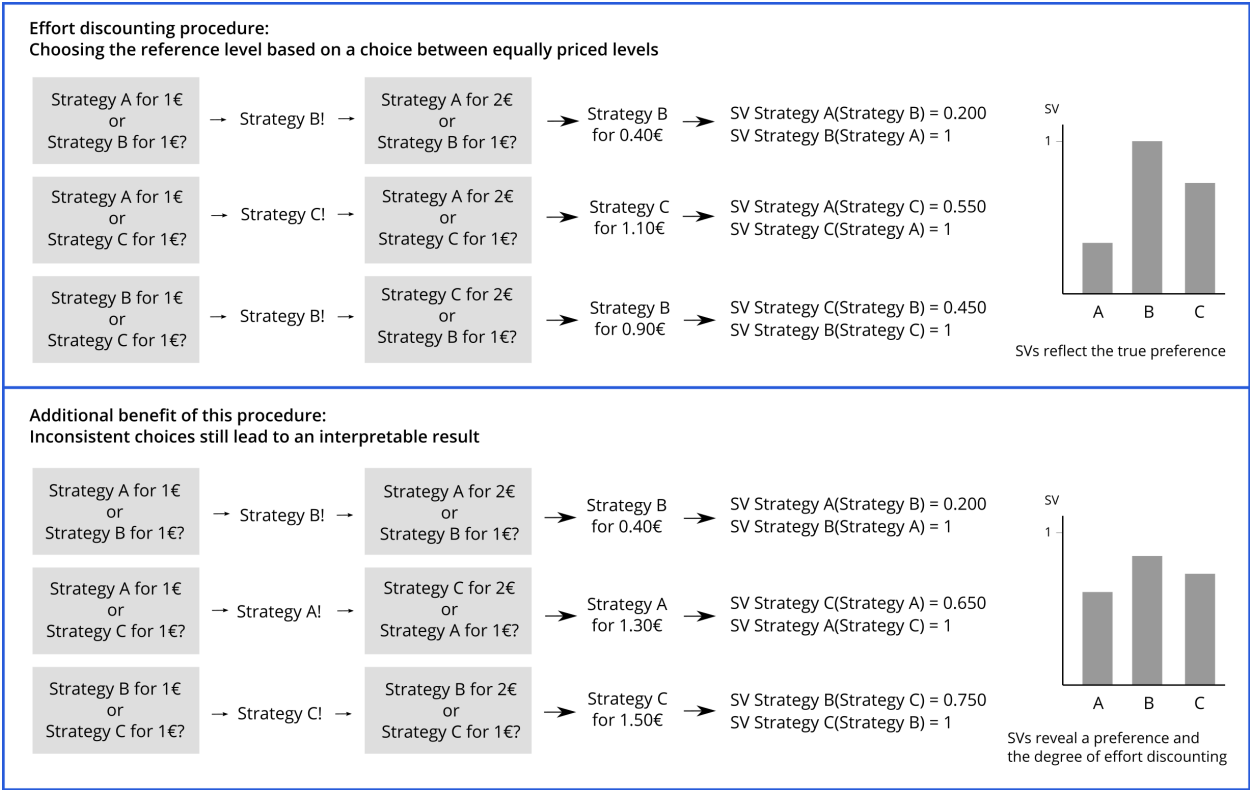
662 **Figures and figure captions**

Figure 1

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

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

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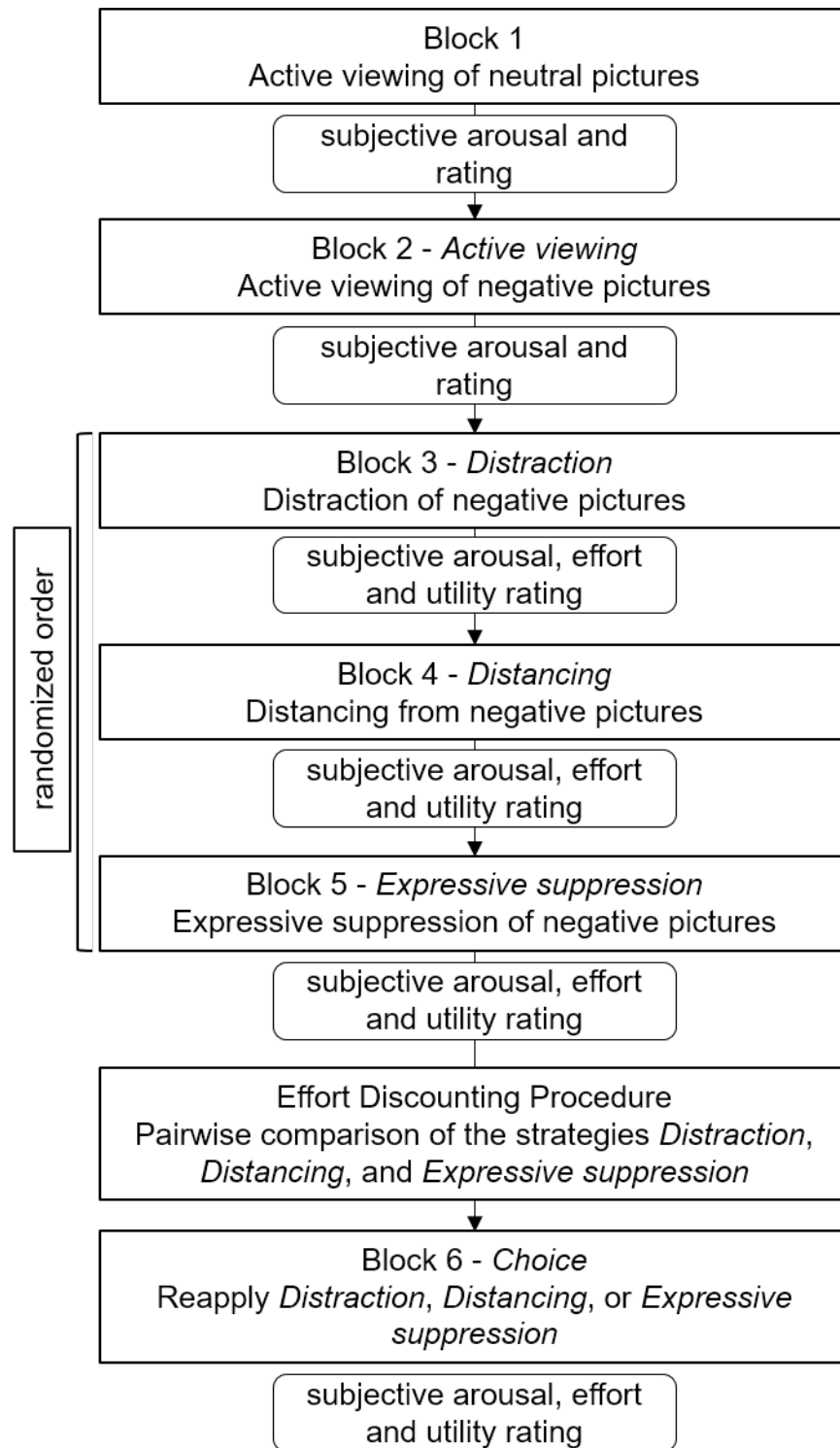
666 be represented by our paradigm.

Figure 2

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

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

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

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

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

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

673 screen with a continuous scale.

674   **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
Input:
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

Output:
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
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 | 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. |

685

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[45,46]. 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 $\alpha = .92$)[46].

Connor-Davidson Resilience Scale. Resilience is assessed using the Connor-Davidson Resilience Scale (CD-RISC)[47–49]. 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[48].

Emotion Regulation Questionnaire. Habitual use of reappraisal and suppression is measured using the 10-item Emotion Regulation Questionnaire (ERQ)[9,50]. 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 $\alpha > .75$).[69]

FlexER Scale. Flexible use of ER strategies is assessed using the FlexER Scale[44] 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.[51] 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 $\alpha = .87$[51].

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

714   short version of the German NFC scale.[52] Responses to each item (e.g., "Thinking is not

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

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

717   The scale shows comparably high internal consistency (Cronbach's $\alpha > .80$)[52,70] and a

718   retest reliability of $r_{tt} = .83$ across 8 to 18 weeks.[71]

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

720   (SRS)[54] is used. The scale has 10 items (e.g., "It is difficult for me to suppress thoughts

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

722   all true) to 4 (exactly true). It has high internal consistency [Cronbach's $\alpha > .80$;].[54]

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

724   Scale (BSCS)[55,56] is used. It comprises 13 items (e.g., "I am good at resisting

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

726   much like me). The scale shows acceptable internal consistency (Cronbach's $\alpha = .81$)[56] .

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

728   Impulsiveness Scale (BIS-11)[57,58] is used. Responses to each item (e.g., "I am

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

730   (almost always/always). An internal consistency of Cronbach's $\alpha = .74$ and a retest

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

732   month were reported.[58]

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

734   Control Scale (ACS)[59] with items such as "My concentration is good even if there is music

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

736   never) to 4 (always). An internal consistency of Cronbach's $\alpha = .88$ was reported.[59]

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

738 **and "Active viewing - negative"**

739 ANOVA:

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

741 $BF10 = 1{,}244.99$

742 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.
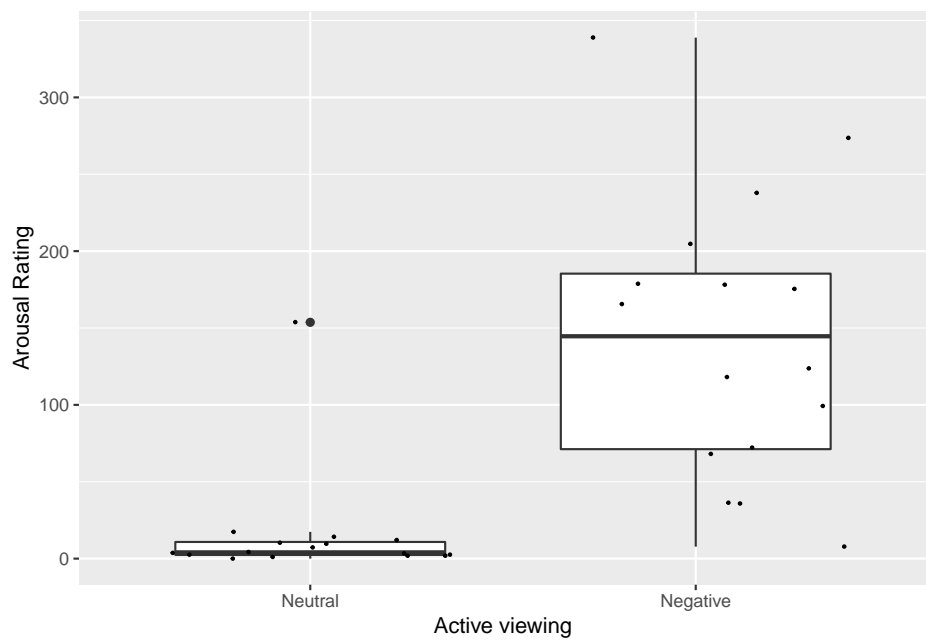
743 Figure:

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.
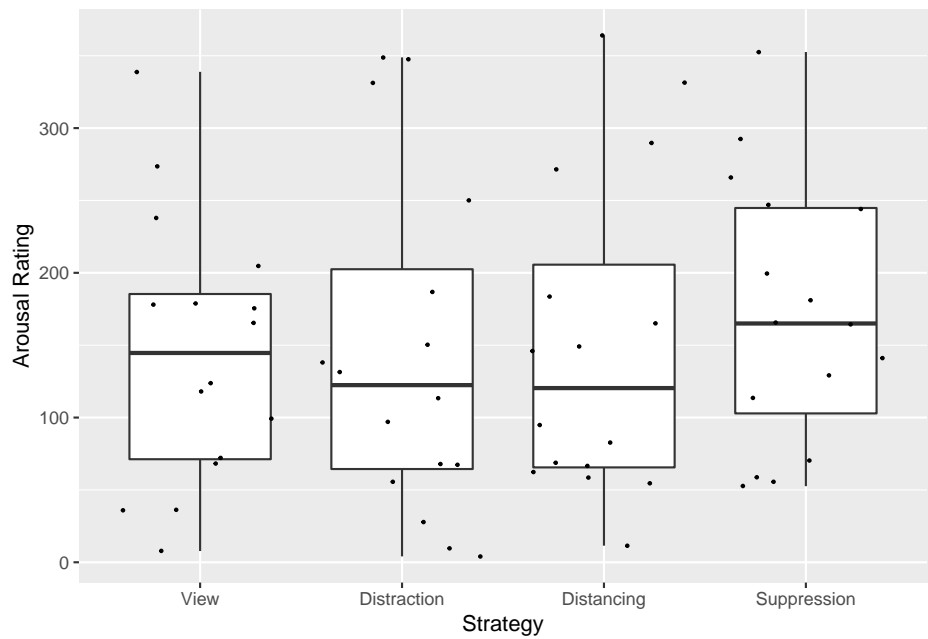
750   Figure:

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.

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

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

753 *Corrugator*: ANOVA:

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

755 $BF10 = 6{,}690{,}401.91$

756 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.

757 *Levator*: ANOVA:

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

759 $BF10 = 48.44$

760 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.
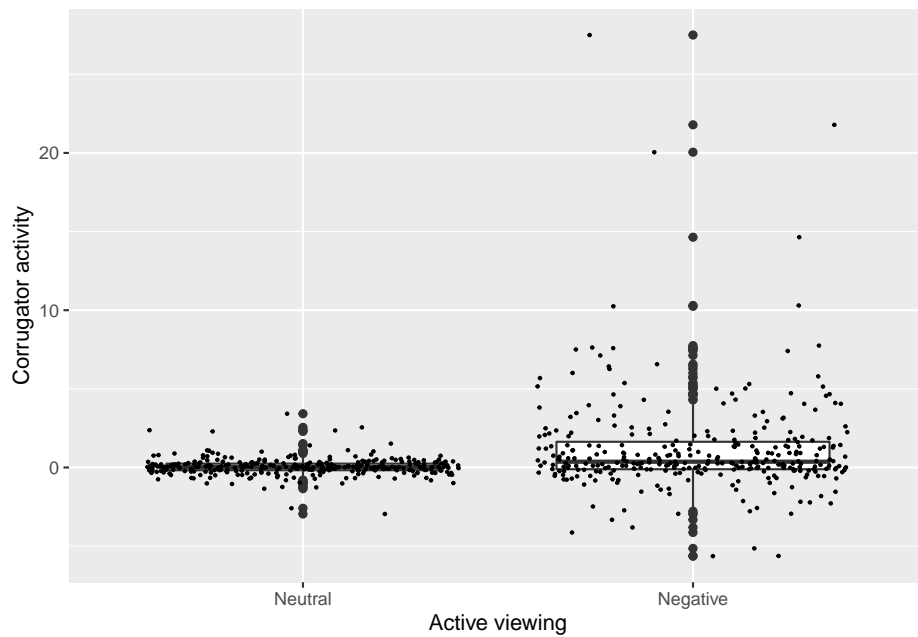
761   Figures:

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.
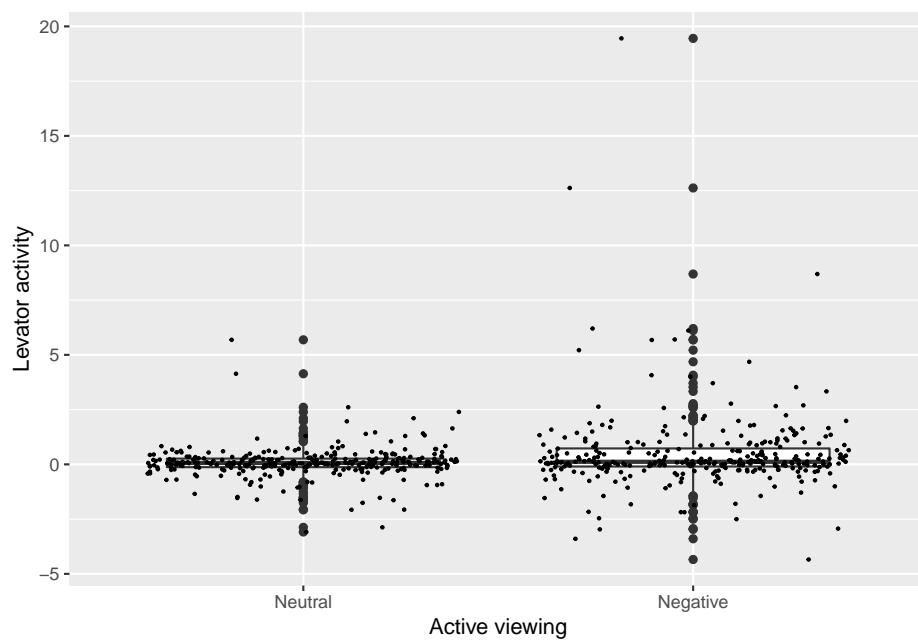

Figure 6. Levator activity for the conditions "Active viewing - neutral" and "Active viewing - negative" visualized as boxplots. Each dot represents the levator activity of a single trial. Bold dots represent outliers.

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

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

764 **"Suppression"**

765 *Corrugator*: ANOVA:

766

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

767 $BF10 = 5,257,689.54$

768 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.

769 *Levator*: ANOVA:

770

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

771 $BF10 = 672,341.29$

772 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.
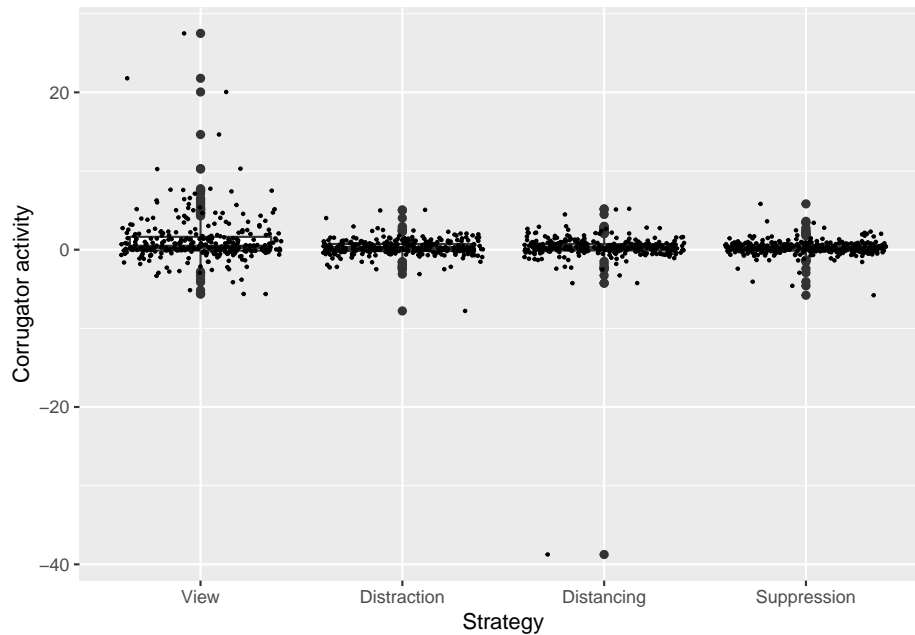
773   Figures:

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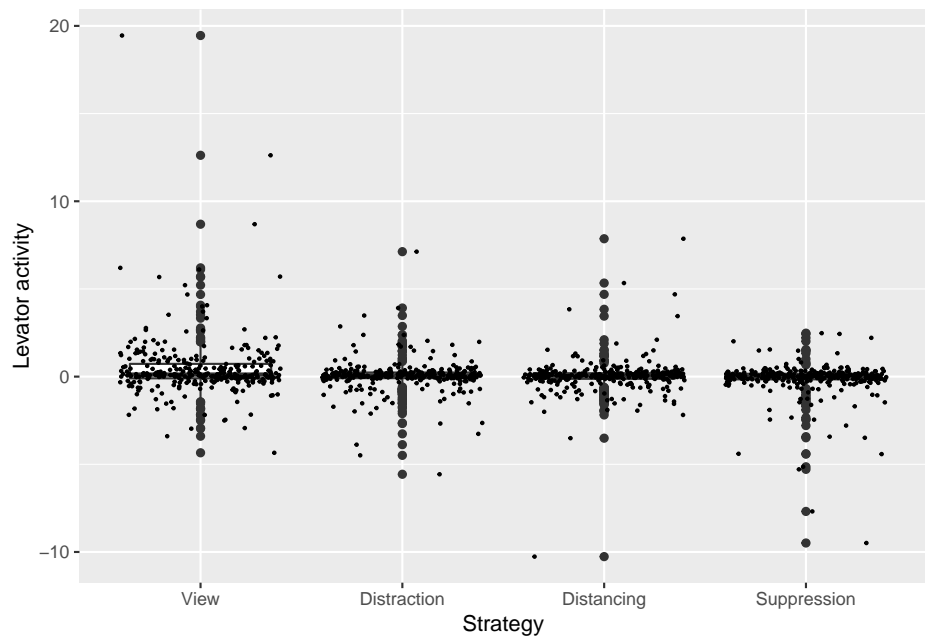
Figure 8. Levator activity for the conditions "Active viewing - negative", "Distraction", "Distancing", and "Suppression" visualized as boxplots. Each dot represents the levator activity of a single trial. Bold dots represent outliers.

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.
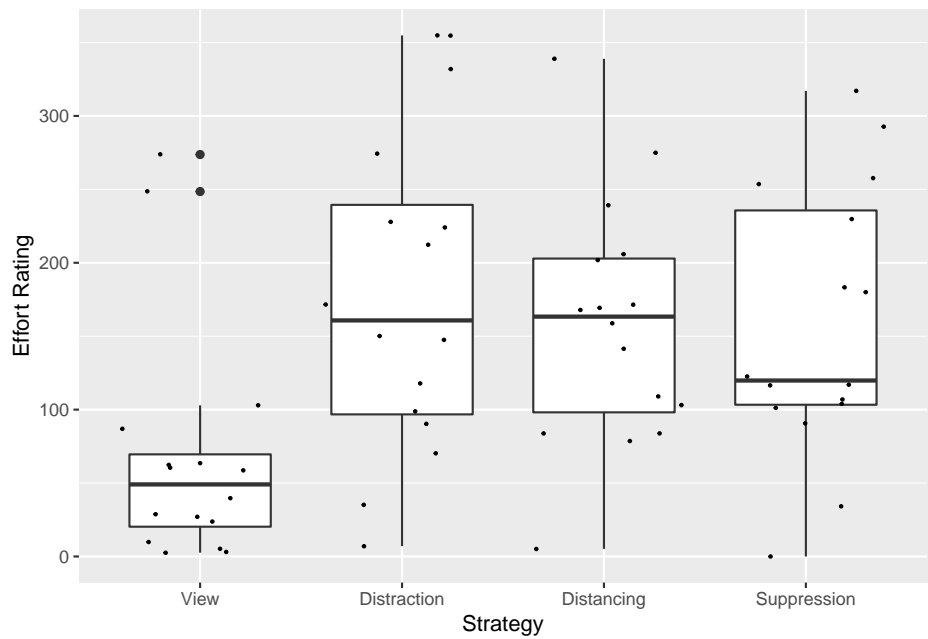
780   Figure:

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.