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: XXXXX

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].

In the original study by Westbrook et al.[29], cognitive load was varied using the
n-back task, a working memory task that requires fast and accurate responses to
sequentially presented stimuli. Participants had to decide in an iterative procedure whether
they wanted to repeat a higher n-back level for a larger, fixed monetary reward, or a lower
level for a smaller, varying reward, with the implicit assumption that the objectively
easiest n-back level has the highest SV. In the present study, we want to use this paradigm
to determine SVs of ER strategies. In doing so, we need to make an important change: We
have to adapt the assumption that the easiest n-back level has the highest SV. As we have
shown in previous studies, there are large inter-individual differences in the preference and
perceived subjective effort of ER strategies[22]. Moreover, there is nothing like an objectively
easiest ER strategy. It could be assumed, that the antecedent-focused strategies,
i.e. attentional deployment and cognitive change, require less effort, because according to
Gross[1] these strategies apply when the emotional reaction has not fully developed, yet. In
contrast, suppression would need ongoing effort, because it takes effect late in the emotion
generating process and does not alter the emotion itself. A similar assumption has been
made by Mesmer-Magnus et al.[31], who state that Surface Acting (the equivalent to
expressive suppression in emotional labor research) is supposed to continuously require
high levels of energy (hence effort). Deep Acting (which refers to reappraisal), in turn, only
initially needs the use of energy. This would be in conflict with findings in our previous
studies, that showed that many people choose expressive suppression because they
evaluated it as less effortful, hence easy[22]. Others define emotion regulation on a continuum
from explicit, conscious, and effortful to implicit, unconscious, automatic and effortless[32].
This would mean, that all explicit strategies that have been proposed by the process model
of emotion regulation are similarly effortful[1]. Similarly, the flexibility approach of emotion
regulation also states, that there is no "best" strategy[33]. An emotion regulation attempt is
adaptive, when the intended, individual goal is reached. Those attempts could also consist
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, Scheffel 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,

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 |

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 |

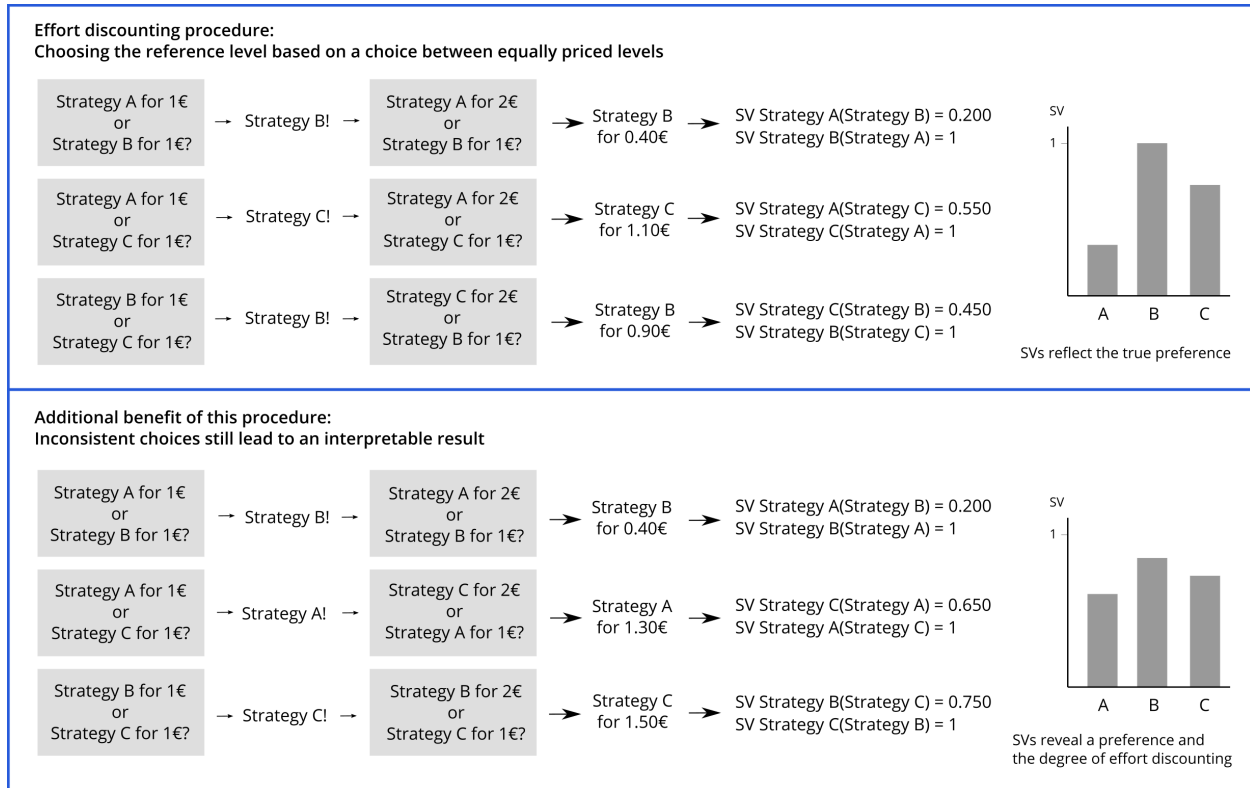SVs reveal a preference and the degree of effort discounting

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. Figure available at https://osf.io/vnj8x/, under a CC-BY4.0 license.

we want to check whether the SV of a strategy is associated with its likelihood of being chosen again, and whether SVs reflect participants' self-reported ER flexibility. All hypotheses are detailed in the design table. Exploratorily, we want to investigate whether individual SVs are related to personality traits and how individual SVs of ER strategies relate to SVs of other tasks with different demand levels, namely n-back.

2. Method

We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study[35]. The paradigm was written and presented using *PsychoPy*[36]. We used *R* with *R Studio*[37,38] with the main packages *afex*[39] and *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/CAD. A complete list of all measures assessed in the study

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

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

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 was obtained. Participants

209 received 24 € 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 OSF repository

220 (https://osf.io/vnj8x/).

2.3 Design

222 Young healthy participants (aged 18 to 30 years) were recruited using the software

223 *ORSEE*[41] at the Technische Universität Dresden. Participants were excluded from

224 participation if they do not fluently speak German, had current or a history of

225 psychological disorders or neurological trauma, or reported to take medication.

226 Participants were invited to complete an online survey containing different questionnaires

227 to assess broad and narrow personality traits and measures of well-being. The study

228 consisted of two lab sessions, which took place in a shielded cabin with constant lighting.

229 Before each session, participants received information about the respective experimental

230 procedure and provided informed consent. In the first session participants filled out a

231 demographic questionnaire and completed an n-back task with the levels one to four. Then,

232 they completed an effort discounting (ED) procedure regarding the n-back levels on screen,

233 followed by a random repetition of one n-back level[34]. The second session took place

234 exactly one week after session one. Participants provided informed consent and received

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

236 training ensured that all participants were able to implement the ER strategies. Next,

237 electrodes to measure facial EMG were attached and the ER task was conducted, followed

238 by an ED procedure regarding the ER strategies. After that, participants chose one ER

239 strategy to repeat one more time. Study data were collected and managed using REDCap

240 electronic data capture tools hosted at Technische Universität Dresden[42,43].

241 **2.3.1 Psychometric measures.**   The online survey contained a number of

242 questionnaires. In the focus of the current project was the Flexible Emotion Regulation

243 Scale (FlexER)[44].

244 It assesses flexible use of ER strategies with items such as "If I want to feel less

245 negative emotions, I have several strategies to achieve this.", which we define as ER

246 flexibility. The items were rated on a 4-point scale ranging from "strongly agree" to

247 "strongly disagree".

248 Further psychological constructs were assessed but had no clear hypotheses in the

249 present work and are therefore investigated only exploratory: General psychological

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

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

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

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

254 control was assessed using the implicit theories questionnaire from Bernecker and Job[51]. To

255 assess Need for Cognition, the German version short form of the Need for Cognition

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

257 following questionnaires were used: the Self-Regulation Scale (SRS)[54], the Brief

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

259 Attentional control were assessed using the Attentional Control Scale (ACS)[59]. For more

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

261 supplementary material.

262   **2.3.2 Emotion regulation paradigm.**   The ER paradigm consisted of three parts

263 that will be described in the following.

264   *Part one: ER task.* Part one was a standard ER task in a block design (see Figure 2),

265 similar to paradigms previously used by our group[22]. Participants were told to actively

266 view neutral and negative pictures (see 2.3.3) or to regulate all upcoming emotions by

267 means of distraction, distancing, and expressive suppression, respectively. Every

268 participant first had the condition "active viewing-neutral" that served as a baseline

269 condition. During this block, 20 neutral pictures were presented. Participants were asked

270 to "actively view all pictures and permit all emotions that may arise." In the second block,

271 participants actively viewed negative pictures. During the third, fourth, and fifth block,

272 participants saw negative pictures and were asked to regulate their emotions using

273 distraction, distancing, and suppression. In order to achieve distraction, participants were

274 asked to think of a geometric object or an everyday activity, like brushing their teeth.

275 During distancing, participants were asked to "take the position of a non-involved observer,

276 thinking about the picture in a neutral way." Participants were told not to re-interpret the

277 situation or attaching a different meaning to the situation. During suppression,

278 participants were told to "suppress their emotional facial expression." They should imagine

279 being observed by a third person that should not be able to tell by looking at the facial

280 expression whether the person is looking at an emotional picture. Participants were

281 instructed not to suppress their thoughts or change their facial expression to the

282 opposite[22]. All participants received written instruction and completed a training session.

283 After the training session, participants were asked about their applied ER strategies to

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

285 suppression) were randomized between participants. Each of the blocks consisted of 20

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

287 with a fixation cross that lasted 3 to 5 seconds (random uniform distributed). It was

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

289 participants retrospectively rated their subjective emotional arousal ("not at all aroused"

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

291 exhausting"), and - after the regulation blocks - the utility of the respective strategy ("not

292 useful at all" to "very useful") on a continuous scale using a slider on screen.

293   *Part two: ER effort discounting.* In the second part, ER effort discounting took

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

295 et al.[29] with a major change. We used the following adaption that allowed the computation

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

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

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

299 strategies were presented with a monetary reward. Because there is no strategy that is

300 objectively more difficult, we added initial comparisons asking the participants to choose

301 between "1 € for strategy A or 1 € for strategy B". They decided by clicking the on-screen

302 button of the respective option. Each of the three strategy pairs were presented three times

303 in total, in a randomized order and randomly assigned which strategy appeared on the left

304 or right side of the screen. For each pair, the strategy that was chosen at least two out of

305 three times was assigned the flexible starting value of 1 €, the other strategy was assigned

306 the fixed value of 2 €. After this, comparisons between strategies followed the original

307 COG-ED paradigm[29]. Each pairing was presented six consecutive times, and with each

308 decision the reward of the strategy with the starting value of 1 € was either lowered (if this

309 strategy was chosen) or raised (if the strategy with the fixed 2 € reward was chosen). The

310 adjustment started at 0.50 € and each was half the adjustment of the previous step,

311 rounded to two digits after the decimal point. If a participant always chose the strategy

312 with the fixed 2 € reward, the other strategy's last value on display was 1.97 €, if they

313 always choose the lower strategy, its last value was 0.03 €. The sixth adjustment of 0.02 €

314 was done during data analysis, based on the participants' decision in the last display of the

315 pairing. Participants were instructed to decide as realistically as possible by imagining that

316 the monetary reward was actually available for choice.

317 *Part three: ER choice.* After the discounting part, participants chose which one of

318 the three ER strategies (distraction, distancing or suppression) they wanted to re-apply.

319 Importantly, there was no further instruction on what basis they should make their

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

321 important for themselves. However, participants were asked to state the reasons for the

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

323 saw the respective instruction and the block with another 20 negative pictures started.

324 **2.3.3 Stimuli.** Pictures that were used in the paradigm were selected from the

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

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

327 $\pm SD = 3 \pm 0.65$) depicted content related to the categories persons, objects, and scenes.

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

329 suffering, violence, and weapons, were used. An evolutionary algorithm[62] was used to

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

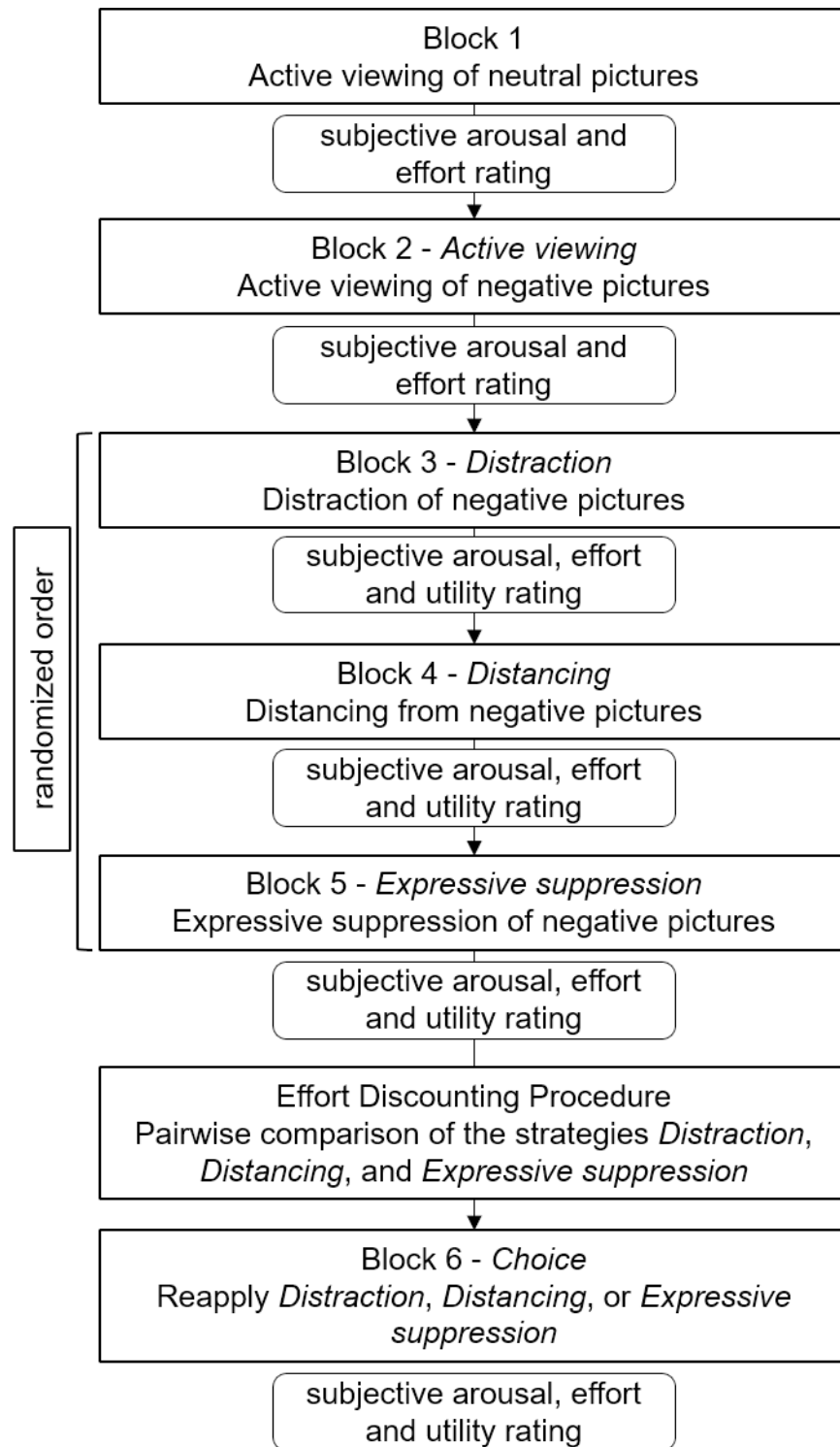331 $M \pm SD = 2.84 \pm 0.57$, A: $M \pm SD = 5.62 \pm 0.34$; set two: V: $M \pm SD = 2.64 \pm 0.46$, A:

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) was randomized between participants. After, the discounting procedure took place. All three regulation strategies were compared pairwise. Before the last block, participants could decide which regulation strategy they wanted to reapply. Subjective arousal and effort ratings were assessed after each block using a slider on screen with a continuous scale. Figure available at https://osf.io/vnj8x/, under a CC-BY4.0 license.

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

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

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

classification into sets can be found in supplementary material table S1. The five sets of

negative pictures were assigned randomly to the blocks.

2.3.4 Facial electromyography. Bipolar facial electromyography (EMG) were

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

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

diameter, 10 mm distance between electrodes) were placed over each left muscle according

to the guidelines of Fridlund and Cacioppo[64]. The ground electrode was placed over the

left *Mastoid*. Before electrode placement, the skin was abraded with Every abrasive paste,

cleaned with alcohol, and filled with Lectron III electrolyte gel. Raw signals were amplified

by a BrainAmp amplifier (Brain Products Inc., Gilching, Germany). Impedance level were

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

Hz high pass (order 8), a 300 Hz low pass (order 8), and a 50 Hz notch filter was applied to

both signals. *Corrugator* and *levator* EMG was analyzed during the 6 s of picture

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

stimulus onset[63]. Last, the sampling rate was changed to 100 Hz, and EMG data were

averaged for each condition and each participant.

2.4 Sampling plan

Sample size calculation was done using *G*Power*[65,66]. 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

358 suitable for study participation (e.g., because the participant does not follow instructions

359 or shows great fatigue), respective data will also be excluded from further analyses.

360 Therefore, we aimed to collect data of $N = 120$ participants, about 50 more data sets, than

361 necessary. Detailed information on power calculation for each hypothesis can be found in

362 the design table.

363 **2.5 Analysis plan**

364   Data collection and analysis were not performed blind to the conditions of the

365 experiments. Data of whole participants were excluded from analysis if participants

366 withdraw their consent or they stated that they did not follow experimental instructions.

367 EMG data of subjects were excluded from analysis if errors occured during recording. No

368 further data exclusions were planned. The level of significance was set to $\alpha = .05$. For

369 hypotheses H1-4, repeated measures analysis of variance (rmANOVA) were conducted and

370 estimated marginal means were computed using the *afex* package[39].

371 Greenhouse-Geisser-corrected degrees of freedom and associated p-values were reported

372 when the assumption of sphericity was violated. If the within-subjects factor of interest

373 was significant, pairwise contrasts were calculated using Bonferroni adjustment for multiple

374 testing. Proportion of explained variance η_p^2 was reported as a measure of effect size.

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

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

377 valence (neutral and negative) for the strategy active viewing was conducted. To examine

378 the impact of valence on physiolocigal responding (H1b and H1c), a rmANOVA with the

379 factor valence (neutral and negative) for the strategy active viewing was conducted for

380 EMG *corrugator* and *levator* activity.

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

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

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

384 subjective arousal ratings was conducted. To examine the effects of the three ER strategies

385 on physiological responding (H3a and H3b), another rmANOVA with the factor strategy

386 (active viewing - negative, distraction, distancing, and suppression) for EMG *corrugator*

387 and *levator* activity was conducted. To examine the effect of ER strategies on subjective

388 effort (H4a), a rmANOVA with the factor strategy (active viewing - negative, distraction,

389 distancing, and suppression) for subjective effort ratings was conducted.

390   *Subjective values of emotion regulation strategies.* For each ER strategy, SVs were

391 calculated as follows: first, the value 0.02 € was added to or subtracted from the last

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

393 to obtain the SV of the fixed strategy (the minimum relative reward required for

394 participants to choose the flexible over the fixed strategy), the last value of the flexible

395 strategy was divided by 2 €. Therefore, the SVs of the flexible strategies were 1, because

396 they were chosen in the initial comparison of each pairing in which the same value was

397 offered for both strategies, so they were the preferred strategy of each pairing. The SVs of

398 the fixed strategies lay between 0 and 1, with lower values indicating that the participant

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

400 the pairing. The final SV per strategy for each participant was computed by averaging the

401 SVs of each strategy across pairings.

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

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

404 (MLM) was specified using the *lmerTest* package[67]. First, ER strategies were recoded and

405 centered for each subject according to their individual SVs: The strategy with the highest

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

407 the lowest SV will be coded as 1. Restricted maximum likelihood (REML) was applied to

408 fit the model. A random slopes model of SVs including subjective effort (effort ratings),

409 subjective arousal (arousal ratings), utility (utility ratings), and physiological responses

410 (*corrugator* and *levator* activity) as level-1-predictors was specified.

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

411 Level-1-predictors were centered within cluster[68]. Residuals of the final model were

412 inspected visually. Intraclass correlation coefficient (ICC), ρ, was reported for each model

413 (null model, as well as full model). The presented MLM followed the conceptualization of

414 Zerna, Scheffel, et al.[34]

415   To investigate whether individual SVs predict ER choice (H7a), a $\chi2$ test with

416 predicted choice (highest SV of each participant) and actual choice was computed.

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

418 independent variables SVs of each strategy was computed.

419   The association between flexible ER and SVs of ER strategies (H7b) was investigated

420 with a linear regression using the individual *intercept* and *slope* of each participants' SVs

421 to predict their FlexER score. To this end, for each participant, SVs were sorted by

422 magnitude in descending order and entered as dependent variable in a linear model, with

423 strategy (centered, i.e., -1, 0, 1) as independent variable. The resulting *intercept* informs

424 about the extent to which an individual considers any or all of the ER strategies as useful

425 for regulation their emotion, while the *slope* informs about the flexibility in the use of

426 emotion regulation strategies. The individual intercepts and slopes were entered as

427 predictors in a regression model with the FlexER score as dependent variable. A positive

428 association with the predictor *intercept* would indicate that overall higher SVs attached to

429 ER strategies predicts higher scores on the FlexER scale. A positive association with the

430 predictor *slope* would indicate that less negative slopes, i.e., a smaller preference for a

431 given ER strategy, would be associated with a higher score of the FlexER scale.

432   The influence of personality traits on SVs were investigated exploratorily. Therefore,

the MLM specified above was 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[40], were reported. Bayes factors were 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.

3. Results

3.1 Participants and descriptive statistics

Data collection took place between 2022-08 and 2023-02. A total of $N = 151$ participants completed the online survey and were invited to participate in the two lab sessions. Of these, $N = 125$ participated in the first laboratory session[34] and $N = 121$ completed the second laboratory session. Of these, $n = 1$ person had to be excluded from analyses because they did not follow the instructions. The final sample consisted of $N = 120$ participants (100 female ; age: $M = 22.5 \pm SD = 3.0$). Please note that sample size for individual calculations may be smaller due to failure of EMG recording ($n = 1$) and failure to record utility ratings ($n = 18$).

3.2. Confirmatory analyses

Manipulation checks.

454 ***Subjective arousal and physiological responding.*** To explore whether

455 negative pictures evoke emotional arousal and physiological responding, we conducted

456 separate ANOVAs for the active viewing condition with predictors subjective arousal,

457 *Corrugator*, and *Levator* activity. We found a highly significant main effect of valence for

458 subjective arousal ($F(1, 119) = 399.95$, $p < .001$, $\hat{\eta}_G^2 = .589$, 90% CI [.498, .659],

459 $BF_{10} = 1.47 \times 10^{44}$), *Corrugator* activity ($F(1, 117) = 27.73$, $p < .001$, $\hat{\eta}_G^2 = .111$, 90% CI

460 [.037, .206], $BF_{10} = 8.67 \times 10^{16}$), and *Levator* activity ($F(1, 117) = 8.87$, $p = .004$,

461 $\hat{\eta}_G^2 = .039$, 90% CI [.002, .111]´, $BF_{10} = 188.72$), indicating that negative pictures

462 successfully evoked emotional arousal and physiological responding.

463 To investigate whether ER strategies reduce emotional arousal and physiological

464 respoindng, we conducted separate rmANOVA comparing subjective arousal, *Corrugator*,

465 and *Levator* activity of four strategies (active viewing, distraction, distancing,

466 suppression). We found a significant effect of strategy for subjective arousal

467 ($F(2.71, 322.55) = 7.39$, $p < .001$, $\hat{\eta}_G^2 = .015$, 90% CI [.000, .036], $BF_{10} = 0.21$), *Corrugator*

468 activity ($F(1.76, 206.02) = 13.70$, $p < .001$, $\hat{\eta}_G^2 = .056$, 90% CI [.019, .094],

469 $BF_{10} = 6.16 \times 10^7$), and *Levator* activity ($F(1.54, 180.41) = 19.95$, $p < .001$, $\hat{\eta}_G^2 = .089$,

470 90% CI [.043, .134], $BF_{10} = 3.22 \times 10^{17}$), indicating that regulation strategies reduced

471 subjective arousal and physiological responding. For detailed information on post-hoc

472 tests, please see supplementary material.

473 ***Subjective effort of ER strategies.*** To investigate whether ER strategies

474 require cognitive effort, we conducted an rmANOVA comparing the subjective effort

475 ratings of four strategies (active viewing, distraction, distancing, suppression). We found a

476 significant effect of strategy ($F(2.92, 347.65) = 128.47$, $p < .001$, $\hat{\eta}_G^2 = .327$, 90% CI

477 [.261, .384], $BF_{10} = 1.84 \times 10^{37}$). Post-hoc test showed significant higher subjective effort

478 for distraction ($t(357) = -17.92$, $p_{\text{Tukey(4)}} < .001$, $BF_{10} = 3.61 \times 10^{30}$), distancing

479 ($t(357) = -15.82$, $p_{\text{Tukey(4)}} < .001$, $BF_{10} = 1.60 \times 10^{28}$), and suppression ($t(357) = -12.26$,

480 $p_{\text{Tukey(4)}} < .001$, $BF_{10} = 1.27 \times 10^{19}$) compared to active viewing. Moreover, we found

481 significantly lower effort during suppression compared with distraction ($t(357) = 5.66$,

482 $p_{\text{Tukey}(4)} < .001$, $\text{BF}_{10} = 1.61 \times 10^6$) and distancing ($t(357) = 3.55$, $p_{\text{Tukey}(4)} = .002$,

483 $\text{BF}_{10} = 29.19$).

484   [... WAHLVERHALTEN FEHLT NOCH ...]

485   ***Subjective values of ER strategies.***   To investigate, which variables can predict

486 individual SVs of ER strategies, a multilevel model approach was chosen. The ICC of the

487 null model was $ICC = 0.19$, indicating that level-2 predictor subject accounted for 19.10

488 percent of total variance. The preregistered model showed a correlation of $r = 0.95$ of the

489 random effects subjects and recoded strategy ($BF10$ of the variable strategy: $\text{BF}_{10} = \infty$).

490 Our model explained 0.90 percent of variance and thus we assumed our model was

491 overfitted due to including recoded strategy as random slope. We therefore set a new

492 model without the recoded strategy as random slope factor to estimate the influence of

493 predictors on SVs more precisely. The second model followed the specification:

$$SV \sim \text{effort rating} + \text{arousal rating} + \text{utility rating} + corrugator \text{ activity}$$
$$+ levator \text{ activity} + (1|subject)$$

494   The second model explained 0.41 percent of variance. All results of the second model

495 are in table @ref(tab:TabMLM_H5).

Table 1
Results of multilevel model predicting subjective values of ER strategies.

Parameter	Beta	SE	p-value	f^2	Random Effects (SD)
Intercept	8.03×10^{-1}	0.01	0.00		0.11
Effort	-6.85×10^{-4}	0.00	0.00	0.03	
Arousal	-7.84×10^{-5}	0.00	0.32	0.00	
Utility	1.42×10^{-3}	0.00	0.00	0.15	
Corrugator activity	7.45×10^{-3}	0.00	0.04	0.00	
Levator activity	5.32×10^{-3}	0.00	0.07	0.00	

496   The predictors effort rating ($\hat{\beta} = 0.00$, 95% CI $[0.00, 0.00]$, $t(5,618.96) = -13.98$,

497 $p < .001$), utility rating ($\hat{\beta} = 0.00$, 95% CI $[0.00, 0.00]$, $t(5,618.96) = -13.98$, $p < .001$),

498 and *Corrugator* activity ($\hat{\beta} = 0.01$, 95% CI $[0.00, 0.01]$, $t(5,618.96) = 2.09$, $p = .037$)

499 showed a significant association with SVs. The values were relatively small, so the

500 respective effect size f^2 was calculated as the explained variance. Interestingly, utility

501 rating showed the greatest effect size of all predictors ($f^2 = 0.155$), indicating that utility

502 rating explained 15.5 percent of variance in SVs. Effort rating showed an effect size of $f^2 =$

503 0.035. The effect sizes of all other predictors were negligibly small ($f^2 < 0.01$).

504   ***Associations between subjective values and flexible ER.***   To investigate the

505 ecological validity of the subjective values of ER strategies we calculated, we looked to see

506 if SVs were associated with the actual choice of participants in the choice block. Therefore,

507 a χ^2 test with predicted choice (i.e., the strategy with the highest SV of each participant)

508 and actual choice was computed. There was a significant association between predicted

509 choice and actual choice ($\chi^2(4, n = 120) = 115.40$, $p < .001$, $\text{BF}_{10} = 1.62 \times 10^{21}$). We then

510 conducted a ordinal regression with the dependent variable "choice" and the individual SVs

511 of all three strategies as independent variables. Overall model fit was fair with $R^2 = 0.27$.

512 The predictor SV of strategy distraction was found to contribute to the model ($b = -6.29$,

513 95% CI $[-10.81, -3.02]$, $z = -3.21$, $p = .001$, $BF10 = 2.00$). The estimated odds ratio

514 indicated a higher chance of choosing strategy distraction, when SV of that strategy is

515 higher. Additionally, the predictor SV of strategy suppression was found to contribute to

516 the model ($b = 2.70$, 95% CI $[0.83, 4.84]$, $z = 2.67$, $p = .008$, $BF10 = 1.99$). The estimated

517 odds ration indicated that is more likely to later choose suppression, when SV of strategy

518 suppression is higher.

519   Last, we investigated whether SVs are associated with ER flexibility. We conducted a

520 logistic regression to inspect whether participants' individual *slopes* and *intercepts* of

521 ordered SVs could predict their ER flexibility score. We found neither a significant

522 associations between *slopes* of SVs and FlexER score ($b = -0.36$, 95% CI $[-1.28, 0.56]$,

$t(117) = -0.77$, $p = .444$, $\mathrm{BF}_{10} = 0.72$), nor between *intercepts* and FlexER score

$(b = 1.32$, 95% CI $[-1.38, 4.02]$, $t(117) = 0.97$, $p = .336$, $\mathrm{BF}_{10} = 0.85$). However, model fit

was relatively low ($R^2 = .03$, $F(2, 117) = 1.93$, $p = .150$).

3.3. Exploratory analyses

We exploratory wanted to investigate the influence of self-control and the investment

trait Need for Cognition (NFC) on individual SVs of ER strategies. The starting point for

this was the model reported before. Only predictors that had previously shown a

significant association with SVs were included in the model together with level 2 predictors

self-control and NFC. The third model followed the specification:

$$SV \sim \text{effort rating} + \text{utility rating} + corrugator \text{ activity}$$

$$\text{self-control} + \text{NFC} + (1|subject)$$

As one would expect, the predictors effort rating ($\hat{\beta} = 0.00$, 95% CI $[0.00, 0.00]$,

$t(5,620.93) = -14.26$, $p < .001$), utility rating ($\hat{\beta} = 0.00$, 95% CI $[0.00, 0.00]$,

$t(5,620.93) = -14.26$, $p < .001$), and *Corrugator* activity ($\hat{\beta} = 0.01$, 95% CI $[0.00, 0.01]$,

$t(5,620.93) = 2.12$, $p = .034$) showed a significant association with SVs. In addition, a

positive association was also found between self-control and SVs ($\hat{\beta} = 0.02$, 95% CI

$[0.00, 0.05]$, $t(97.97) = 2.04$, $p = .044$). However, effect size of self-control was negligibly

small ($f^2 = 0.002$). Detailed information can be found in the supplementary material.

References

1.   Gross, J. J. Antecedent- and response-focused emotion regulation: Divergent conse-

quences for experience, expression, and physiology. *Journal of Personality and Social

Psychology* **74**, 224–37 (1998).

2.   Gross, J. J. The emerging field of emotion regulation: An integrative review. *Review of General Psychology* **2**, 271–299 (1998).

3.   Powers, J. P. & LaBar, K. S. Regulating emotion through distancing: A taxonomy, neurocognitive model, and supporting meta-analysis. *Neuroscience and Biobehavioral Reviews* **96**, 155–173 (2019).

4.   Webb, T. L., Miles, E. & Sheeran, P. Dealing with feeling: A meta-analysis of the effectiveness of strategies derived from the process model of emotion regulation. *Psychological Bulletin* **138**, 775–808 (2012).

5.   Zaehringer, J., Jennen-Steinmetz, C., Schmahl, C., Ende, G. & Paret, C. Psychophysiological effects of downregulating negative emotions: Insights from a meta-analysis of healthy adults. *Front Psychol* **11**, 470 (2020).

6.   Burr, D. A., Pizzie, R. G. & Kraemer, D. J. M. Anxiety, not regulation tendency, predicts how individuals regulate in the laboratory: An exploratory comparison of self-report and psychophysiology. *Plos One* **16**, (2021).

7.   Gärtner, A., Jawinski, P. & Strobel, A. Individual differences in inhibitory control are not related to emotion regulation. *PsyArXiv* (2021) doi:10.31234/osf.io/cd8rx.

8.   Schönfelder, S., Kanske, P., Heissler, J. & Wessa, M. Time course of emotion-related responding during distraction and reappraisal. *Social Cognitive and Affective Neuroscience* **9**, 1310–9 (2014).

9.   Gross, J. J. & John, O. P. Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology* **85**, 348–62 (2003).

10.   Aldao, A., Nolen-Hoeksema, S. & Schweizer, S. Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review* **30**, 217–237 (2010).

11. Yoon, K. L., Maltby, J. & Joormann, J. A pathway from neuroticism to depression: Examining the role of emotion regulation. *Anxiety, Stress, & Coping* **26**, 558–72 (2013).

12. Aldao, A., Sheppes, G. & Gross, J. J. Emotion regulation flexibility. *Cognitive Therapy and Research* **39**, 263–278 (2015).

13. Bonanno, G. A. & Burton, C. L. Regulatory flexibility: An individual differences perspective on coping and emotion regulation. *Perspectives on Psychological Science* **8**, 591–612 (2013).

14. Dixon-Gordon, K. L., Aldao, A. & De Los Reyes, A. Repertoires of emotion regulation: A person-centered approach to assessing emotion regulation strategies and links to psychopathology. *Cogn Emot* **29**, 1314–25 (2015).

15. Lougheed, J. P. & Hollenstein, T. A limited repertoire of emotion regulation strategies is associated with internalizing problems in adolescence. *Social Development* **21**, 704–721 (2012).

16. Southward, M. W., Altenburger, E. M., Moss, S. A., Cregg, D. R. & Cheavens, J. S. Flexible, yet firm: A model of healthy emotion regulation. *Journal of Social and Clinical Psychology* **37**, 231–251 (2018).

17. Blanke, E. S. *et al.* Mix it to fix it: Emotion regulation variability in daily life. *Emotion* **20**, 473–485 (2020).

18. Tamir, M., Bigman, Y. E., Rhodes, E., Salerno, J. & Schreier, J. An expectancy-value model of emotion regulation: Implications for motivation, emotional experience, and decision making. *Emotion* **15**, 90–103 (2015).

19. Kable, J. W. & Glimcher, P. W. The neural correlates of subjective value during intertemporal choice. *Nat Neurosci* **10**, 1625–33 (2007).

20. Sheppes, G. *et al.* Emotion regulation choice: A conceptual framework and supporting evidence. *Journal of Experimental Psychology: General* **143**, 163–81 (2014).

21. Sheppes, G., Scheibe, S., Suri, G. & Gross, J. J. Emotion-regulation choice. *Psychological Science* **22**, 1391–6 (2011).

22. Scheffel, C. *et al.* Effort beats effectiveness in emotion regulation choice: Differences between suppression and distancing in subjective and physiological measures. *Psychophysiology* **00**, e13908 (2021).

23. Inzlicht, M., Shenhav, A. & Olivola, C. Y. The effort paradox: Effort is both costly and valued. *Trends Cogn Sci* **22**, 337–349 (2018).

24. Hull, C. L. *Principles of behavior: An introduction to behavior theory.* (Appleton-Century-Crofts, 1943).

25. Gonzalez-Garcia, C. *et al.* Induced affective states do not modulate effort avoidance. *Psychol Res* **85**, 1016–1028 (2021).

26. Kool, W., McGuire, J. T., Rosen, Z. B. & Botvinick, M. M. Decision making and the avoidance of cognitive demand. *J Exp Psychol Gen* **139**, 665–82 (2010).

27. Cheval, B. *et al.* Higher inhibitory control is required to escape the innate attraction to effort minimization. *Psychology of Sport and Exercise* **51**, (2020).

28. Cacioppo, J. T. & Petty, R. E. The need for cognition. *Journal of Personality and Social Psychology* **42**, 116–131 (1982).

29. Westbrook, A., Kester, D. & Braver, T. S. What is the subjective cost of cognitive effort? Load, trait, and aging effects revealed by economic preference. *PLOS ONE* **8**, e68210 (2013).

30. Strobel, A. *et al.* Dispositional cognitive effort investment and behavioral demand avoidance: Are they related? *PLoS One* **15**, e0239817 (2020).

31. Mesmer-Magnus, J. R., DeChurch, L. A. & Wax, A. Moving emotional labor beyond surface and deep acting: A discordance-congruence perspective. *Organizational Psychology Review* **2**, 6–53 (2012).

32. Gyurak, A., Gross, J. J. & Etkin, A. Explicit and implicit emotion regulation: A dual-process framework. *Cogn Emot* **25**, 400–12 (2011).

33. Gross, J. J. Emotion regulation: Current status and future prospects. *Psychological Inquiry* **26**, 1–26 (2015).

34. Zerna, J., Scheffel, C., Kührt, C. & Strobel, A. When easy is not preferred: An effort discounting for estimating subjective values of taks. *PsyArXiv* (2022) doi:10.31234/osf.io/ysh3q.

35. Simmons, J. P., Nelson, L. D. & Simonsohn, U. A. A 21 word solution. *SSRN Electronic Journal* (2012) doi:10.2139/ssrn.2160588.

36. Peirce, J. *et al.* PsychoPy2: Experiments in behavior made easy. *Behavior Research Methods* **51**, 195–203 (2019).

37. R Core Team. *R: A language and environment for statistical computing.* (R Foundation for Statistical Computing, 2021).

38. RStudio Team. RStudio: Integrated development for R. (2020).

39. Singmann, H., Bolker, B., Westfall, J., Aust, F. & Ben-Shachar, M. S. *Afex: Analysis of factorial experiments.* (2021).

40. Morey, R. D. & Rouder, J. N. *BayesFactor: Computation of Bayes factors for common designs.* (2021).

41. Greiner, B. Subject pool recruitment procedures: Organizing experiments with ORSEE. *Journal of the Economic Science Association* **1**, 114–125 (2015).

42. Harris, P. A. *et al.* Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics* **42**, 377–381 (2009).

43. Harris, P. A. *et al.* The REDCap consortium: Building an international community of software platform partners. *Journal of Biomedical Informatics* **95**, 103208 (2019).

44. Dörfel, D., Gärtner, A. & Strobel, A. A new self-report instrument for measuring emotion regulation flexibility. *Society for Affective Science (SAS) Annual Conference* (2019).

45. Bech, P. Measuring the dimensions of psychological general well-being by the WHO-5. *Quality of life newsletter* **32**, 15–16 (2004).

46. Brähler, E., Mühlan, H., Albani, C. & Schmidt, S. Teststatistische prüfung und normierung der deutschen versionen des EUROHIS-QOL lebensqualität-index und des WHO-5 wohlbefindens-index. *Diagnostica* **53**, 83–96 (2007).

47. Connor, K. M. & Davidson, J. R. Development of a new resilience scale: The connor-davidson resilience scale (CD-RISC). *Depression and Anxiety* **18**, 76–82 (2003).

48. Sarubin, N. *et al.* First analysis of the 10-and 25-item german version of the connor-davidson resilience scale (CD-RISC) regarding psychometric properties and components. *Zeitschrift Fur Gesundheitspsychologie* **23**, 112–122 (2015).

49. Campbell-Sills, L. & Stein, M. B. Psychometric analysis and refinement of the connor-davidson resilience scale (CD-RISC): Validation of a 10-item measure of resilience. *Journal of Traumatic Stress* **20**, 1019–28 (2007).

50. Abler, B. & Kessler, H. Emotion regulation questionnaire - a german version of the ERQ by gross and john. *Diagnostica* **55**, 144–152 (2009).

51. Bernecker, K. & Job, V. Implicit theories about willpower in resisting temptations and emotion control. *Zeitschrift Fur Psychologie-Journal of Psychology* **225**, 157–166 (2017).

52. Bless, H., Wanke, M., Bohner, G., Fellhauer, R. F. & Schwarz, N. Need for cognition - a scale measuring engagement and happiness in cognitive tasks. *Zeitschrift Für Sozialpsychologie* **25**, 147–154 (1994).

53. Paschke, L. M. *et al.* Individual differences in self-reported self-control predict successful emotion regulation. *Social Cognitive and Affective Neuroscience* **11**, 1193–204 (2016).

54. Schwarzer, R., Diehl, M. & Schmitz, G. S. Self-regulation scale. (1999).

55. Tangney, J. P., Baumeister, R. F. & Boone, A. L. High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality* **72**, 271–324 (2004).

56. Sproesser, G., Strohbach, S., Schupp, H. & Renner, B. Candy or apple? How self-control resources and motives impact dietary healthiness in women. *Appetite* **56**, 784–787 (2011).

57. Patton, J. H., Stanford, M. S. & Barratt, E. S. Factor structure of the barratt impulsiveness scale. *Journal of Clinical Psychology* **51**, 768–774 (1995).

58. Hartmann, A. S., Rief, W. & Hilbert, A. Psychometric properties of the german version of the barratt impulsiveness scale, version 11 (BIS-11) for adolescents. *Perceptual and Motor Skills* **112**, 353–368 (2011).

59. Derryberry, D. & Reed, M. A. Anxiety-related attentional biases and their regulation by attentional control. *Journal of abnormal psychology* **111**, 225–236 (2002).

60. Wessa, M. *et al.* EmoPicS: Subjective und psychophysiologische evalueation neuen bildmaterials für die klinisch-biopsychologische forschung. *Zeitschrift für Klinische Psychologie und Psychotherapie* **39**, 77 (2010).

61. Lang, P. J., Bradley, M. M. & Cuthbert, B. N. *International affective picture system (IAPS): Affective ratings of pictures and instruction manual.* (University of Florida, 2008).

62. Yu, X. & Gen, M. *Introduction to evolutionary algorithms.* (Springer Science & Business Media, 2010).

63. Bradley, M. M. & Lang, P. J. Measuring emotion: Behavior, feeling, and physiology. in *Cognitive neuroscience of emotion* (eds. Lane, R. D. & Nadel, L.) 242–276 (Oxford University Press, 2000).

64. Fridlund, A. J. & Cacioppo, J. T. Guidelines for human electromyographic research. *Psychophysiology* **23**, 567–89 (1986).

65. Faul, F., Erdfelder, E., Lang, A.-G. & Buchner, A. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods* **39**, 175–191 (2007).

66. Faul, F., Erdfelder, E., Buchner, A. & Lang, A.-G. Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods* **41**, 1149–1160 (2009).

67. Kuznetsova, A., Brockhoff, P. B. & Christensen, R. H. B. lmerTest package: Tests in linear mixed effects models. *Journal of Statistical Software* **82**, 1–26 (2017).

68. Enders, C. K. & Tofighi, D. Centering predictor variables in cross-sectional multilevel models: A new look at an old issue. *Psychological Methods* **12**, 121–138 (2007).

69. Preece, D. A., Becerra, R., Robinson, K. & Gross, J. J. The emotion regulation questionnaire: Psychometric properties in general community samples. *J Pers Assess* **102**, 348–356 (2020).

70. Fleischhauer, M. *et al.* Same or different? Clarifying the relationship of need for cognition to personality and intelligence. *Personality & Social Psychology Bulletin* **36**, 82–96 (2010).

71. Fleischhauer, M., Strobel, A. & Strobel, A. Directly and indirectly assessed Need for Cognition differentially predict spontaneous and reflective information processing behavior. *Journal of Individual Differences* **36**, 101–109 (2015).

681

Competing Interests

690

691   The authors declare no competing interests.

692 **Figures and figure captions**

Figure 1

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 also
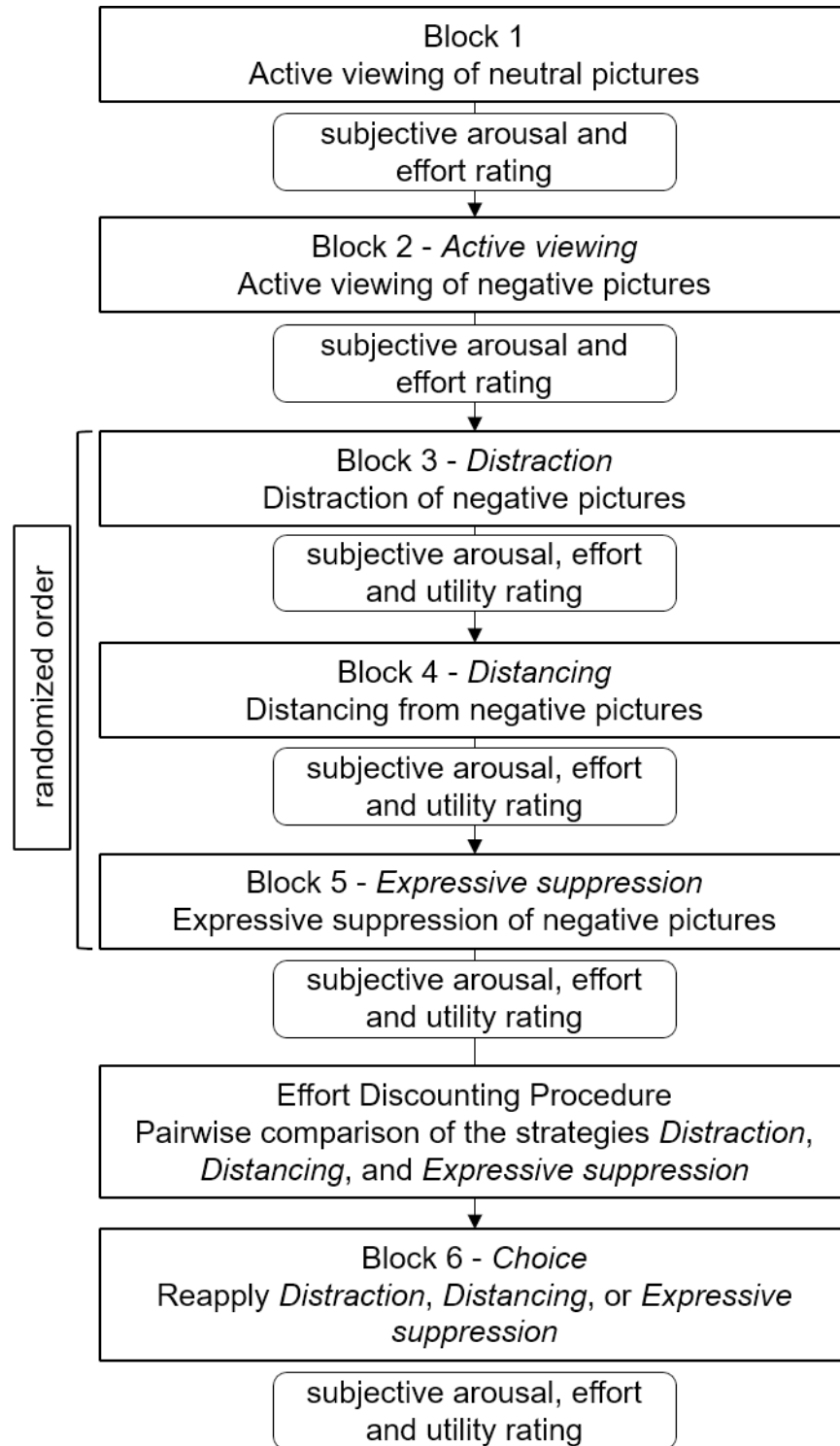
be represented by our paradigm.

Figure 2

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

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

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

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

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

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

703   screen with a continuous scale.

704   **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 EMG *corrugator* activity 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 EMG *levator* activity 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 ($\eta_p{}^2$ = 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 (η_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
<u>Output:</u>
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
<u>Input:</u>
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
<u>Output:</u>
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 <u>Input:</u> 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 <u>Output:</u> 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. |

715 **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].

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

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

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

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

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

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

[749]   *Self-Regulation Scale.* As one measure of self-control, the Self-Regulation Scale

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

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

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

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

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

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

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

[757]   *Barratt Impulsiveness Scale.* As a third measure of self-control, the Barratt

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

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

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

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

[762] month were reported[58].

[763]   *Attentional Control Scale.* Attentional control is measured using the Attentional

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

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

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

767 **Test for normal distribution of predictor variables**

Table S.2
Results of Shapiro-Wilk test for normal distribution of subjective arousal and effort ratings for all strategies.

	M	SD	W	p
Arousal View Neu	26.63	39.12	0.68	0.00
Arousal View Neg	187.78	87.31	0.98	0.06
Arousal Distraction	158.13	92.49	0.97	0.01
Arousal Distancing	168.62	95.75	0.98	0.04
Arousal Suppression	163.96	87.17	0.98	0.07
Effort View Neu	18.15	27.37	0.65	0.00
Effort View Neg	49.40	62.26	0.74	0.00
Effort Distraction	208.46	96.15	0.98	0.13
Effort Distancing	158.26	99.50	0.97	0.01
Effort Suppression	189.80	92.34	0.98	0.12

Table S.3
Results of Shapiro-Wilk test for normal distribution of Corrugator and Levator activity for all strategies.

	M	SD	W	p
Corrgator View Neu	0.04	6.99	0.05	0.00
Corrgator View Neg	1.03	7.21	0.19	0.00
Corrgator Distraction	0.00	7.67	0.04	0.00
Corrgator Distancing	0.07	3.78	0.08	0.00
Corrgator Suppression	0.25	1.92	0.35	0.00
Levator View Neu	0.09	1.84	0.38	0.00
Levator View Neg	0.58	3.20	0.43	0.00
Levator Distraction	-0.05	1.16	0.52	0.00
Levator Distancing	-0.03	0.92	0.48	0.00
Levator Suppression	0.01	1.00	0.55	0.00

768 **Post-hoc tests of strategies for effects of ER on subjective arousal and**

769 **physiological responding**

Table S.4
Post-hoc tests for effects of ER strategies on subjective arousal ratings.

Contrast	Estimate	SE	df	t	p	$BF10$	η_p^2	$95\%CI$
$View_{neg} - Distraction$	29.65	6.68	357.00	4.44	0.00	168.48	0.05	[0.02, 1.00]
$View_{neg} - Distancing$	23.82	6.68	357.00	3.57	0.00	62.99	0.03	[0.01, 1.00]
$View_{neg} - Suppression$	19.16	6.68	357.00	2.87	0.03	1.97	0.02	[0.00, 1.00]
$Distraction - Distancing$	-5.83	6.68	357.00	-0.87	1.00	0.18	2.13e-03	[0.00, 1.00]
$Distraction - Suppression$	-10.49	6.68	357.00	-1.57	0.70	0.31	6.86e-03	[0.00, 1.00]
$Distancing - Suppression$	-4.66	6.68	357.00	-0.70	1.00	0.14	1.36e-03	[0.00, 1.00]

Table S.5
Post-hoc tests for effects of ER strategies on Corrugator activity

Contrast	Estimate	SE	df	t	p	$BF10$	η_p^2	$95\%CI$
$View_{neg} - Distraction$	0.18	0.04	351.00	4.79	0.00	21,919.73	0.06	[0.03, 1.00]
$View_{neg} - Distancing$	0.19	0.04	351.00	5.09	0.00	139,814.01	0.07	[0.03, 1.00]
$View_{neg} - Suppression$	0.21	0.04	351.00	5.67	0.00	1.84×10^7	0.08	[0.04, 1.00]
$Distraction - Distancing$	0.01	0.04	351.00	0.30	1.00	3.77×10^{-2}	2.61e-04	[0.00, 1.00]
$Distraction - Suppression$	0.03	0.04	351.00	0.88	1.00	8.02×10^{-2}	2.21e-03	[0.00, 1.00]
$Distancing - Suppression$	0.02	0.04	351.00	0.58	1.00	4.79×10^{-2}	9.51e-04	[0.00, 1.00]

Table S.6
Post-hoc tests for effects of ER strategies on Levator activity

Contrast	Estimate	SE	df	t	p	$BF10$	η_p^2	$95\%CI$
$View_{neg} - Distraction$	0.34	0.05	351.00	6.73	0.00	2.02×10^{11}	0.11	[0.07, 1.00]
$View_{neg} - Distancing$	0.28	0.05	351.00	5.66	0.00	3.99×10^7	0.08	[0.04, 1.00]
$View_{neg} - Suppression$	0.32	0.05	351.00	6.37	0.00	8.60×10^{10}	0.10	[0.06, 1.00]
$Distraction - Distancing$	-0.05	0.05	351.00	-1.07	1.00	0.22	3.26e-03	[0.00, 1.00]
$Distraction - Suppression$	-0.02	0.05	351.00	-0.36	1.00	3.91×10^{-2}	3.70e-04	[0.00, 1.00]
$Distancing - Suppression$	0.04	0.05	351.00	0.71	1.00	9.86×10^{-2}	1.44e-03	[0.00, 1.00]

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Table S.7

Exploratory analysis: Results of MLM predicting SVs of ER strategies with level 2 predictors self-control and NFC.

Parameter	Beta	SE	p-value	f^2	Random Effects (SD)
Intercept	8.03×10^{-1}	0.01	0.00		0.11
Effort	-6.93×10^{-4}	0.00	0.00	0.04	
Utility	1.44×10^{-3}	0.00	0.00	0.20	
Corrugator activity	7.54×10^{-3}	0.00	0.03	0.00	
Self-Control	2.44×10^{-2}	0.01	0.04	0.00	
NFC	7.58×10^{-4}	0.00	0.44	0.00	