

That's Not Funny! - But It Should Be: Effects of Humorous Emotion Regulation on Emotional Experience and Memory

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1 **That’s Not Funny! – But It Should Be: Effects of Humorous Emotion** 2 **Regulation on Emotional Experience and Memory**

3

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10 **Keywords: emotion regulation, humor, reappraisal, memory, coping.**

11

12 **Abstract**

13 Previous research has shown that humorous reappraisal can reduce elicited negative emotions,
14 suggesting that humor may be a functional strategy to cope with emotionally negative situations.
15 However, the effect of humorous reappraisal on later memory about the emotion-eliciting situation is
16 currently unknown, although this is crucial for more adaptive responding in future situations. To
17 address this issue, we examined the effects of humorous reappraisal on both emotional experience
18 and memory, compared to non-humorous rational reappraisal and a non-reappraisal control condition.
19 Replicating previous findings, humorous reappraisal reduced evoked negative valence and arousal
20 levels very effectively, and the down-regulation of experienced negative emotions was even more
21 pronounced after humorous compared to rational reappraisal. Regarding later memory for emotion-
22 eliciting stimuli, both humorous and rational reappraisal reduced free recall, but recognition memory
23 was unaffected, with memory strength being stronger after humorous than after rational reappraisal.
24 These results indicate that humor seems to be indeed an optimal strategy to cope with negative
25 situations because humor can help us to feel better when confronted with negative stimuli, but still
26 allows us to retrieve stimulus information later when afforded to do so by the presence of appropriate
27 contextual features.

28 **1. Introduction**

29 A central question of emotion research is how to functionally regulate evoked negative emotional
30 experiences. As suggested early in psychoanalytic theory (Freud, 1905/1960; 1928), one promising
31 strategy to functionally regulate negative emotional experiences may be humor. Indeed, such an
32 assumption seems to be supported by more recent experimental research, showing that viewing
33 negative stimuli in a humorous way can reduce the strength of elicited negative emotions (e.g.,
34 Samson & Gross, 2012; Samson, Glassco, Lee, & Gross, 2014; Strick, Holland, van Baaren, & van
35 Knippenberg, 2009). Such beneficial effects of humor have been attributed to a number of
36 mechanisms such as cognitive distraction from negative stimuli (e.g., Strick et al., 2009), cognitive
37 reappraisal of negative stimuli in less threatening ways (e.g., Samson & Gross, 2012), and an
38 “undoing” of negative by positive emotions (Fredrickson & Levenson, 2000).

39 However, in order to more fundamentally evaluate the functionality of an emotion regulation
40 strategy, it is not enough to look at the effects of emotion regulation on the strength of emotional
41 responding in the current situation. Rather, it is additionally important to take into account the effects
42 of emotion regulation on later memory about the emotion-eliciting event (e.g., Richards & Gross,
43 2000). Basically, emotions are assumed to exist for the sake of signaling the consequences of a
44 stimulus for one's motives and goals (e.g., Frijda, 1988), with negative emotions signaling that
45 stimuli may be harmful. Accordingly, in order to prepare the organism for a more adaptive
46 responding in future situations, it would be adaptive to retain the emotion-eliciting stimuli as well as
47 possible, an assumption which is supported by the fact that later memory for negative stimuli is
48 typically enhanced compared to neutral stimuli (see Hamann, 2001, for a review). Thus, if an
49 emotion regulation strategy would down-regulate negative emotional experiences at the cost of
50 reduced memory for the emotion-eliciting event, it may help in the short term to cope with negative
51 emotional experiences in the current situation, but it may be detrimental for a more adaptive
52 responding to the negative event in future situations.

53 Although the effects of humor on the strength of elicited negative emotions when confronted with
54 negative stimuli have been examined in previous research, to our knowledge, research on the effects
55 of humor on later memory about negative stimuli is lacking. In particular, the suggested mechanisms
56 that may underlie the effects of humor on experienced emotions make rather different predictions
57 about how humor may affect later memory. If the beneficial effect of humor on experienced emotions
58 is based on the mechanism that humorous processing requires attentional resources so that people are
59 distracted from negative stimuli (Strick et al., 2009), later memory for negative stimuli should be
60 decreased because attention is a prerequisite for later memory (e.g., Mulligan, 2008), an assumption
61 which is supported by the finding that emotion regulation by distraction seems to reduce later
62 memory for the emotion eliciting event (e.g., Sheppes & Meiran, 2007). If the beneficial effect of
63 humor on experienced emotions is based on a cognitive reinterpretation of negative stimuli in less
64 threatening ways (Samson & Gross, 2012), later memory may not be affected by humor because the
65 emotion-eliciting event is still fully attended, an assumption which is supported by the finding that
66 (non-humorous) cognitive reappraisal seems not reduce later memory (Hayes, et al., 2010; Richards
67 & Gross, 2000). Finally, it may even be that humor enhances later memory for humorously
68 reappraised negative stimuli. If the beneficial effect of humor on experienced negative emotions is
69 based on an undoing of negative by positive emotions, the evoked positive emotions may bring about
70 an additional boost for memory (e.g., Herbert, Junghöfer, & Kissler, 2008), an assumption which is
71 supported by findings that humorous material is better remembered than neutral material (e.g.,
72 Carlson, 2011; Schmidt, 1994; 2002).

73 The aim of the present study was to examine the effects of humorous emotion regulation on both
74 current emotional experiences and later memory about emotion-eliciting stimuli. Basically, we
75 followed the procedure introduced by Samson and colleagues (2012; 2014) where participants rate
76 their emotional responses to negative pictures that are shown with the instruction to either simply
77 view the pictures (control condition), rationally reappraise the pictures (rational reappraisal
78 condition), or humorously reappraise the pictures (humorous reappraisal condition). However, in
79 order to overcome a few methodological shortcomings of previous studies, a number of changes were
80 made. First, we included not only emotionally negative pictures but also emotionally neutral pictures
81 in order to be able to examine whether the effects of humorous reappraisal are similar for neutral and
82 negative pictures, or specific to negative pictures. Second, to standardize reappraisal, rather than
83 asking participants to provide individual remarks in the reappraisal conditions, pictures were
84 accompanied by standardized written humorous or rationalizing comments (for examples, see Fig. 1).
85 Third, in order to control for the potential confounding effect that pictures in the control condition are

86 simply viewed whereas pictures in the reappraisal conditions are additionally verbally processed,
87 pictures in the control condition were shown with a written comment as well that simply described
88 the picture content. After picture presentation, memory for the pictures was assessed both for free
89 recall and recognition memory, in order to obtain a comprehensive view of the effects of humor on
90 later memory.

91 With respect to the effects of humor on the strength of elicited emotional experiences, we expected
92 that humorous reappraisals should down-regulate evoked negative emotions, replicating findings by
93 Samson and Gross (2012). In particular, based on the recent findings of Samson and colleagues
94 (2014), we expected that humorous reappraisal should be more effective in down-regulating negative
95 emotions than rational reappraisal because the elicitation of positive emotions involved in
96 humorously reappraisal can help to further “undo” negative emotions beyond the effects of purely
97 rational reappraisal. With respect to the effects of humor on later memory for reappraised stimuli, if
98 the beneficial effects of humor on emotional experiences are mainly based on cognitive distraction,
99 memory performance should be decreased in the humorous reappraisal condition compared to the
100 other conditions. If the beneficial effects of humor on emotional experiences are based on cognitive
101 reappraisal, memory performance should be similar between the humorous and rational reappraisal
102 conditions, and according to the findings by Richards and Gross (2000), memory performance in the
103 reappraisal conditions should be comparable to the control condition. If the beneficial effects of
104 humor on emotional experiences are based on an undoing of negative by positive emotions, memory
105 performance in the humorous reappraisal condition may even be increased compared to the other
106 conditions.

107 2. Materials and Methods

108 2.1. Participants

109 To detect small-sized effects ($d = 0.4$, $\alpha = .05$) with sufficient power (.80), a sample size of 52 is
110 required. Therefore, we planned to collect data from at least 52 participants until the end of the
111 semester. This resulted in a sample of 63 undergraduate students (45 females, mean age = 24.92
112 years, $SD = 4.61$), who participated for course credit. Each person was tested individually. The study
113 was conducted in accordance with the Helsinki declaration and the University Research Ethics
114 Standards.
115

116 2.2. Materials

117 Twenty-four neutral and twenty-four negative pictures were selected. Most of the pictures were
118 drawn from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1995),
119 additionally, three of the neutral pictures were taken from the Geneva affective picture database
120 (GAPED; Dan-Glauser & Scherer, 2011). Pictures were chosen by the criteria of reasonableness and
121 differentiability, and every negative picture was yoked with a visually similar neutral picture.
122 Negative pictures were selected to be more negatively valenced and more arousing than neutral
123 pictures (Valence: $M_{\text{Negative}} = 2.84$, $SD = 0.65$; $M_{\text{Neutral}} = 5.33$, $SD = 0.52$; Arousal: $M_{\text{Negative}} = M =$
124 5.59 , $SD = 0.80$; $M_{\text{Neutral}} = 3.79$, $SD = 1.01$).

125 For each picture, a humorous, a rationalizing, and a neutral comment were generated (all comments
126 are provided as Supplementary Material; for examples see Fig. 1). The humorous comments reflected
127 a positive form of humor in the sense of Samson and Gross (2012) and were generated according to
128 their instructions (i.e., reappraising in a benevolent and amusing way without becoming hostile or

129 aggressive, focusing on absurdities of situations). The rationalizing comments reflected a rational
 130 form of cognitive reappraisal in the sense of Richards and Gross (2000), and were generated
 131 according to their instructions (i.e., adopting a neutral attitude when watching a picture by thinking
 132 about it objectively and analytically); the non-reappraisal comments verbally described what could be
 133 seen on the picture. The three types of comments were matched on the number of words ($M_{\text{Humorous}} =$
 134 14.52 , $M_{\text{Rational}} = 14.56$, $M_{\text{Neutral}} = 13.96$).

135 2.3. Design and procedure

136 A 2 x 3 within-subject design was used with the factors of emotional content of a picture (neutral vs.
 137 negative) and reappraisal condition (humorous vs. rational vs. neutral). The participants were shown
 138 the 24 neutral and 24 negatives pictures on a computer screen in random order using E-Prime 2.0
 139 (PST, Pittsburgh, PA) with the instruction to rate their emotional responses to each picture on
 140 valence (1 = extremely negative to 9 = extremely positive) and arousal (1 = not at all aroused to 9 =
 141 extremely aroused). No mention was made that memory for the pictures will be tested later. One third
 142 of the neutral, respectively negative, pictures were shown with a humorous comment, one third with
 143 a rationalizing comment, and one third with a neutral comment. The assignment of type of comments
 144 to the pictures was counterbalanced across participants.

145 Each picture was shown for 10 sec at the center of the screen with the comment displayed below the
 146 picture (see Fig. 1). Participants were instructed to look at the pictures as long as they were presented
 147 and to read the respective comments carefully. After presentation of each picture, the valence and
 148 arousal scales were shown and participants made their ratings without any time restriction. After the
 149 presentation of all 48 pictures, a 1-min distractor phase followed in which participants had to solve
 150 simple arithmetic problems. A surprise free recall test for the presented pictures followed, in which
 151 participants were instructed to verbally describe on a provided sheet as many of the previously
 152 presented pictures as could be recalled any time restriction. After another 1-min distractor phase, a
 153 surprise recognition memory test followed. Participants were shown all initially presented pictures
 154 again together with 48 new pictures (24 negative and 24 neutral pictures, taken from the IAPS and
 155 GAPED data bases) in random order. In order to measure not only general recognition memory in an
 156 all-or-none fashion but also assess the memory strength of recognized pictures, we used a successive
 157 disclosure procedure. Each picture was presented in 100 gradation slides in ascending order, starting
 158 with a completely grey slide until the picture was entirely visible. Each gradation slide was shown for
 159 66 ms so that the picture sequence appeared as a continuum. Participants were asked to press a button
 160 as soon as they were able to identify a picture as having been shown before. If the disclosed picture
 161 was judged to be new, they were asked to wait until the picture was fully visible without pressing any
 162 button. General recognition memory was measured as the proportion of correctly recognized pictures
 163 independently of when the button was pressed during the disclosure sequence, and memory strength
 164 was measured as the time necessary for correctly recognizing a previously presented picture.

165 3. Results

166 3.1. Elicited emotions

167 Figure 2 shows valence (2A) and arousal (2B) ratings of participants as a function of emotional
 168 content of pictures and reappraisal condition. To analyze the effect of type of reappraisal on
 169 emotional experiences, we conducted analyses of variances (ANOVA) for valence and arousal
 170 ratings with factors of emotional content of pictures (neutral vs. negative) and reappraisal condition
 171 (humorous vs. rational vs. control). For valence, there was a significant main effect of emotional

172 content of pictures, $F(1, 62) = 152.62, p < .001, \eta_p^2 = .71$, indicating that negative pictures were
 173 much more negatively experienced than neutral pictures. There was also a significant main effect of
 174 reappraisal condition, $F(2, 124) = 14.94, p < .001, \eta_p^2 = .19$, indicating that experienced negativity
 175 varied as a function of type of reappraisal. The interaction between both factors was also significant,
 176 $F(2, 124) = 10.60, p < .001, \eta_p^2 = .15$, indicating that the differential effects of reappraisal type
 177 differed between neutral and negative pictures. For negative pictures, humorous reappraisal increased
 178 valence ratings compared to both the control condition, $t(62) = 6.40, p < .001, d = 0.81, 95\% \text{ CI: } 0.43$
 179 $- 0.81$, and the rational reappraisal condition, $t(62) = 5.84, p < .001, d = 0.74, 95\% \text{ CI: } 0.35 - 0.72$;
 180 valence ratings did not significantly differ between the rational reappraisal and control conditions,
 181 $t(62) = 1.07, p = .290, d = 0.13, 95\% \text{ CI: } -0.07 - 0.25$ For neutral pictures, valence ratings did not
 182 significantly differ between conditions, $F(2, 124) = 1.02, p = .364, \eta_p^2 = .02$.

183 For arousal, there also were significant main effects of emotional content of pictures, $F(1, 62) =$
 184 $97.35, p < .001, \eta_p^2 = .61$, and reappraisal condition, $F(2, 124) = 5.96, p = .003, \eta_p^2 = .09$, and a
 185 significant interaction between both factors, $F(2, 124) = 20.86, p < .001, \eta_p^2 = .25$. For negative
 186 pictures, both humorous and rational reappraisal decreased arousal ratings, compared to the control
 187 condition, $t(62) = -2.71, p = .009, d = 0.34, 95\% \text{ CI: } -0.46 - -0.07$, and $t(62) = -2.86, p = .006, d =$
 188 $0.36, 95\% \text{ CI: } -0.45 - -0.08$, respectively; arousal ratings between the humorous and rational
 189 reappraisal conditions did not differ, $t(62) = 0.00, p = .999, d = 0.00, 95\% \text{ CI: } -0.20 - 0.20$. For
 190 neutral pictures, humorous reappraisal increased arousal ratings compared to both the control
 191 condition, $t(62) = 3.43, p = .001, d = 0.43, 95\% \text{ CI: } 0.20 - 0.77$, and the rational reappraisal
 192 condition, $t(62) = 4.67, p < .001, d = 0.59, 95\% \text{ CI: } 0.36 - 0.94$, whereas arousal ratings did not
 193 significantly differ between the rational reappraisal and control conditions, $t(62) = -1.55, p = .126, d$
 194 $= 0.20, 95\% \text{ CI: } -0.39 - 0.05$.

195 3.2. Memory performance

196 3.2.1. Free recall

197 Figure 2C shows free recall memory performance as a function of emotional content of pictures and
 198 reappraisal condition. An ANOVA with factors of emotional picture content (neutral vs. negative)
 199 and reappraisal condition (neutral vs. humorous vs. rational) revealed a significant main effect of
 200 picture content, $F(1, 62) = 70.84, p < .001, \eta_p^2 = .53$, indicating that negative pictures were much
 201 better remembered than neutral pictures. There was also a significant main effect of reappraisal
 202 condition, $F(2, 124) = 4.22, p = .017, \eta_p^2 = .06$, indicating that memory performance varied as a
 203 function of type of reappraisal. The interaction between both factors was not significant, $F(2, 124) =$
 204 $0.66, p = .518, \eta_p^2 = .01$. Overall, compared to the control condition, both humorous ($M_{\text{Decrease}} = -5.49$
 205 $\%$) and rational reappraisal ($M_{\text{Decrease}} = -5.37\%$) decreased memory performance, $t(62) = -2.35, p =$
 206 $.022, d = 0.30, 95\% \text{ CI: } -0.10 - -0.01$, and $t(62) = -2.98, p = .004, d = 0.38, 95\% \text{ CI: } -.09 - -.02$,
 207 respectively. Amount of decrease did not differ between the humorous and rational reappraisal
 208 conditions, $t(62) = -0.05, p = .961, d = 0.01$. Analyzing data separately for negative and neutral
 209 pictures revealed that for negative pictures, memory performance was decreased both in the
 210 humorous and rational reappraisal conditions, compared to the control condition, $t(62) = -2.51, p =$
 211 $.015, d = 0.31, 95\% \text{ CI: } -0.14 - -0.02$, and $t(62) = -2.12, p = .038, d = 0.27, 95\% \text{ CI: } -0.11 - 0.00$,
 212 respectively. For neutral pictures, memory performance did not significantly differ between
 213 conditions, $F(2, 124) = 1.20, p = .304, \eta_p^2 = .02$.

214 3.2.2. Recognition

215 The false alarm rate was very low and did not vary as a function of emotional contents of lures
 216 ($M_{\text{Negative}} = 2.05\%$, $SD = 2.89$; $M_{\text{Neutral}} = 1.59\%$, $SD = 2.84$), $t(62) = 1.12$, $p < .266$, $d = 0.14$, 95%
 217 CI: 0.00 – 0.13. Figure 2D (left panel) shows the proportion of correctly recognized pictures as a
 218 function of emotional content of pictures and reappraisal condition. An ANOVA with factors of
 219 emotional picture content (neutral vs. negative) and reappraisal condition (neutral vs. humorous vs.
 220 rational) revealed a significant main effect of picture content, $F(1, 62) = 5.44$, $p = .023$, $\eta_p^2 = .08$,
 221 indicating that negative pictures were better recognized than neutral pictures. There was also a
 222 significant main effect of reappraisal condition, $F(2, 124) = 5.89$, $p = .004$, $\eta_p^2 = .09$, indicating that
 223 recognition memory performance varied as a function of type of reappraisal. The interaction between
 224 both factors was also significant, $F(2, 124) = 3.62$, $p = .030$, $\eta_p^2 = .06$, indicating that the differential
 225 effects of reappraisal type differed between neutral and negative pictures. For negative pictures,
 226 recognition memory performance did not significantly differ between conditions, $F(2, 124) = 0.53$, p
 227 $= .590$, $\eta_p^2 = .01$. For neutral pictures, rational reappraisal decreased recognition memory
 228 performance compared to both the humorous condition, $t(62) = -2.93$, $p = .005$, $d = 0.37$, 95% CI: -
 229 0.06 – -0.01, and the control reappraisal condition, $t(62) = -2.87$, $p = .006$, $d = 0.36$, 95% CI: -0.07 –
 230 -0.01; recognition memory performance did not significantly differ between the humorous
 231 reappraisal and control conditions, $t(62) = -0.241$, $p = .811$, $d = 0.03$, 95% CI: -0.02 – 0.01.

232 Figure 2D (right panel) shows the time necessary for correctly recognizing a previously presented
 233 picture, reflecting underlying memory strength, as a function of emotional content of pictures and
 234 reappraisal condition. An ANOVA with factors of emotional picture content (neutral vs. negative)
 235 and reappraisal condition (neutral vs. humorous vs. rational) revealed a significant main effect of
 236 picture content, $F(1, 62) = 28.37$, $p < .001$, $\eta_p^2 = .31$, indicating that negative pictures were more
 237 quickly recognized than neutral pictures. There was also a significant main effect of reappraisal
 238 condition, $F(2, 124) = 3.07$, $p = .050$, $\eta_p^2 = .05$, indicating that recognition speed varied as a function
 239 of type of reappraisal. The interaction between both factors was not significant, $F(2, 124) = 0.53$, $p =$
 240 $.591$, $\eta_p^2 = .01$. In the rational reappraisal condition, recognition speed was decreased compared to
 241 both the humorous condition, $t(62) = -1.96$, $p = .054$, $d = 0.25$, 95% CI: -2.79 – 0.03, and the control
 242 condition, $t(62) = -2.43$, $p = .018$, $d = 0.31$, 95% CI: -2.72 – -.26. Recognition speed did not differ
 243 between the humorous and control conditions, $t(62) = 0.16$, $p < .873$, $d = 0.02$, 95% CI: -1.27 – 1.49.

244 4. Discussion

245 In the present study, we investigated whether humor may be a functional strategy to regulate negative
 246 emotions by examining the effects of humorous reappraisal compared to rational reappraisal and non-
 247 reappraisal on evoked emotional experiences and later memory for the emotion-eliciting stimuli. The
 248 results showed that humor seems to be indeed an optimal strategy to adaptively cope with stimuli that
 249 elicit negative emotions. Regarding evoked emotional experiences, humorous reappraisal reduced
 250 experienced negative valence and arousal, replicating previous findings (Samson & Gross, 2012).
 251 Thus, humor can indeed help us to feel better when being confronted with negative events. In
 252 particular, replicating the recent findings by Samson and colleagues (2014), our results showed that
 253 humorous reappraisal is more successful in down-regulating negative emotions than rational
 254 reappraisal because rational reappraisal reduced only arousal levels but not experienced negative
 255 valence.

256 Regarding later memory for emotion-eliciting stimuli, the results showed that humorous reappraisal
 257 reduced free recall for negative stimuli compared to non-reappraisal, indicating that humor reduces
 258 the presence of previously experienced negative events in mind when actively reconstructing our
 259 past. However, the results for the recognition test showed that at the same time recognition memory

260 for negative stimuli was completely intact in the humorous reappraisal condition, indicating that
261 emotion-eliciting events were still fully stored in memory. From a functional perspective, such a
262 pattern seems to be adaptive because on the one hand, undergone negative experiences less strongly
263 infiltrate our minds when remembering our past in contexts that do not match the previous emotion-
264 eliciting situation. On the other hand, however, when the contextual information matches the features
265 of the previous emotion-eliciting situation, then past experiences can nevertheless be fully retrieved
266 in order to prepare for appropriate responding. In particular, similar to the effects on elicited
267 emotional experiences, humorous reappraisal seems to be even more functional than rational
268 reappraisal because rational reappraisal did not only reduce free recall but also reduce the strength of
269 recognition memory.

270 There is still a debate on whether the effectiveness of humor as an emotion regulation strategy is
271 attributable to the mechanisms of cognitive distraction from negative stimuli (e.g., Strick et al.,
272 2009), or to cognitive reappraisal of negative stimuli in less threatening ways (e.g., Samson & Gross,
273 2012). Previous research has shown that distraction and reappraisal differ with respect to the
274 consequences for later memories about the emotion-eliciting event, with distraction, but not
275 reappraisal, impairing later recognition memory (e.g., Richards & Gross, 2000; Sheppes & Meiran,
276 2007). Thus, the finding of the present study that humorous reappraisal did not impair recognition
277 memory strongly supports the view that the mechanism underlying humor as an emotion regulation
278 strategy is reappraisal.

279 Indeed, such a view is further supported by the finding that humorous reappraisal differentially
280 affected recognition memory and free recall. Whereas humor did not influence recognition memory,
281 free recall was impaired. Such a pattern speaks against the assumption that distraction may underlie
282 the effects of humorous reappraisal because previous research has shown that cognitive distraction
283 during encoding impairs both free recall and recognition memory (e.g., Craik, Govoni, Naveh-
284 Benjamin, & Anderson, 1996). Instead, such differential effects on recognition and free recall support
285 the assumption that the effect of humor is based on cognitive reappraisal. One factor which is known
286 to differentially influence free recall and recognition is whether processing during encoding is
287 focused on the relationship between a stimulus and other stimuli (i.e., relational processing), or on
288 the individual characteristics of a stimulus (i.e., item-specific processing). Whereas item-specific
289 processing reduces free recall because the memory representation of a stimulus is less strongly
290 activated by other stored stimuli so that active reproduction is impaired, item-specific processing
291 does not impair recognition memory because an active reproduction of the to-be-remembered
292 stimulus is not necessary for recognition (e.g., Einstein & Hunt, 1980; Engelkamp, Biegelmann, &
293 McDaniel, 1998). Thus, as the attempt to reappraise a stimulus in a humorous way requires focusing
294 on the to-be-reappraised stimulus, the underlying mechanism of the effects of humor on memory
295 seems to be the induction of item-specific processing.

296 In fact, a similar mechanism may explain the effect of rational reappraisal on memory. Replicating
297 previous findings, recognition accuracy for negative pictures was not impaired by rational reappraisal
298 (Hayes et al., 2010; Richards & Gross, 2000). However, going beyond previous findings, the present
299 results demonstrate that free recall is impaired. Thus, similar to humorous reappraisal, rational
300 reappraisal seems also to induce an item-specific processing of the to-be-reappraised stimuli, leading
301 to the observed differential effects on later free recall and recognition memory. However, with
302 respect to the effects on elicited emotions, the results indicate that cognitive reappraisal alone is less
303 effective in down-regulating negative emotions than when the cognitive reappraisal additionally
304 evokes positive emotions due to a humorous reinterpretation of stimuli. Thus, an evoking of positive
305 emotions, as induced by humorous reappraisal, seems to be necessary to really undo experienced

306 negative emotions (e.g., Fredrickson & Levenson, 1998). However, the undoing of negative by
307 humor-induced positive emotions seems not to be strong enough to bring about an additional boost in
308 memory.

309 One interesting finding of the present study is that rational reappraisal was rather ineffective in down-
310 regulating negative emotions because only elicited emotional arousal but not negative valence was
311 reduced. On first glance, such a finding seems to deviate from previous studies showing decreased
312 valence ratings when rationally reappraising compared to when simply watching emotion-eliciting
313 stimuli in a non-reappraisal control condition (e.g., Hayes et al., 2010; Richards & Gross, 2000).
314 However, a closer look reveals that there is one important difference between the present and the
315 previous studies. In previous studies, reappraisal and control conditions differed not only in terms of
316 reappraisal but also in terms of cognitive processing in general because participants in the control
317 condition were instructed to simply watch the pictures, whereas in the reappraisal condition
318 additional cognitive processing was required. In the present study, the control and reappraisal
319 conditions were matched on required cognitive processing in order to control for the potential
320 confounding effect of cognitive processing in general. The finding that the benefits from rational
321 reappraisal were rather small under such conditions suggest that the down-regulating of negative
322 emotions found in previous studies may more likely reflect the effect of cognitive processing in
323 general, rather than specific effects of rational reappraisal. Indeed, such an assumption is supported
324 by recent findings showing that additional cognitive processing during the perception of emotional
325 events can reduce negative emotions (e.g., Strick et al., 2009; Van Dillen & Koole, 2007). However,
326 given that the present study did not include a condition where emotional stimuli were simply
327 watched, further research is needed to clarify the specific effects of rational reappraisal beyond the
328 effects of cognitive processing in general.

329 In the present study, the form of reappraisal employed in the rational reappraisal condition reflected a
330 rational form of cognitive reappraisal where emotion regulation is based on the attempt to adopt a
331 neutral attitude when watching a picture by thinking about it objectively and analytically (e.g.,
332 Richards & Gross, 2000). However, there are other forms of cognitively reappraising emotionally
333 negative situations, such as trying to think about a situation in a more positive light, or thinking about
334 the positive bearing an event could have on the persons involved in the situation (e.g., Troy,
335 Wilhelm, Shallcross, & Mauss, 2010). One important difference between these different forms of
336 cognitive reappraisals is that the latter one may additionally elicit positive emotions due to the
337 thinking about potential positive aspects of the given negative situation. Thus, it may be that such
338 “positive” forms of cognitive reappraisal may be similar effective than humorous reappraisal where
339 the elicitation of positive emotions seems to play an important role as well, an open question that
340 warrants future research.

341 In conclusion, humor seems to be indeed an especially functional emotion regulation strategy that
342 can outperform other emotion regulation strategies such as rational reappraisal. Thus, Freud
343 (1905/1960) may indeed have been right in assuming that humor can be seen as the most valuable
344 high-level defense of displeasure.
345

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Provisional

407 **Figure legends**

408 **Figure 1: Procedure of the experiment.** Participants were shown 24 negative and 24 neutral
409 pictures provided with a neutral, rational, or humorous comment in random order. Each picture was
410 rated on experienced emotional valence and arousal. After picture presentation, a surprise memory
411 test followed. In a first free recall test, participants were asked to verbally describe as many of the
412 previously presented pictures as possible. In a subsequent recognition test, all initially presented
413 pictures were shown again together with 48 new pictures, and participants were instructed to indicate
414 whether a picture was old or new. In order to measure memory strength of recognized pictures, we
415 used a successive disclosure procedure where participants were asked to press a button as soon as
416 they were able to identify a picture as having been shown before.

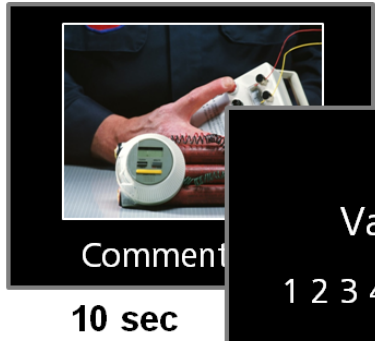
417 **Figure 2. Results of the Experiment.** (A) Emotional valence ratings (1 = extremely negative to 9 =
418 extremely positive), (B) emotional arousal ratings (1 = not at all aroused to 9 = extremely aroused),
419 (C) free recall performance, and (D) recognition performance as a function of emotional content of
420 pictures (neutral, negative) and reappraisal condition (control, rational, humorous). The left panel in
421 (D) shows recognition accuracy (probability of correct recall), the right panels shows the time needed
422 to correctly identify a previously presented. Error bars represent standard errors.

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Figure 1.TIF

REAPPRAISAL

- NEUTRAL:** The thumb of a man's hand is resting on the red button of a bomb's ignition.
- RATIONAL:** Depending on its size and explosive power, dynamite causes damage of varied expenses.
- HUMOROUS:** Peter built an alarm clock out of sausages that will smell like salami at the set time.



MEMORY

Free Recall Test



Recognition Test



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Figure 2.TIF

