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1 **Savoring the Present: The Reciprocal Influence Between Positive Emotions**  
2 **and Positive Emotion Regulation in Everyday Life**

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37 **ABSTRACT**

38 A growing body of research has investigated the regulation of negative emotions in ecological settings,  
39 but little is known about the mechanisms underlying positive emotion regulation in everyday life.  
40 Although some evidence suggests that adopting positive strategies is beneficial for emotional well-  
41 being, the literature is inconsistent about the effects of positive emotions on subsequent regulatory  
42 processes. In the present study, we adopted a two-week ecological momentary assessment to explore  
43 the association between positive emotions and positive emotion regulation in daily life. According to  
44 our results, the less individuals felt positive emotions at one point, the more they tended to enhance their  
45 use of positive strategies from this time to the next, which in turn resulted in subsequent higher levels  
46 of positive emotions. This prototype of positive regulation can be seen as a highly adaptive mechanism  
47 that makes it possible to compensate for a lack of positive emotions by enhancing the deployment of  
48 positive strategies. The theoretical and clinical implications of these findings are discussed.

49 **Keywords:** positive emotions; positive emotion regulation; ecological momentary assessment.

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## 62 1. INTRODUCTION

63 The pursuit of happiness is considered one of the most important life goals of individuals (1),  
64 who intensely seek to create pleasant experiences throughout their lives. Positive emotions  
65 (PE) are a core component of well-being because they are not limited to pleasant sensations,  
66 but rather produce short- and long-term psychological benefits and improve both physical and  
67 mental health (2–5). More specifically, PE temporarily extend the scope of attention, cognition  
68 and action (6), which in turn promotes resilience and psychological well-being (7).  
69 Accordingly, people spend most of their time trying to downregulate negative emotions and  
70 upregulate positive ones (8).

71 Emotion regulation is a process through which individuals try to influence their emotional state  
72 in order to achieve personal goals (9). To date, most of the literature has focused on the  
73 regulation of negative emotional states. Nevertheless, there is increasing evidence highlighting  
74 the crucial role of positive emotion regulation (10,11), that is, the set of strategies people  
75 implement to create, maintain and enhance PE for two main purposes. First, people upregulate  
76 PE for its own sake, that is, to experience pleasurable states and increase happiness (12).  
77 Second, the upregulation of PE has been recognised as a mood repair mechanism, i.e., a process  
78 that helps individuals to reduce negative affect and recover from stressful events (13,14).

79 Although originally conceptualized for negative emotion, Gross' extended model (2015) has  
80 also been used to understand positive emotion regulation (10). Accordingly, different types of  
81 positive strategies can be deployed in different stages of the emotion generation process: (a) by  
82 selecting a situation that is expected to improve affect (situation selection); (b) by actively  
83 changing a situation in order to get the most out of it (situation modification); (c) by redirecting  
84 the attention towards specific features or details of a situation that might increase positive  
85 emotions (attentional deployment); (d) by changing the appraisal of an emotion-eliciting

86 stimulus in order to amplify the associated pleasant state (cognitive change); and (e) by  
87 experientially, physiologically, or behaviourally expressing ongoing PE to further increase  
88 their intensity (response modulation). These strategies are implemented not only during the  
89 experience of a positive emotional state (10). They might also be used before (i.e., while  
90 anticipating a positive event) (16) or after (i.e., while recalling a positive memory) (17) the  
91 emotion-generative process (10,11). For the purposes of the present study, however, we will  
92 mainly focus on the available literature exploring PE regulation in the present.

93 When assessed in naturalistic settings, people use on average a repertoire of sixteen strategies  
94 in response to PE (18). The implementation of positive emotion regulation has been shown to  
95 be beneficial for mental health, and a growing body of studies has revealed that people who  
96 frequently adopt strategies to intensify and prolong positive experiences (that is, savoring (19))  
97 show enhanced emotional well-being (20,21) and more sustained PE over time (22). For  
98 instance, a more extensive use of some strategies, such as counting blessings or sharing, leads  
99 to greater levels of happiness, despite experiencing few daily positive events (21,23). In another  
100 study, Langston et al. (24) found that capitalizing on positive events (i.e., the process of  
101 beneficially seizing and interpreting positive situations) further increases the experience of  
102 positive emotions. Furthermore, the intense use of strategies, such as mindfulness and positive  
103 reappraisal, has been found to predict higher levels of psychological well-being and enhanced  
104 experience of positive emotional states (25,26). In sum, there is a growing body of evidence  
105 that highlights the important emotional outcomes associated with the use of positive emotion  
106 regulation in daily life.

107 However, not only can emotion regulation influence emotional outcomes, but emotions can  
108 also determine subsequent emotion regulation processes (27). This hypothesis is further  
109 confirmed by the evidence showing that momentary mood predicts subsequent affect levels

110 (28), which suggests that emotion regulation might be partly determined by an individual's  
111 momentary emotional state (29). Nonetheless, the previous literature has been inconsistent  
112 about the association between PE and positive emotion regulation.

113 On the one hand, the broaden-and-build theory states that the experience of PE enhances one's  
114 attentional scope and thought-action repertoire, leading to cognitive and behavioural  
115 broadening mechanisms (7,30) such as increased creativity or cognitive flexibility (31,32).  
116 These mechanisms have been hypothesized to affect emotion regulation processes as well.  
117 Thus, positive emotions are likely to encourage the adoption of adaptive, broadminded  
118 strategies that further enhance positive states (7,33). Consistent with this theory, the momentary  
119 experience of high levels of PE has been found to predict greater subsequent adoption of  
120 adaptive strategies such as problem solving (29) and mindfulness (34).

121 On the other hand, pro-hedonic theories, such as the hedonic flexibility principle, suggest that  
122 people are likely to implement behavioural strategies based on their momentary mood in order  
123 to minimize negative affect and maximize positive emotions (35,36). More specifically, the  
124 experience of low positive emotions is supposed to motivate actions and behaviours to enhance  
125 mood. Thus, individuals are likely to increase their attempts to upregulate PE when  
126 experiencing a low rather than high level of PE. Recent studies have demonstrated that, when  
127 experiencing bad moods, people are more likely to engage in mood-enhancing activities, such  
128 as doing sport, going out in nature or chatting with a friend, whereas useful but mood-  
129 decreasing activities are pursued when the current mood is already high (36,37). In another  
130 study, individuals were found to seek pleasant social relationships when feeling bad and prefer  
131 solitude or less pleasant social interactions when feeling good (38).

132 In sum, despite the growing evidence highlighting the importance of PE in mental health, there  
133 are still many unanswered questions about the regulatory mechanisms underlying positive

134 states. Although positive emotion regulation has received increasing attention in the past  
135 decade, the effects of its momentary use are still unexplored. More specifically, whereas the  
136 findings about the emotional outcomes of positive emotion regulation are quite consistent, the  
137 effect of momentary PE on subsequent strategy implementation is still largely unknown.  
138 Importantly, momentary PE not only reflect the experience of a pleasant state, but they also  
139 represent an important source of information that drives regulatory mechanisms. Thus,  
140 exploring the reciprocal influences between PE and positive emotion regulation is important in  
141 order to disentangle the factors determining past, present and future positive emotional  
142 experiences.

### 143 *The current study*

144 The aim of the current study was to explore the reciprocal interconnection between PE and  
145 positive emotion regulation in daily life. To do so, we asked 85 undergraduate students to use  
146 a two-week Ecological Momentary Assessment (EMA) to report their momentary levels of PE  
147 and rate the adoption of positive strategies to regulate ongoing PE. Despite the evidence  
148 showing that people's repertoire of positive strategies is quite large (18), it would have been  
149 too demanding and time-consuming to assess a high quantity of items at each assessment.  
150 Accordingly, we decided to focus on a limited number of positive strategies and to exclude  
151 dampening ones (i.e., strategies that decrease the intensity of ongoing PE).

152 The rationale adopted for selecting the strategies was based on Quoidbach et al.'s theory (2015)  
153 of positive emotion regulation. While the effectiveness of situation selection and situation  
154 modification strategies to enhance PE has been found to be weak or even largely unknown and  
155 controversial, there is more consistent evidence that supports the value of attentional  
156 deployment, cognitive change and response modulation strategies to increase positive  
157 emotions, especially in the short-term (10). We therefore decided to focus on these three

158 categories and, for each of them, two strategies were selected based on the previous literature  
159 relating positive emotion regulation to PE, thus making a total of 6 strategies: mindfulness,  
160 stimulus control, broadening, counting blessings, emotion expression, and sharing. The use of  
161 this rational allowed us to explore the association between PE and positive emotion regulation  
162 both at a strategy and category levels.

163 Attentional deployment refers to the set of strategies specifically designed to direct one's  
164 attention in order to savour a pleasant emotional state, which in turn increases the experience  
165 of positive states both in the short and long terms (10). In the present study, we explored the  
166 momentary use of mindfulness, which is focusing the attention on the present situation, and  
167 stimulus control, which refers to the attempt to avoid other negative thoughts in order to focus  
168 on the pleasant state. According to the previous literature, both strategies can play a role in  
169 daily positive emotional states. Indeed, a growing body of literature has found mindfulness to  
170 be associated with more intense and frequent positive emotions (20,25,39), which in turn has  
171 been shown to increase next-day mindfulness levels (34). Furthermore, Heij and Cheavens  
172 (18) found stimulus control to be one of the most frequently adopted strategies in response to  
173 PE that positively affect general mood.

174 Cognitive change refers to the attempt to influence the meaning of a positive stimulus, for  
175 example, by reappraising a positive situation as a special moment or by increasing the value  
176 attributed to a positive event. Generally, previous research has shown that reappraising a  
177 positive stimulus (40,41) and increasing the perceived value of a positive experience (42) are  
178 associated with enhanced levels of positive emotions. Indeed, not only does the adoption of  
179 cognitive change strategies enhance momentary positive emotional states, but it also has a  
180 modest impact on PE in the long-terms (10). In the present study, we assessed participants'  
181 use of broadening, which is thinking about the current pleasant state as part of a worthy life,



182 and counting one's blessings, i.e., thinking about the special moments by not taking them for  
183 granted. Whereas one's perceived satisfaction and fulfilment in different aspects of life have  
184 been found to significantly affect emotional well-being (43), Wood et al. (2010) showed the  
185 significant effect of counting one's blessings on increasing positive emotions.

186 Finally, response modulation includes strategies to influence the physiological, experiential or  
187 behavioural response to a positive state, which usually involve expressing the emotion with  
188 either verbal or nonverbal communication. Indeed, the accumulated literature coming from  
189 embodied cognition research has suggested that expressing positive emotions both physically  
190 – for example, by facial display (45,46) - and verbally (24,47) can boost the experience of the  
191 associated positive state. Consistently, we assessed the momentary use of emotion expression  
192 (i.e., the use of the body to express and communicate ongoing PE) as well as sharing (i.e., the  
193 tendency to share positive experiences through verbal communication with other people).

194 The first objective of this study was to explore which of the two aforementioned theories better  
195 explains the association between PE and positive emotion regulation strategies. According to  
196 the broaden-and-build theory, the experience of intense PE fosters broadening mechanisms and  
197 the use of broad-minded positive strategies. In this case, and consistent with previous findings,  
198 high levels of PE should determine an increase in the subsequent use of positive strategies. In  
199 contrast, the hedonic flexible principle states that low mood, compared to high mood, predicts  
200 the implementation of strategies to enhance momentary emotions. Thus, a lower level of PE at  
201 a certain time should predict an increase in the use of positive emotion regulation from that  
202 time to the next.

203 The second objective of this study was to explore the unique impact of six positive emotion  
204 regulation strategies on subsequent PE. Consistent with the ample evidence showing the

205 beneficial emotional outcomes of positive regulation, we expected to find that increased use of  
206 positive strategies at one point predicted enhanced PE in the following assessment.

207 The third objective was to investigate whether the reciprocal influence between PE and positive  
208 emotion regulation changes significantly depending on the intrinsic nature of strategies, as  
209 defined by the three categories explored in the present study: attentional deployment, cognitive  
210 change and response modulation. To this aim, we explored whether strategy category  
211 significantly moderated the association between positive emotion regulation and PE and, more  
212 specifically: (a) whether the strategy category moderated the impact of PE at t0 on positive  
213 regulation at t1, and (b) whether the strategy category moderated the effect of positive  
214 regulation on subsequent levels of PE.

## 215 **2. MATERIAL AND METHODS**

### 216 *2.1 Inclusion criteria and sample*

217 In order to exclude the potential confounding effect of depression, which has been shown to be  
218 associated with an impaired use of savoring strategies and an increased adoption of dampening  
219 strategies (48,49), individuals with a score above 14 on the Patient Health Questionnaire (PHQ-  
220 9) (50) were excluded from the study (i.e., individuals with moderate to severe depressive  
221 conditions;  $n=6$ ). Similar to the sample size of previous EMA studies on emotion regulation  
222 (29,51), we recruited 85 undergraduate students at Jaume I University (Castellon, Spain). The  
223 sample was composed of 67 females (77.9%) and 19 males (22.1%); their ages ranged between  
224 18 and 36 years ( $M: 22.07$ ;  $SD:3.45$ ).

225 This study was approved by the ethics committee of Jaume I University (certificate number:  
226 CD/57/2019), and informed consent was obtained from each participant.

## 227 2.2 Material

228 Participants were prompted three times a day for two weeks to complete a brief questionnaire  
229 on their smartphone, reaching a total of 42 potential observations for each participant.  
230 Consistent with previous studies, this sampling frequency has been shown to be adequate for  
231 the assessment of daily emotion regulation patterns (18) and it leads to good compliance levels  
232 (16,17). In the present study, 2726 out of 3570 possible assessments were obtained, thus  
233 revealing a mean compliance of 76.34% ( $SD=18.12$ ), ranging between 33% and 100%.

234 At each prompt, participants were first asked to rate the momentary intensity of seven PE on a  
235 Likert scale from 1 to 5 (1 = *not at all*, 5 = *a lot*). The seven emotions were selected in order to  
236 include both low-arousal (hope, serenity, gratitude) and high-arousal (happiness, amusement,  
237 excitement, pride) positive emotions (52), which is consistent with the evidence showing the  
238 influence of positive regulation on both types of positive emotions (26). To obtain a general  
239 indicator of PE, the seven positive emotions rated at each assessment were averaged. The  
240 composite score obtained showed high internal consistency at both the between- ( $\alpha=.96$ ) and  
241 within-individual levels ( $\alpha=.86$ ).

242 Participants were also asked to rate the momentary adoption of six positive strategies on a 0-  
243 100 scale (0 = *no adoption*, 100 = *high adoption*), which were selected with the aim of  
244 exploring three categories of positive regulation (10): mindfulness and stimulus control for the  
245 category ‘attentional deployment’; broadening and counting blessings for the category  
246 ‘cognitive change’; emotion expression and sharing for the category ‘response modulation’.  
247 Due to the lack of validated questionnaires to assess positive strategies, ad hoc single items  
248 were created (see **Table 1**), as is common in ecological studies exploring emotion regulation  
249 (see, for example, 25,30,32,38). These items were mostly inspired by a previous study (18).

250 Similar to previous EMA studies exploring the reciprocal influences between emotion and

251 emotion regulation (see for example 28,35,43), change scores were calculated for each strategy,  
252 indicating whether a strategy was used more or less at a certain time (t1), compared to the  
253 previous assessment (t0). These scores were calculated to analyse to what extent PE at t0  
254 influenced positive emotion regulation change from t0 to t1. To compute change scores that  
255 are not affected by the so-called ‘regression toward the mean effect’, change scores were  
256 computed through linear mixed-effects models with maximum likelihood by taking the  
257 residuals of a model in which the strategy at t1 was regressed on itself at t0. In addition, strategy  
258 type was also taken into account in the analyses to explore further the relationship between PE  
259 and positive regulation depending on the intrinsic nature of the strategies adopted. To do so,  
260 strategies were averaged based on their category. This made it possible to obtain three new  
261 variables that reflected the intensity of use of each category of strategy. To assess the internal  
262 consistency of the new variables, correlations for each pair of strategies were performed at the  
263 between-individual level (attentional deployment:  $r = .882, p < .001$ ; cognitive change:  $r =$   
264  $.981, p < .001$ ; response modulation:  $r = .936, p < .001$ ) and within-individual level (attentional  
265 deployment:  $r = .556, p < .001$ ; cognitive change:  $r = .732, p < .001$ ; response modulation:  $r =$   
266  $.630, p < .001$ ).

### 267 **2.3 Procedure**

268 Participants were recruited via social media and poster advertisements placed in different  
269 buildings at the university. Students willing to participate were invited to visit the laboratory  
270 to receive more details about the study design and sign the informed consent.

271 The EMA phase lasted 14 days. Participants received three daily semi-random prompts  
272 (between 9:30 - 14:00, 14:00 - 18:30, and 18:30 - 23:00) to complete the momentary assessment  
273 through the data collection program Qualtrics. To prevent backfilling, participants were given  
274 sixty minutes to access the survey; after that period of time, the assessment was marked as

275 missing. During the entire study, participants could contact a researcher on the team to resolve  
276 technical issues.

277 At the end of the study, participants were invited to return to the laboratory for a debriefing  
278 session. Participants who replied to at least 65% of the total EMA assessments received a  
279 monetary remuneration of 10 euros.

#### 280 *2.4 Statistical analyses*

281 The datasets of the analyses and the R code are contained in an open-access file available on  
282 the OSF website at <https://doi.org/10.17605/OSF.IO/TEUBR>. The data analytic strategy  
283 followed three steps that are similar to the steps found in previous ecological momentary  
284 assessment studies on reciprocal influences between emotions and actions (29,36,53).

285 In an initial data preparation step, all the variables of interest were person-mean-centred to  
286 enable the examination of within-individual processes. Then, to analyse the relationships  
287 between variables assessed at two consecutive time points ( $t_0$  and  $t_1$ ), data were lagged. This  
288 meant deleting assessments that were not directly preceded or followed by another completed  
289 assessment ( $n=558$ ). Consequently, each row of the data frame analysed contained participants'  
290 responses to two consecutive assessments (see the 'Data.csv' file at  
291 <https://doi.org/10.17605/OSF.IO/TEUBR>).

292 The first aim of the study was to examine the effect of the PE felt at a given time on the  
293 subsequent implementation of positive strategies. To this end, a series of linear mixed-effects  
294 models containing one random intercept per participant were estimated using maximum  
295 likelihood with the R lmerTest package (54). Linear mixed-effects models were computed to  
296 take into account the hierarchical nature of the data. In this step, six models were computed  
297 (i.e., one per strategy). The dependent variable entered in each model was the change in the

298 strategy of interest from t0 to t1, whereas the main independent variable was PE at t0. Two  
299 other independent variables were also included to neutralize their possible confounding effects:  
300 the use of each strategy at t0 and PE at t1. PE at t1 was included as a control variable. Not  
301 controlling for PE at t1 could produce a biased estimation of the effect of PE at t0 on the  
302 subsequent implementation of emotion regulation strategies. As PE at t1 was related to PE at  
303 t0 and strategy changes from t0 to t1, it could represent a confounding variable when attempting  
304 to determine the specific relationship between PE at t0 and strategy changes from t0 to t1.  
305 Therefore, to ensure that the effect of PE at t0 on strategy changes from t0 to t1 was not actually  
306 explained by PE at t1's relationships with both variables, we controlled for PE at t1

307 The second aim of the study was to examine the effect of positive emotion regulation strategies  
308 on subsequent PE level. To this end, one linear mixed-effects model was computed that  
309 contained PE at t1 as the dependent variable and change in the use of each strategy from t0 to  
310 t1 as independent variables. PE at t0 was also included as a control variable to neutralize the  
311 so-called regression towards the mean effect. Taken together, the analyses conducted to explore  
312 the first and second objectives of this study made it possible to analyse similar phenomena to  
313 those analysed in previous studies on reciprocal influences between emotions and actions in  
314 everyday life without resorting to their semi-retrospective assessment of strategy use (i.e., the  
315 effect of emotions at one time on the actions occurring between this time and a following time,  
316 and the effect of the actions performed within this time interval on concurrent emotional  
317 changes (e.g., 28,35,43)).

318 The third aim of the study was to explore whether the relationships between PE and positive  
319 emotion regulation significantly changed depending on strategy category. To this end, the  
320 dataset on which our analyses were based was restructured to obtain a data frame where each  
321 row contained a participant's responses to two consecutive assessments for one strategy

322 category. In this restructured data frame, each pair of consecutive assessments completed  
323 consisted of three rows (one for the intensity of the use of attentional deployment strategies,  
324 one for the intensity of the use of cognitive change strategies and one for the intensity of the  
325 use of response modulation strategies; see the ‘Data\_ST.csv’ file at  
326 <https://doi.org/10.17605/OSF.IO/TEUBR>). Then, the two types of linear mixed-effects models  
327 mentioned for the first and second aims of the study were computed again, but with slight  
328 modifications. A first model was designed to examine whether the effect of PE at t0 on the  
329 change in strategy use depended on the category of the strategy considered. The dependent  
330 variable was change in strategy use from t0 to t1, whereas the independent variables were PE  
331 at t0 and the interaction with the strategy category (i.e., a categorical variable with three  
332 modalities: attentional deployment, cognitive change, response modulation), with PE at t1 as a  
333 control variable. A second model was designed to examine the effects of change in strategy use  
334 on subsequent PE depending on the category of strategy considered. This model included PE  
335 at t1 as the dependent variable, whereas the independent variables were change in strategy  
336 intensity, its interaction with the strategy category, and PE at t0.

### 337 **3. RESULTS**

#### 338 *3.1 The influence of experienced positive emotions on positive emotion regulation*

339 Descriptive statistics are shown in **Table 1**. They provide an initial general overview of the  
340 association between PE and positive emotion regulation.

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**Table 1:** Correlations between emotion regulation and PE at the within-individual level. Means and standard deviations were computed on raw variables. Categories were obtained by averaging strategies in the following way: mindfulness and stimulus control for ‘attentional deployment’, broadening and counting blessings for ‘cognitive change’, and emotion expression and sharing for ‘response modulation’. (PE: positive emotions)

	<i>M</i> ( <i>SD</i> )	1	2	3	4	5	6	7	8	9
1. PE	2.77 (0.97)	1.00								
STRATEGIES										
2. Mindfulness: <i>I'm trying to be focused on the present and concentrate on how good I feel</i>	56.34 (27.06)	.538***	1.00							
3. Stimulus control: <i>I'm trying to avoid all negative thoughts and stressors in order to focus and make the most of my positive emotions</i>	52.5 (28.89)	.400***	.556***	1.00						
4. Broadening: <i>I'm thinking about all the good things I have and that are happening in my life as well</i>	51.65 (28.96)	.489***	.601***	.565***	1.00					
5. Counting blessings: <i>I'm thinking about how lucky I am to live in this moment and feel so good</i>	51.35 (29.02)	.504***	.625***	.558***	.732***	1.00				
6. Emotion expression: <i>I'm trying to express and emphasize my emotions on the outside by showing them</i>	46.95 (30.39)	.422***	.462***	.368***	.474***	.463***	1.00			
7. Sharing: <i>I'm sharing my positive emotions with other people, for example, with my friends, partner, and/or family</i>	44.59 (31.98)	.406***	.422***	.377***	.468***	.452***	.630***	1.00		
CATEGORIES										
8. Attentional deployment	54.43 (25.93)	.520***	.854***	.891***	.646***	.650***	.454***	.444***	1.00	
9. Cognitive change	51.51 (28.03)	.527***	.653***	.591***	.923***	.931***	.497***	.489***	.686***	1.00
10. Response modulation	45.81 (29.57)	.454***	.487***	.409***	.514***	.500***	.896***	.899***	.494***	.539***

\* $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

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347 The first aim of the study was to explore the effects of PE on positive emotion regulation. In a  
348 series of linear mixed-effects models (**Table 2**), we therefore examined how PE at t0 influenced  
349 changes in each of the strategies at t1, controlling for the use of each strategy at t0 and for PE  
350 at t1.

351 Results showed that the effects were all negative and significant. In other words, the less  
352 individuals felt positive emotions at t0, the more they tended to enhance the use of mindfulness  
353 ( $b = -0.16$ ,  $SE = 0.023$ ,  $p < 0.001$ ), stimulus control ( $b = -0.105$ ,  $SE = 0.025$ ,  $p < 0.001$ ),  
354 broadening ( $b = -0.075$ ,  $SE = 0.024$ ,  $p < 0.01$ ), counting blessings ( $b = -0.124$ ,  $SE = 0.023$ ,  $p <$   
355  $0.001$ ), emotion expression ( $b = -0.0647$ ,  $SE = 0.025$ ,  $p < 0.01$ ), and sharing ( $b = -0.069$ ,  $SE =$   
356  $0.025$ ,  $p < 0.01$ ) from this time to the next. Therefore, our results seem to confirm the hypothesis  
357 postulated by the hedonic flexibility principle, suggesting that the experience of low PE is  
358 likely to motivate individuals to subsequently increase the use of positive strategies in order to  
359 upregulate positive emotional states.

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**Table 2:** Results of the six linear mixed-effects models predicting change in strategy use from PE at t0. (PE: positive emotions)

	<i>Change in Mindfulness</i>		<i>Change in Stimulus control</i>		<i>Change in Broadening</i>		<i>Change in Counting blessings</i>		<i>Change in Emotion expression</i>		<i>Change in Sharing</i>	
	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>
FIXED EFFECTS												
PE (t0)	-.16***	.023	-.11***	.025	-.075**	.023	-.124***	.023	-.065**	.025	-.069**	.025
Mindfulness (t0)	-.082**	.025	.038	.027	.054*	.026	.020	.026	.051	.027	.029	.028
Stimulus control (t0)	.012	.023	-.067**	.025	.043	.024	.024	.023	.004	.025	.029	.025
Broadening (t0)	.069*	.028	.024	.03	-.14***	.028	.096***	.028	.027	.031	.0097	.031
Counting blessings (t0)	.034	.028	.032	.031	.04	.029	-.124***	.029	-.019	.03	-.014	.031
Emotion expression (t0)	.038	.023	-.007	.025	.051*	.024	.025	.024	-.072**	.025	-.018	.025
Sharing (t0)	.014	.023	.023	.025	-.016	.024	.027	.024	.054*	.025	-.034	.025
PE (t1)	.55***	.019	.40***	.02	.48***	.019	.502***	.019	.044***	.02	.041***	.025

\* $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

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372 **3.2 The influence of positive emotion regulation on experienced positive emotions**

373 The second aim of the study was to explore the emotional outcomes of positive emotion  
 374 regulation. We hypothesized that strategy change at t0 would predict PE at t1 and, more  
 375 specifically, that an increase in the use of positive strategies would be associated with a greater  
 376 experience of PE in the subsequent assessment.

377 To test this hypothesis, a linear mixed-effects model was performed that included PE at t1 as  
 378 the dependent variable (**Table 3**). Confirming our hypothesis, all the strategies were found to  
 379 predict PE positively at t1, and, thus, an increase in the use of positive strategies at one time  
 380 enhanced the experience of PE in the subsequent assessment (mindfulness:  $b = 0.284$ ,  $SE =$   
 381  $0.024$ ,  $p < 0.001$ ; stimulus control:  $b = 0.046$ ,  $SE = 0.021$ ,  $p < 0.05$ ; broadening:  $b = 0.093$ ,  $SE =$   
 382  $0.026$ ,  $p < 0.001$ ; counting blessings:  $b = 0.125$ ,  $SE = 0.025$ ,  $p < 0.001$ ; emotion expression:  
 383  $b = 0.192$ ,  $SE = 0.022$ ,  $p < 0.001$ ; sharing:  $b = 0.093$ ,  $SE = 0.022$ ,  $p < 0.001$ ), controlling for  
 384 PE at t0 ( $b = 0.21$ ,  $SE = 0.016$ ,  $p < .001$ ).

385

386 **Table 3:** Results of the linear mixed-effect model predicting PE at t1 from change in the use of each  
 387 strategy at t0. (PE=positive emotions)  
 388

	<i>PE (t1)</i>			
	<i>b</i>	<i>SE</i>	<i>df</i>	<i>t</i>
FIXED EFFECTS				
Change in mindfulness	0.284***	0.024	2168	12.66
Change in stimulus control	0.046*	0.021	2168	2.12
Change in broadening	0.093***	0.026	2168	3.73
Change in counting blessings	0.125***	0.025	2168	4.87
Change in emotion expression	0.192***	0.022	2168	5.47
Change in sharing	0.093***	0.022	2168	4.27
PE (t0)	0.21***	0.016	2168	12.85

389 \* $p < .05$ , \*\*  $p < .01$ , \*\*\* $p < .001$

390

391 **3.3 The moderating role of strategy category**

392 Finally, we explored whether the association between PE and positive emotion regulation

393 significantly changed depending on the strategy category. A first linear mixed-effects model  
 394 investigated whether the strategy category affected the impact of PE at t0 on strategy use at t1  
 395 (**Table 4**). However, no significant interactions were observed.

396  
 397 **Table 4:** Results of the linear mixed-effect model predicting the effect of positive emotions at t0 on  
 398 change in strategy intensity at t1, moderated by strategy category. Attentional deployment represents  
 399 the reference group. (PE: positive emotions)  
 400

	<i>Change in use intensity (t1)</i>			
	<i>b</i>	<i>SE</i>	<i>df</i>	<i>t</i>
FIXED EFFECTS				
PE (t0)	-.174***	.019	6546	-9.31
Cognitive change (vs. attentional deployment)	-.103***	.024	6546	-4.29
Response modulation (vs. attentional deployment)	-.283***	.025	6546	-11.53
Strategy intensity (t0)	-.010	.011	6546	-.91
PE (t1)	.464***	.011	6546	43.37
PE (t0) * Cognitive change (vs. attentional deployment)	.028	.025	6546	1.13
PE (t0) * Response modulation (vs. attentional deployment)	.045	.025	6546	1.83

\* $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

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 402

403 We then examined whether the strategy category influenced the effect of change in strategy  
 404 use on subsequent levels of PE (**Table 5**).

405 **Table 5:** Results of the linear mixed-effect model predicting the effect of change in strategy use  
 406 intensity at t0 on PE at t1, moderated by strategy category. Attentional deployment represents the  
 407 reference group. (PE: positive emotions)  
 408

	<i>PE (t1)</i>			
	<i>b</i>	<i>SE</i>	<i>df</i>	<i>t</i>
FIXED EFFECTS				
Change in use intensity (t1)	.564***	.021	6486.91	26.89
Cognitive change (vs. attentional deployment)	.058*	.025	6439.02	2.36
Response modulation (vs. attentional deployment)	.132***	.024	6440.36	5.33
PE (t0)	.252***	.01	6538.48	4.06
Change in use intensity (t1) * Cognitive change (vs. attentional deployment)	-.054	.029	6524.83	-1.89
Change in use intensity (t1) * Response modulation (vs. attentional deployment)	-.161***	.027	5933.7	-5.92

\* $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

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411 Interestingly, results revealed that the strategy category moderated the association between the  
 412 change in strategy use and PE. More specifically, there was a significant interaction between

413 change in strategy use and response modulation ( $b = -0.161, SE = .027, p < .001$ ) and a close-  
414 to-significant trend in the interaction between change in strategy intensity and cognitive change  
415 ( $b = -0.054, SE = .027, p = .059$ ). As **Figure 1** shows, the use of response modulation strategies  
416 to enhance PE was significantly less effective than the adoption of attentional deployment  
417 strategies.

418

419 **Figure 1:** Graphical representation of the effect of change in strategy use on subsequent positive  
420 emotions, moderated by strategy category (PE=positive emotions)

421

#### 422 **4. DISCUSSION**

423 To date, although the use of strategies to regulate negative emotions has been extensively  
424 explored, the regulation of positive emotional states in everyday life has received little  
425 attention. The aim of the current study was to deepen our knowledge about PE and its  
426 underlying regulatory mechanisms. Overall, we showed that PE determines positive emotion  
427 regulation, which in turn affects subsequent levels of PE, thus confirming the existence of a  
428 reciprocal influence between momentary PE and positive emotion regulation.

429 The first aim of the study was to explore the effects of PE on positive emotion regulation. The  
430 results showed that PE at  $t_0$  significantly predicted positive emotion regulation at  $t_1$  and, more  
431 specifically, that the less individuals felt PE at one time ( $t_0$ ), the more they tended to increase  
432 the use of positive strategies from this point to the next (from  $t_0$  to  $t_1$ ). Experiencing low levels  
433 of PE is, therefore, likely to shift one's efforts towards implementing strategies to reach a more  
434 positive emotional state. These findings are consistent with the hedonic flexibility principle  
435 (35,36), suggesting that individuals are likely to be motivated to upregulate PE as a  
436 consequence of low momentary affect. This regulatory mechanism might be seen as a highly  
437 adaptive process that can compensate for the lack of PE through an increased use of positive

438 strategies, regardless of their nature (i.e., attentional, cognitive or behavioural). Moreover, the  
439 findings of the present study might also be understood in light of the affective baseline theory  
440 (55), which postulates the existence of a baseline functioning of an individual's affective  
441 system. According to this theory, although fluctuations around the home-base are the natural  
442 consequence of internal and external life events, affect is constantly brought back to the  
443 baseline by an attractive component consisting of regulatory mechanisms. Thus, the experience  
444 of low PE might encourage individuals to implement strategies that induce a return to the  
445 baseline, which has been shown to be defined by a slightly positive valence (56).

446 In spite of being coherent with the hedonic theories, our results diverge from previous studies  
447 that showed increased implementation of positive strategies as a consequence of high levels of  
448 positive emotions (18,29,53). A possible explanation for these divergent results might be found  
449 in the EMA design. All the previous studies adopted a momentary evaluation of the emotional  
450 state but a retrospective assessment of emotion regulation, asking participants to rate the  
451 strategies used since the last prompt (i.e., in the previous few hours). Thus, when analysing the  
452 effect of emotions at one point on subsequent strategy use, emotion regulation strategies were  
453 closer in time to the emotions than in our study, which assessed emotion regulation at exactly  
454 the same time as PE. In fact, there is evidence showing that soon after an emotion, mood-  
455 congruent processes take place, whereas mood-incongruent processes tend to follow (57).  
456 Furthermore, the two theories suggested by the previous literature could be reconciled. The  
457 broaden-and-build theory states that the experience of PE encourages the building of adaptive  
458 resources and boosts the creation of coping skills, which in turn foster well-being. Accordingly,  
459 this 'resource-building process' might involve mechanisms that help to enhance affect when  
460 experiencing low PE and maintain a positive mood (i.e., consistent with hedonic theories),  
461 which in turn would promote psychological well-being and resilience in the long term.

462 The second aim of the study was to explore the unique emotional outcomes of positive emotion  
463 regulation. Confirming our hypothesis, an increase in the use of all six strategies resulted in  
464 enhanced PE in the subsequent assessment. In previous studies, trait savoring was found to be  
465 associated with greater happiness and well-being (20), whereas state savoring was shown to  
466 predict increased positive emotions (21). Therefore, these results are consistent with the  
467 previous literature and support the adaptive role of positive emotion regulation in emotional  
468 well-being.

469 Finally, our third aim was to investigate whether the reciprocal influence between PE and  
470 positive emotion regulation changed significantly depending on the intrinsic nature of the  
471 strategies. The results showed that the strategy category significantly moderated the association  
472 between the change in strategy use and subsequent PE. More specifically, the use of response  
473 modulation strategies (e.g., sharing and emotional expression) was significantly less effective  
474 than the adoption of attentional deployment strategies and produced a less important increase  
475 in subsequent PE. Sharing positive experiences has been shown to improve one's perception  
476 in the eyes of others, leading to increased self-esteem (58) and life satisfaction (20). This  
477 strategy might, therefore, indirectly increase PE by mainly targeting other dimensions of an  
478 individual's well-being. Furthermore, the benefits of sharing have been shown to depend on  
479 how the recipient responds to the news (actively/constructively or passively/destructively)  
480 (58), which could further justify the mitigated effects of this strategy on momentary PE found  
481 in our study. In contrast, emotional expression refers to the verbal or nonverbal expression of  
482 an ongoing emotion (59), which makes it possible to rapidly and adaptively react to  
483 environmental threats and opportunities (60). Emotional expression may foster PE, especially  
484 in the short term (i.e., soon after the emotion is produced), thus showing reduced effects in the  
485 long term. As suggested in a previous study (20), positive emotion regulation might not only  
486 increase only PE. Instead, each strategy may target different dimensions of the person's

487 emotional well-being, thus involving different emotional outcomes. However, further studies  
488 are needed to disentangle the unique emotional consequences of positive emotion regulation.

489 Although this study sheds new light on the mechanisms underlying the experience of PE, we  
490 acknowledge several limitations that could be addressed by future research.

491 First, our study involved a sample of 85 healthy undergraduate individuals. Future studies are  
492 needed to explore the reciprocal influence between PE and positive emotion regulation in a  
493 more diverse sample.

494 Second, we excluded participants who presented moderate-to-severe depressive symptoms. It  
495 is possible that the patterns observed in the present study cannot be extended to samples of  
496 patients suffering from an emotional disorder (61), who are typically prone to dampening rather  
497 than savoring PE (48,49). Reasonably, an abnormal functioning of this mechanism might be  
498 observed in this population, which could be defined by a lack of motivation or capacity to  
499 implement positive strategies despite experiencing low PE, or by reduced efficacy in using  
500 positive strategies to increase PE levels. Future studies should confirm this hypothesis.

501 Third, our study specifically focused on PE, without studying the role of negative affect on  
502 positive emotion regulation. A growing body of evidence shows that positive and negative  
503 affect do not lie on opposite ends of a bipolar scale; instead, they can be experienced  
504 simultaneously (62,63). In our study, we found that the experience of low PE was associated  
505 with a greater use of positive strategies, which might suggest that upregulating PE also serves  
506 as a mechanism to repair mood (64). Nevertheless, the absence of a variable assessing  
507 momentary negative emotions keeps us from confirming this hypothesis, which should be  
508 addressed in future studies.

509 Fourth, the daily EMA included the assessment of only six positive strategies. On the one hand,



510 there is evidence that people's repertoire for dealing with PE includes a wider range of  
511 strategies that were not explored in this study (65). On the other hand, the use of maladaptive  
512 strategies in response to positive states (e.g., dampening) was not taken into consideration, thus  
513 limiting the findings of the present study to the mechanisms underlying the upregulation of PE.

514 Finally, the use of ad hoc single items to assess a multifaceted construct such as emotion  
515 regulation might not fully capture the complexity of this process. In addition to the fact that the  
516 use of ad hoc items is common in EMA studies (see for example, 25,30,32,38), the validated  
517 questionnaires available to assess positive emotion regulation mainly measure an individual's  
518 tendency to savour positive emotions (see for example (11,66,67)), rather than measuring to  
519 what extent specific strategies are adopted in response to a specific stimulus (e.g., state emotion  
520 regulation). The lack of validated measures for the assessment of momentary positive  
521 regulation led us to create our own single items. Moreover, there is evidence that long EMA  
522 questionnaires usually lead to higher perceived burden (68), which further supports the decision  
523 to include only a few items to assess emotion regulation. Indeed, the inclusion of a broader set  
524 of items could have resulted in decreased compliance and increased participant burden, thus  
525 affecting the quality of the data collected. As Trull and Ebner-Premier (69) recently stated,  
526 EMA is still a field with several methodological aspects that remain unclear. Accordingly, there  
527 is the need to expand and improve this research field further by, for instance, creating validated  
528 measures to be used in EMA designs or developing rigorous guidelines that guides researchers  
529 in the design of EMA studies.

530 Despite these limitations, our research adds to the previous literature by extending our  
531 knowledge about PE and the underlying regulatory mechanisms. More specifically, we showed  
532 that low levels of PE determine an increase in the use of strategies to upregulate PE, which in  
533 turn results in a better mood.

534 Although further studies are needed to confirm these findings, our study sheds new light on the  
535 importance of PE for emotional well-being, and it opens up new avenues to understand the  
536 dysfunctional regulation of positive emotional states in emotional disorders.

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### 540 **DATA AVAILABILITY STATEMENT**

541 The data supporting the findings of this study are openly available in OSF at  
542 <https://doi.org/10.17605/OSF.IO/TEUBR>.

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