

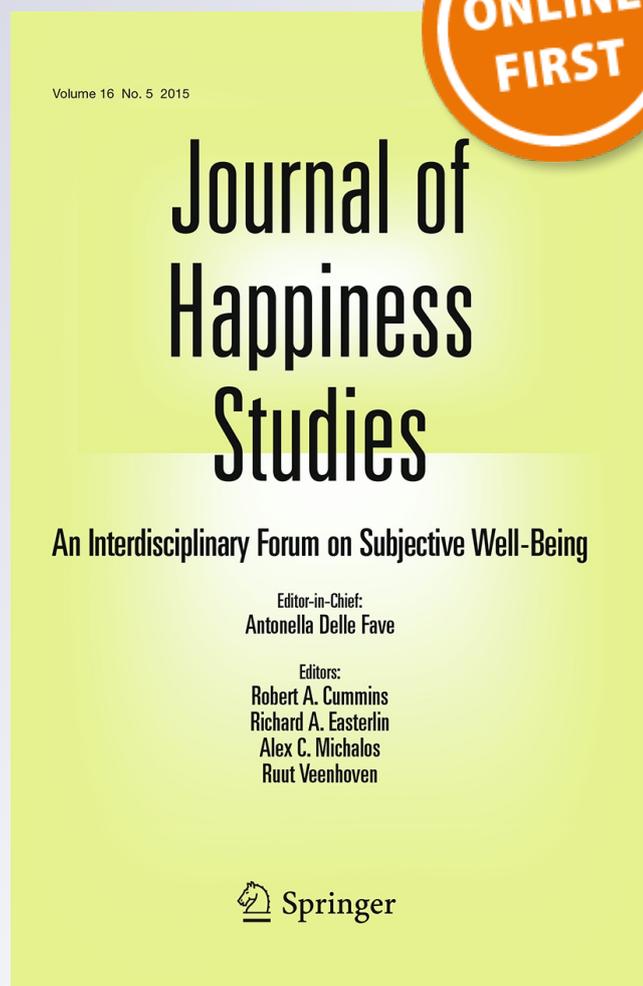
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Affect and Affect Regulation Strategies Reciprocally Influence Each Other in Daily Life: The Case of Positive Reappraisal, Problem-Focused Coping, Appreciation and Rumination

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Abstract Feelings of positive or negative affect are not restricted to temporary states. They can also determine future affective experiences, by influencing the building of an individual's personal resources. The present study was designed to understand the daily fluctuations in positive and negative affect more fully. To this end, we examined the involvement of a variety of affect regulation strategies in these fluctuations. The affect regulation strategies we explored included positive reappraisal, problem-focused coping, appreciation and rumination. We adopted an experience sampling method, consisting of five daily assessments over a 2-week period. As expected, within a few hours of experiencing more positive affect, participants engaged in greater positive reappraisal, problem-focused coping and appreciation. In turn, greater use of each of these three strategies was followed by more intense experiences of positive affect. We observed analogous reciprocal influences between rumination and the experience of negative affect, within the same time interval. Changes in affective experience over several hours were also directly influenced by concurrent use of these strategies. More specifically, greater positive reappraisal, problem-focused coping and appreciation accelerated the rise in positive affect that follows low feelings of positive affect, and slowed the decline in positive affect that follows high feelings. Rumination had an analogous influence on change in negative affect. The clinical implications of these findings are discussed.

Keywords Affective fluctuation · Positive affect · Negative affect · Affect regulation · Affect regulation strategies

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1 Introduction

The experience of positive and negative affect represents an important component of human flourishing. It constitutes the affective aspect of wellbeing, and is therefore associated with overall life satisfaction judgments (Diener et al. 1999). Moreover, analysis of affective fluctuations over time reveals that valenced affective experiences are not restricted to temporary pleasant or unpleasant states. Rather, current feelings of positive and negative affect have been shown to determine future experiences of positive and negative affect, be it just a day later or as long as 2 years later (e.g., Headey and Wearing 1989; Pettersson et al. 2013). The adaptive function of affective valence is one possible explanation for this remarkable phenomenon (Fredrickson 1998, 2001). The momentary experience of positive affect is thought to broaden our thought-action repertoire, enabling us to build personal resources that can have a decisive impact on our future experiences of positive affect. Conversely, momentary experiences of negative affect are believed to narrow the scope of our cognition and behaviour, dismantling our resources, and giving rise to fresh experiences of negative affect.

The building of affect regulation, a resource that has a decisive effect on affective experiences, may depend on momentary feelings of positive and negative affect. Broadened cognition and behaviour may facilitate the modification of an adverse environment through direct actions, the generation of alternative ways of reappraising a painful situation, or even the creation of a positive connection to various aspects of the environment, three affect regulation strategies believed to trigger feelings of positive affect. By the same token, narrowed cognition and behaviour may increase the inclination to dwell on the same idea or event, a strategy thought to increase negative affect experiences. Consistent with this, when Burns et al. (2008) and Fredrickson and Joiner (2002) conducted two assessments more than a month apart, they found that feelings of positive affect and the implementation of particular affect regulation strategies reciprocally influenced each other. However, to the best of our knowledge, the involvement of affect regulation resources in shorter-term affective fluctuations has received little attention. This lack of interest deserves to be remedied, insofar as the acquisition of lasting resources may rely on the accumulation of short-term advances (Fitzpatrick and Stalikas 2008).

The present study was designed to increase our knowledge of the natural relationships between previous and subsequent affective experiences in daily life. To this end, we considered the involvement of affect regulation in these relationships, within intervals of no more than a few hours. More specifically, we addressed the question of whether reciprocal influences between the experience of positive or negative affect and the implementation of affect regulation strategies known to impact affective valence can be observed within such short intervals. We further examined the particular way in which affective valence influences the subsequent use of such strategies, and the particular way in which strategy use influences subsequent affective valence.

1.1 Affective Valence Fluctuations

In this paper, we used *affect* as an umbrella term for all affective states, including emotions and moods (Mikolajczak et al. 2009). On this basis, *emotions* are viewed as very short episodes of affect, and *moods* as more lasting ones. We focused more specifically on valence, characterizing affective states according to whether they are pleasant (positive) or unpleasant (negative; Yik et al. 2011). Thus, the term *affective valence* referred to the

experience of positive or negative affect (Yik et al. 2011), while the term *affective well-being* referred to an intense experience of positive affect and/or a nonintense experience of negative affect (Diener et al. 1999).

One of the main characteristics of affective valence is its variation over time (Congard et al. 2011; Kuppens et al. 2010). Initial evidence suggests that we each have a baseline level of positive and negative affect, mainly determined by our genes (Braungart et al. 1992), our personality (DeNeve and Cooper 1998) and our life history (Jeronimus et al. 2013). Positive and negative affect experiences fluctuate around this baseline, as a function of the events we encounter (Lazarus and Folkman 1984; Lyubomirsky et al. 2006). Once triggered, instead of remaining stationary, these affective experiences tend to be drawn back to their baseline by an attractor strength consisting of regulation mechanisms (Congard et al. 2011; Headey and Wearing 1989; Kuppens et al. 2010). Thus, intense affective feelings are generally followed by a decline in affective intensity, whereas weak affective feelings are followed by a rise in intensity. Interestingly, despite this attractor strength, affective experiences are by no means purely temporary, and devoid of influence on future experiences. On the contrary, one of the most remarkable findings pertaining to affective valence is that the more positive or negative affect a person feels at a particular time, the more he or she will feel positive or negative affect in the future. This has been observed for intervals not just of a day (Pettersson et al. 2013), but also of several weeks (Burns et al. 2008) and even years (Headey and Wearing 1989).

The mechanisms underpinning the relationship between previous and subsequent affective experiences are now starting to be unravelled. Focusing on the adaptive function of affective valence, the broaden-and-build theory (Fredrickson 1998, 2001) states that the opposite functions that positive and negative affect have taken on in the course of evolution either enable or disable the building of resources believed to play a key role in future affective experiences. This theory focuses specifically on momentary affective experiences (i.e., emotions). However, as valence characterizes all affective states, the proposed mechanisms probably operate in all of them. The adaptive function assigned to negative affect in this theory is the narrowing of the thought-action repertoire in order to deal more effectively with immediate and precise adverse events. This narrowing mechanism is thought to impact attention first, accelerating the identification of these adverse events. For instance, feeling anxiety focuses attention on threats (Matthews and Wells 2000), while feeling negative affect triggers local information processing (Gasper and Clore 2002). The narrowing mechanism related to a momentary experience of negative affect is also thought to influence behaviour, favouring actions that enable individuals to respond to the identified adversity, by stimulating the skills required to fight or flight. This is particularly observable for fear (Hamilton 1989). Thus, feeling negative affect appears to be helpful in adverse situations. However, this narrowing of cognition and behaviour can make it difficult to build some resources. For example, individuals who chronically experience intense or frequent negative affect are in poorer physical health and are more dissatisfied with their social relationships than their peers who experience this type of affect less intensely or frequently (Finch et al. 2012; Lopes et al. 2003). In turn, the lack of resources may engender fresh experiences of negative affect.

The adaptive function assigned to positive affect in the broaden-and-build theory contrasts with the one assigned to negative affect. Fredrickson (1998, 2001) argues that feeling positive affect momentarily broadens individuals' thought-action repertoire, encouraging them to explore their environment, discover new ways of assessing situations, and fruitfully integrate their past experiences. Thus, numerous psychological phenomena associated with the experience of positive affect, including enhanced creativity (Davis

2009), cognitive flexibility (Tsai et al. 2014), and global information processing (Gasper and Clore 2002), may simply be features of the broadening process that follows a feeling of positive affect. We can surmise that this momentarily broadened functioning engenders the building of resources that can be mobilized to cope with future adversities. That is probably why feeling positive affect tends to promote better mental and physical health (Lyubomirsky et al. 2005). This resource building may explain why current feelings of positive affect influence future experiences of positive affect.

One of the resources that may be impacted by these narrowing and broadening processes is affect regulation, which strongly contributes to subsequent affective valence (see Mikolajczak et al. 2009, for a review). Consistent with this, when Burns et al. (2008) and Fredrickson and Joiner (2002) carried out two assessments 8 and 5 weeks apart, respectively, they found that some so-called broadminded affect regulation strategies were involved in positive affect change. In the following section, we describe our strategy-based perspective on affect regulation, as well as the precise affect regulation strategies we decided to explore, before explaining why we assumed these strategies to be triggered by previous affective experiences.

1.2 Affect Regulation and Its Impact on Affective Valence

Affect regulation covers the whole gamut of processes that individuals implement to modify and control their affect (Mikolajczak et al. 2009). The extent to which it enables individuals to achieve affective goals (e.g., being happier) and/or fulfil basic needs (e.g., protecting their health) depends mostly on which strategies are used, more or less consciously. We chose to focus on four affect regulation strategies that strongly influence affective valence, namely positive reappraisal, problem-focused coping, appreciation and rumination. The influence of the first three on affective valence is shown to depend mostly on their impact on positive affect, while the influence of the last one is thought to depend mostly on its impact on negative affect. We chose these four strategies because, as we explain later, their implementation appears to be particularly sensitive to broadening or narrowing mechanisms.

Positive reappraisal consists in reframing negative events by focusing on their positive features. More specifically, it is a strategy whereby negative events are reappraised as being partly beneficial and meaningful (Folkman 1997). Its potential impact on affective valence has been identified in various settings. In a laboratory study, for instance, implementation of positive reappraisal while watching films eliciting sadness or disgust resulted in an enhanced positive affective experience, compared with situations in which either detached reappraisal or no strategy was implemented (Shiota and Levenson 2012). Its influence has also been observed in reaction to stressful life events. For example, when participants are asked to think about a recent stressful event, their use of positive reappraisal brings about a significantly larger increase in their experience of positive affect, compared with their use of strategies such as acceptance (Rood et al. 2012). Furthermore, positive reappraisal seems to protect against the onset of affective disorders characterized by excessive experiences of negative affect (Garnefski et al. 2002).

Problem-focused coping consists in taking action to change the situation from which affect is derived. Instead of modifying the appraisal of a situation, it involves either altering the situation itself, or establishing an action plan for this purpose (Aldwin and Revenson 1987). Problem-focused coping is regarded as a way of responding to stressful events. For example, its implementation over a period characterized by intense stress (e.g., the period surrounding the diagnosis of a serious illness) has been shown to increase the

positive affect experienced not only during this period, but also several months later (Lowe et al. 2000). More generally, the more individuals use problem-focused coping, the less they appear to experience a variety of psychopathological symptoms, including depression (Aldwin and Revenson 1987; Billings and Moos 1984). Like positive reappraisal, problem-focused coping appears to guard against the onset of affective disorders (Billings and Moos 1984).

Appreciation consists of the initiative to focus on and savour those aspects of life one might otherwise overlook or rush through (Seligman et al. 2006). It involves the construction of a more meaningful connection to the environment (Fagley 2012). Its implementation appears to influence affective valence. For example, when individuals are induced to watch a positive affect-eliciting film in a mindful way, they experience greater positive affect than individuals in a control condition (Erisman and Roemer 2010). Over the longer term, the tendency to show appreciation is associated with enhanced levels of positive affect and life satisfaction, even after controlling for the Big Five personality traits (Fagley 2012; Quoidbach et al. 2010). Finally, appreciation seems to decrease depressive symptoms when included in a positive psychotherapy (Seligman et al. 2006).

Rumination represents the generation of repetitive and passive thoughts about negative events or negative affect. These thoughts can encompass the current emotional state, as well as its possible causes and consequences (Nolen-Hoeksema 2000). Rumination impacts affective valence, by contributing to the intensification and maintenance of negative affect in both the short term (Nolen-Hoeksema and Morrow 1993; Nolen-Hoeksema et al. 1993) and the longer term. The tendency to ruminate has indeed been found to predict the onset of major depressive episodes, as well as depressive and anxious symptoms 1 year later (Nolen-Hoeksema 2000).

1.3 Affective Valence and Its Impact on Affect Regulation

Affective valence may not merely be a *consequence* of the implementation of positive reappraisal, problem-focused coping, appreciation and rumination. It may also *determine* the implementation of these strategies. Any investigation of the processes that underpin the use of these strategies therefore requires us to assume that their implementation depends, at least in part, on the broadening or narrowing influences that experiences of positive or negative affect exert on the scope of people's thoughts and actions.

First, broadened thoughts may facilitate the implementation of positive reappraisal, because the latter's use may rely on cognitive abilities that are enhanced by a broadening mechanism. More specifically, in order to use this strategy, individuals have to disengage from their initial appraisal, and generate alternative appraisals on which they successively focus. It therefore seems to require both cognitive flexibility (i.e., the ability to defocus attention from one stimulus and refocus it on another) and creativity (i.e., the ability to find various solutions to ill-defined problems). It should be recalled that cognitive flexibility and creativity have been empirically shown to be features of the broadened cognition stimulated by positive affect (Davis 2009; Tsai et al. 2014). Moreover, Fredrickson and Joiner (2002)'s study featuring two assessments 5 weeks apart provided empirical support for the idea that feeling positive affect can facilitate the implementation of positive reappraisal. We postulated that this can also occur within a far shorter timeframe, insofar as the broadening mechanism has been shown to rapidly follow a momentary experience of positive affect.

Second, the implementation of problem-focused coping may be facilitated by broadened thoughts and actions. Solving a problem involves generating a variety of solutions to it, and

then considering the effectiveness of each one (D'Zurilla and Nezu 1990). Once again, creativity and cognitive flexibility may prove helpful in this process. In addition, broadening the repertoire of actions may increase the propensity to implement these solutions through concrete actions. It is noteworthy that the more inclined individuals are to integrate pleasure into their lives, the more engaged they tend to be in a variety of activities (Peterson et al. 2005).

Third, appreciation also appears to involve cognitive flexibility and creativity, in that individuals have to disengage from their old habits in order to adopt a new perspective on life. De Rivera et al. (1989) were the first to provide evidence suggesting that the display of appreciation can follow an experience of positive affect. These authors asked participants to remember a situation in which they felt particular types of positive affect, and to report some of the tendencies that followed this feeling. Among other things, several individuals reported an inclination to appreciate the present, and more especially to momentarily feel a closer and more meaningful relationship with the environment.

Fourth and last, rumination emerges as a prototypical consequence of a narrowed thought-action repertoire. Engaging in ruminative thinking prevents individuals from allocating their focus other than to a past or present negative experience. At first glance, rumination-related thoughts appear to be aimed at solving the problem, insofar as they pertain to its meaning, causes and consequences. However, ruminating actually impairs problem-solving abilities and promotes passivity (Lyubomirsky et al. 1999). This contradiction can be accounted for by the narrowing of cognition and behaviour, as solving a problem requires individuals not only to focus on it, but also to identify various solutions and engage in the relevant behaviours, as mentioned above.

Importantly, the implementation of affect regulation strategies depends on more enduring phenomena than previous affective states. For example, life histories characterized by frequent failures of affect regulation, which tends to engender helplessness in this area, are known to influence people's current affect regulation behaviours (Mikulincer 1994). Nevertheless, in this article, we focused specifically on short-term influences on affect regulation.

1.4 The Present Study

The primary purpose of the present study was to better understand the influence of momentary experiences of positive and negative affect on subsequent affective experiences. To this end, we analysed the natural relationships that occur between affective experiences and affect regulation in daily life. As explained above, the influence of several affect regulation strategies on subsequent affective experience is well documented. By contrast, few studies have addressed the question of whether affective experience has an impact on the subsequent implementation of affect regulation strategies. The only two studies to have explored this issue so far featured two assessments carried out more than a month apart, and thus neglected short-term affective fluctuations (Burns et al. 2008; Fredrickson and Joiner 2002). We hypothesized that the experience of positive or negative affect and the implementation of affect regulation strategies such as positive reappraisal, problem-focused coping, appreciation and rumination, can reciprocally influence each other in the space of just a few hours. We decided to use an experience sampling method, on account of its ecological and temporal nature (Hektner et al. 2006). This consisted of five daily assessments over a 2-week period. As there was an interval of only a few hours between any two assessments, we were able to analyse short-term affective fluctuations. Assessments took place approximately every 3 h in the course of a day.

We formed two main hypotheses. Our first hypothesis was that positive affect experienced at a particular time would trigger the implementation of positive reappraisal, problem-focused coping and appreciation within just a few hours. Likewise, negative affect experienced at a particular time would rapidly trigger rumination. Furthermore, a precise consideration of broaden-and-build theory (Fredrickson 1998, 2001) led us to hypothesize that the experience of positive affect can have a nonlinear influence on the use of the three above-mentioned strategies. Whereas a broadening mechanism is thought to be triggered by a high level of positive affect, a lack of positive affect is not believed to trigger a narrowing mechanism. Accordingly, we hypothesized that the implementation of each of the three strategies would be encouraged by high feelings of positive affect, whereas low feelings of positive affect would have no influence on the use of these strategies. By the same token, whereas a narrowing mechanism is believed to be triggered by a high level of negative affect, a lack of negative affect is not supposed to trigger a broadening mechanism. We therefore expected to observe a similar pattern regarding the effect of feelings of negative affect on subsequent rumination.

Our second hypothesis was that the implementation of positive reappraisal, problem-focused coping and appreciation within a few hours would enhance the positive affect experienced at the end of this interval. Similarly, the use of rumination within a few hours would heighten the negative affect experienced at the end of this interval. Moreover, we predicted that the way positive and negative affect changed within the space of a few hours would reflect the degree to which the affect regulation strategies were concurrently implemented. More specifically, the use of positive reappraisal, problem-focused coping and appreciation would facilitate the rise in positive affect intensity that follows low feelings of positive affect, whereas it would slow its decline following high feelings. Similarly, intense rumination would facilitate the rise in negative affect intensity that follows low feelings of negative affect, whereas it would slow its decline following high feelings.

2 Method

2.1 Participants

The sample comprised 84 participants (63 % female) aged 12–80 years ($M = 44.26$, $SD = 18.35$). Participants were recruited via the experimenters' social networks. Most of them came from the French regions of Provence-Alpes-Côte-d'Azur, Brittany and Lorraine. Exclusion criteria were the diagnosis of a mental disorder associated with an affect regulation disability (i.e., anxiety disorders, mood disorders, eating disorders, depression and attention deficit hyperactivity disorder), and the display of alexithymia, as measured by the French version of the Toronto Alexithymia Scale (TAS; Bagby et al. 1994), validated in French by Loas et al. (1996). We did not collect any data about participants' socioeconomic status because, to the best of our knowledge, there are no findings showing that this variable can influence the relationships between affective experiences and the use of affect regulation strategies.

2.2 Procedure

The experimenter conducted an interview with each participant. Participants could choose whether to have a face-to-face or a telephone interview. In the first part of the interview,

after providing their informed consent (or the consent of a parent for adolescents), participants were asked to give basic information, such as their date of birth and telephone number. They were then asked to indicate two consecutive weeks when they would be available for the experience sampling. Together, the experimenter and each participant determined the times at which the five daily assessments would take place during this period. An interval of at least 2½ h and at most 3½ h between two assessments was required, but each person's schedule was also considered. The second part of the interview was used to determine the wording of the affect and affect regulation strategies on which participants would be assessed. Interindividual differences in labelling affective experience were taken into account. The experimenter used a technique designed to ensure that the affect he or she wanted to assess matched the participant's understanding of that affect. This technique drew on Nesselroade et al. (2007)'s work on how to tailor a construct to each individual, all the while leading all the individuals to assign the same core meaning to this construct. More specifically, for each affect the experimenter wanted to assess, a list of statements describing this affect was read out to each participant, who had to supply the adjective that best summarized them. A similar technique was used for the affect regulation strategies, but because it is difficult to reduce the use of such strategies to a single adjective, participants were asked to provide one short sentence. To avoid any misunderstanding, participants were then asked to express the meanings they assigned to each of the adjectives and short sentences they had given. All the adjectives and short sentences supplied by each participant were written on a card that he or she kept throughout the whole experience sampling period as a reminder.

The experience sampling phase lasted two consecutive weeks. Five times a day, participants received a text message on their mobile phone sent by a web server, to which they had to respond within 30 min, so that the different assessments were neither too close nor too far apart. On each occasion, participants were assessed on their current affective experience (through the list of adjectives written on their card) and the way they had regulated their affect since the last assessment (through the list of short sentences written on their card). The assessments were approximately 3 h apart. It should be noted that, for the first assessment of the day, as well as for assessments that directly followed one to which they had not responded, participants were explicitly assessed on the way they had regulated their affect for the previous 3 h. On average, participants responded to 84 % of the 70 text messages that were sent during the experience sampling period.

2.3 Material

2.3.1 Affect

A list of 12 kinds of affect inspired by the 12-point affect circumplex (12-PAC; Yik et al. 2011) model was used to assess the participants' affective experience. Five degrees of positive affect can be extracted from this model: highly activated, activated, neither activated nor deactivated, deactivated and highly deactivated. This model also distinguishes between five degrees of negative affect, again according to their arousal level. Finally, this model contains two neutrally valenced affects: one that is highly activated, and one that is highly deactivated. In each assessment, participants were asked to report the extent to which they currently experienced the 12 kinds of affect, on a Likert scale ranging from 1 (*not at all*) to 5 (*a lot*). An indicator of positive affect was calculated by averaging the scores for the five degrees of positive affect ($\alpha = .83$). Similarly, averaging the scores for the five degrees of negative affect yielded an indicator of negative affect ($\alpha = .86$). As

they were not relevant to this study, the scores for the two neutrally valenced affects were not considered. Our decision to analyse positive and negative affect separately was based on the theoretical framework that inspired the present study. The broaden-and-build theory (Fredrickson 1998, 2001) posits that positive and negative affect evolved separately and play different roles. More specifically, a narrowing process is thought to be triggered by high negative affect, but not by low positive affect. Conversely, a broadening process is assumed to be triggered by high positive affect, but not by low negative affect. Moreover, the factorial validity of our measure of positive and negative affect was not assessed by the tools that are usually used to gauge factorial validity. This was because of the difficulty of interpreting the results they yield when they are applied to repeated measures nested within individuals, a difficulty that has been highlighted for many decades (Cattell 1944). Instead, both of the indicators we used appeared to have good construct validity. As outlined below, the relationship between these indicators and those of strategy implementation was consistent with the results reported in the literature.

2.3.2 Affect Regulation Strategies

A list of seven affect regulation strategies was used to assess the way participants regulated their affect. This list included positive reappraisal, problem-focused coping, appreciation, rumination and three other strategies that are not relevant to this article (i.e., social support-focused coping, avoidance and expressive suppression). On the basis of our conceptualization of these three strategies, we deemed that their use is less sensitive to the change in creativity, flexibility, or global/local information processing that accompanies affective valence experiences. We therefore decided not to take them into account. The list of sentences that participants had to summarize contained items like “I tried to see what positive things a negative event can bring me” for positive reappraisal, “I established an action plan” for problem-focused coping, “I took the time to savour a moment of the day” for appreciation, and “I wasted time thinking of a past event again and again” for rumination. At each assessment, participants were asked to indicate the extent to which they had used each strategy since the last assessment, on a Likert scale ranging from 1 (*not at all*) to 5 (*a lot*). As regards the factorial and construct validity of this measure of strategy implementation, similar ideas to the ones developed for the factorial and construct validity of our measure of affective experience can be advanced.

2.4 Data Analysis Strategy

In order to test our hypotheses, we needed to organize the data collected from the assessments in a particular way. We therefore arranged these data to yield two times (T1 and T2) corresponding to two consecutive assessments. This resulted in the deletion of data for 13 % of the assessments to which participants responded, as these were not directly preceded or followed by a completed assessment. Consequently, the analyses reported below were performed on data collected from 4283 assessments to which participants responded, representing 74 % of the total number of assessments to which they could have responded. It should be noted that T1 and T2 were relative. For example, the second assessment that took place at midday for the first participant was T2 in relation to the first assessment that took place at 9 am, but T1 in relation to the third assessment that took place at 3 pm. Considering the data collected from two consecutive assessments allowed us to focus on three kinds of data corresponding to three successive times. The first kind related to affect experienced at T1, labelled *TIPA* for positive affect and *TINA* for negative

affect. The second kind related to strategies used between T1 and T2, referred to as *T1–T2 PR* for positive reappraisal, *T1–T2 PFC* for problem-focused coping, *T1–T2 App* for appreciation and *T1–T2 Rum* for rumination. The third and final kind related to affect experienced at T2 (*T2PA* and *T2NA*).

We used the method of generalized estimating equations (GEE; Liang and Zeger 1986) to test our hypotheses. These are designed to analyse longitudinal repeated-measures data, similarly to mixed-effects models. GEEs were used in this study because they make it possible to draw inferences by considering not only variations in affective experience over time within individuals, but also variations in affective experience between individuals (Liang and Zeger 1986). Mixed-effects models were used when we only required inferences at the within-individual level, as they neutralize interindividual differences.

Finally, in order to control for the effect of potential confounding variables, we included age and sex in the predictor variables of all the models described below.¹ We paid particular attention to age, as there are empirical findings about its moderating influence on relationships between affect and affect regulation strategies. Each of the models described below, which all included the additive effect of age in their predictor variables, was compared with a model that included the multiplicative effect of age in its predictor variables. The results of these comparisons suggested that considering the moderating effect of age did not significantly improve the accuracy of any of the models. Consequently, we did not explore the potentially moderating effect of age any further.

3 Results

3.1 Initial Analyses

We established descriptive statistics and calculated correlations between the variables of interest to obtain initial information about our participants' affective experience (see Table 1). Their average level of positive affect was neither low nor high, whereas their average level of negative affect was relatively low. Although the distribution of the experience of negative affect was positively skewed, we chose not to transform it. The different variables of interest therefore remained on the same scale, making it easier to illustrate the effects set out below using graphical representations. Furthermore, when we inspected the distribution of the residuals of each of the models reported below, we found that it was always normal. In addition, positive and negative affect experienced at the same time were negatively correlated ($r = -.53, p < .001$). Therefore, the experience of positive affect only explained 28 % of the negative affect experienced at the same time, justifying our decision to analyse them separately. Finally, correlation directions were consistent with our hypotheses, although further analyses were required to test them.

As a last step before testing our hypotheses, we checked the appropriateness of the interval separating two consecutive assessments for capturing affective changes over time. This step was key to subsequently describing the manner in which the implementation of affect regulation strategies impacted such changes. According to our understanding of affective fluctuation, a displacement in affective experience intensity is followed by a

¹ The inclusion of age and sex in the predictor variables of the models described below had only a minor influence on their coefficients, and consequently on the predictions computed from these models, which served to create graphs. Thus, the predictions illustrated in all the figures presented below were calculated on the basis of the simplest models, which did not include age and sex in their predictor variables.

Table 1 Means, standard deviations, skewness and correlations between affective valence and strategy implementation at two consecutive assessments (T1 and T2)

	Mean	SD	Skewness	1	2	3	4	5	6	7
1. T1PA	3.09	.88	-.08							
2. T1NA	1.68	.84	1.47	-.53*						
3. T1-T2 PR	2.86	1.20	-.08	.25*	-.01					
4. T1-T2 PFC	2.87	1.29	-.05	.19*	.13*	.40*				
5. T1-T2 App	3.43	1.22	-.41	.39*	-.22*	.25*	.16*			
6. T1-T2 Rum	2.00	1.21	1.01	-.11*	.40*	.13*	.21*	-.10*		
7. T2PA	3.09	.87	-.07	.70*	-.36*	.35*	.25*	.52*	-.16*	
8. T2NA	1.67	.84	1.49	-.37*	.72*	-.08*	.10*	-.32*	.48*	-.53*

PA positive affect, NA negative affect, PR positive reappraisal, PFC problem-focused coping, App appreciation, Rum rumination

* $p < .001$

gradual return to baseline, brought about by a regulatory mechanism that individuals ordinarily possess (Kuppens et al. 2010). We reasoned that the gradual nature of this movement would be captured if the experience of positive and negative affect at one assessment was related to the positive and negative affect experienced at the following assessment. More specifically, effect sizes very close to 0 would indicate that the interval was too long to observe the expected movement, whereas effect sizes very close to 1 would indicate that the interval was too short to identify it. The correlations observable in Table 1 could not tell us whether these effects were due to interindividual differences, or to intraindividual variations over time. Accordingly, we used mixed-effects models, which neutralized any interindividual variation. We tested two linear mixed-effects models, with T2PA as the outcome variable and T1PA as a predictor variable for the first one, and T2NA as the outcome variable and T1NA as a predictor variable for the second one, including a random intercept per participant to partial out the individual baselines. As expected, T1PA was significantly related to T2PA ($\beta = .40, p < .001$), while T1NA was significantly related to T2NA ($\beta = .40, p < .001$). These results showed that the interval between two consecutive assessments was appropriate for capturing the affective fluctuations we expected to identify.

3.2 Hypothesis Testing

3.2.1 The Influence of Affect on Affect Regulation Strategies

Our first hypothesis was that the positive affect experienced at one assessment would determine the implementation of positive reappraisal, problem-focused coping and appreciation between this assessment and the following one. Likewise, the negative affect experienced at one assessment would determine the occurrence of rumination between this assessment and the following one.

Some of the correlations shown in Table 1 were consistent with this prediction. However, we expected to identify not only linear effects, but also nonlinear, second-order effects. In particular, we expected the use of positive reappraisal, problem-focused coping and appreciation to be triggered by high positive affect, but did not expect low positive affect to have any impact on their implementation. Similarly, high negative affect was

expected to trigger the implementation of rumination, whereas low negative affect was not expected to influence its use.

Accordingly, we constructed four polynomial regression models, fitted by means of GEEs, with *T1–T2 PR* as the outcome variable for the first one, *T1–T2 PFC* for the second one, *T1–T2 App* for the third one and *T1–T2 Rum* for the fourth one. *TIPA* first and second orthogonal polynomials were entered as predictor variables in the first three equations, and *TINA* first and second orthogonal polynomials were entered as predictor variables in the fourth equation. Results partially confirmed our hypothesis. *TIPA* had a significant linear effect on *T1–T2 PR* ($\beta = .25, p < .001, R^2 = .07$) but a nonsignificant quadratic effect ($\beta = .06, p = .22$). The lefthand graph in Fig. 1 illustrates the essentially linear relationship between *TIPA* and *T1–T2 PR*. Enhancement of initially low positive affect increased the use of positive reappraisal, not significantly less than enhancement of high positive affect did. Moreover, *TIPA* exerted significant quadratic effects on both *T1–T2 PFC* ($\beta = .12, p < .05$) and *T1–T2 App* ($\beta = .07, p < .05$), in addition to its linear effects ($\beta = .19, p < .01, R^2 = .06$ and $\beta = .38, p < .01, R^2 = .16$, respectively). The lefthand graph in Fig. 1 showing both quadratic effects suggests that they followed the expected pattern. Finally, *TINA* had a linear effect on *T1–T2 Rum* ($\beta = .40, p < .001, R^2 = .17$), but no quadratic effect ($\beta = .04, p = .26$). The righthand graph in Fig. 1 indicates that the use of rumination was increased by enhancement of both high and low negative affect.

Taken together, these results reveal that feeling positive affect at a particular time determined the intensity with which positive reappraisal, problem-focused coping and appreciation were subsequently implemented in the space of just a few hours. Similarly, within the same interval, the intensity with which rumination was used was determined by previous experience of negative affect. These influences were particularly great when high positive or negative affect was experienced. Notwithstanding, variations in low positive and negative affect also determined the use of positive reappraisal and rumination, respectively. The determination coefficients ranging from .06 to .17 were interesting, because previous affective experiences are just one of a variety of phenomena that can influence the use of affect regulation strategies.

3.2.2 The Influence of Affect Regulation Strategies on Affect and Affective Fluctuation

Our second hypothesis was that the implementation of positive reappraisal, problem-focused coping or appreciation between T1 and T2 would determine the positive affect

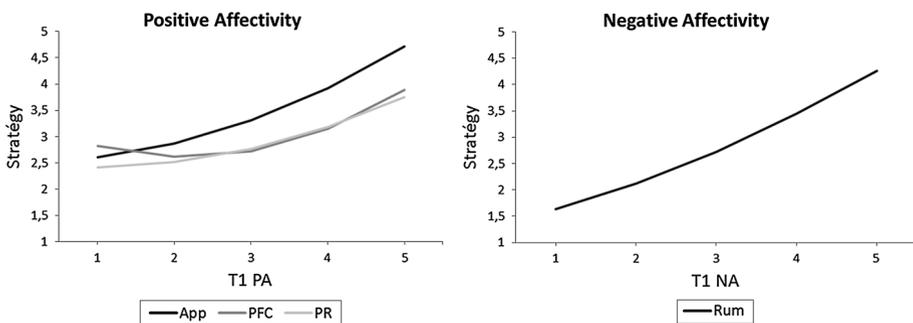


Fig. 1 Implementation of positive reappraisal (PR), problem-focused coping (PFC), appreciation (App) and rumination (Rum) between T1 and T2 as a function of the positive or negative affect experienced at T1

experienced at T2. Likewise, the use of rumination between T1 and T2 would determine the negative affect experienced at T2. Along with our first hypothesis, if confirmed, this would suggest the presence, within the interval separating the two assessments, of reciprocal influences between positive affect and positive reappraisal, positive affect and problem-focused coping, positive affect and appreciation, and negative affect and rumination.

To test this hypothesis, we constructed four regression models on the basis of GEEs. The predictor variable was *T1–T2 PR* for the first model, *T1–T2 PFC* for the second one, *T1–T2 App* for the third one and *T1–T2 Rum* for the fourth one. The outcome variable was *T2PA* in the first three equations, and *T2NA* in the fourth equation. Results confirmed our hypothesis. *T1–T2 PR* exerted a positive influence on *T2PA* ($\beta = .35, p < .001, R^2 = .12$), *T1–T2 PFC* had a positive effect on *T2PA* ($\beta = .25, p < .001, R^2 = .06$), and *T1–T2 App* exerted a positive effect on *T2PA* ($\beta = .51, p < .001, R^2 = .26$), while *T1–T2 Rum* had a positive influence on *T2NA* ($\beta = .47, p < .001, R^2 = .22$). As expected, the implementation of positive reappraisal, problem-focused coping and appreciation was not only stimulated by previous experiences of positive affect. It also appeared to promote future experiences of positive affect. Similarly, the use of rumination was not only heightened by previous experiences of negative affect, but also seemed to facilitate subsequent experiences of negative affect, all within the space of a few hours. Moreover, the determination coefficients ranging from .08 to .29 were considerable, given that we only considered one such strategy.

As the fitted models did not control for the potential effect of previous affective experience, another possible interpretation of the results we obtained is that some assessments were collected in more favourable periods than others (e.g., owing to the environment). Thus, they were not enough to prove the temporal causality between affect and strategies. If strategy implementation really impacted affective experience, then the implementation of positive reappraisal, problem-focused coping or appreciation between two assessments should not only be linked to the subsequent experience of positive affect, but should also influence positive affect change in the meantime. Similarly, the use of rumination between two assessments should influence change in negative affect within this interval. In the model of affective fluctuation described above (Kuppens et al. 2010), two main types of change in affective experience are identified. The first one is the departure from the affective baseline triggered by environmental stimulation. The second one is the return to this baseline brought about by regulatory processes, on which our hypothesis led us to focus. We expected to find that when low positive affect was experienced at T1, the normal rise in positive affect intensity between T1 and T2 would be facilitated by intensive (as opposed to nonintensive) implementation of positive reappraisal, problem-focused coping or appreciation. Conversely, we expected to find that when the experience of positive affect at T1 was high, the subsequent decline in positive affect intensity between T1 and T2 would be slowed by intensive (as opposed to nonintensive) use of each of these strategies. We assumed that there would be analogous patterns regarding negative affect and rumination. Compared with the nonintensive use of this strategy, intensive rumination between T1 and T2 would facilitate the increase in negative affect intensity following a low experience of negative affect at T1, and slow its decline following a high experience of negative affect at T1.

To analyse these phenomena, *T1PA* was added to the predictor variables of the first three models described above, and *T1NA* was added to the predictor variables of the fourth one. By controlling for the previous affective experience, these models could analyse the contribution of each strategy to affective change between T1 and T2. Results showed

significant effects of appreciation ($\beta = .29, p < .001, R^2 = .57$), positive reappraisal ($\beta = .19, p < .001, R^2 = .53$) and problem-focused coping ($\beta = .12, p < .001, R^2 = .50$) on positive affect change, and a significant effect of rumination on negative affect change ($\beta = .23, p < .001, R^2 = .56$). Interestingly, the increase in the determination coefficients associated with the consideration of the previous affective experience was another argument for the continuity of affective experience between two assessments. The estimated coefficients of these models were used to compute the predictions illustrated in Fig. 2. The expected affect level at T2 was computed as a function of its level at T1 and the level of strategy use between T1 and T2. Low *TIPA* was fixed at one standard deviation below the mean, and high *TIPA* one standard deviation above. As its distribution was not normal, we operationalized low *TINA* with its first decile and high *TINA* with its ninth decile. Three intensity levels for each strategy were fixed at one standard deviation below and above the mean, and the mean itself.

The lefthand and top righthand graphs in Fig. 2 show the predicted levels of *T2PA* according to *TIPA* and *T1-T2 PR*, *T1-T2 PFC* or *T1-T2 App*. They reveal an analogous pattern for each strategy. When *TIPA* was low, intensive implementation of the strategy accentuated the increase in positive affect intensity between T1 and T2 more than non-intensive implementation did. Conversely, when *TIPA* was high, the decrease in positive affect intensity between T1 and T2 was less marked when the strategy was used intensively

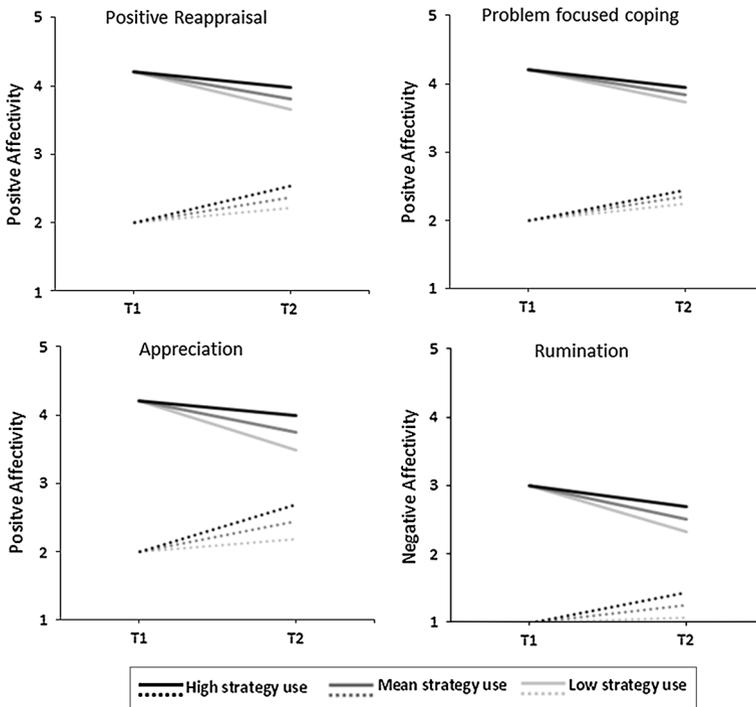


Fig. 2 Experience of positive and negative affect at T2 predicted by low or high experience of positive and negative affect at T1, and nonintensive, moderate or intensive implementation of positive reappraisal, problem-focused coping, appreciation or rumination between T1 and T2

rather than nonintensively. As expected, the increase in positive affect intensity following a low experience of positive affect was facilitated by intensive implementation of positive reappraisal, problem-focused coping and appreciation. Conversely, the decline in intensity following a high experience of positive affect was slowed by intensive use of each of these strategies. Similar patterns can be seen in the bottom righthand graph in Fig. 2 showing the predicted level of *T2NA* according to *T1NA* and *T1–T2 Rum*. When *T1NA* was low, the increase in negative affect intensity between T1 and T2 was greater when rumination was used intensively rather than nonintensively. Conversely, when *T1NA* was high, intensive rumination reduced the decline in negative affect intensity between T1 and T2 more than nonintensive rumination did. Thus, intensive use of rumination enhanced the rise in negative affect intensity following a low level of negative affect, and slowed the decline in intensity following a high experience of negative affect.

4 Discussion

The present study was designed to improve our understanding of affective fluctuation, focusing on the mechanisms that underpin the relationship between previous and subsequent affective experiences. It was based on the premise that affective valence is not merely a consequence of engaging adaptive resources, but may also trigger the inclination to build and use such resources. Using an experience sampling method that enabled us to have assessments a few hours apart, we investigated the daily relationships between affective experience and the implementation of one particular type of resource, namely affect regulation strategies.

Our results first suggest that, within the space of a few hours, feelings of positive affect and the implementation of positive reappraisal, problem-focused coping or appreciation reciprocally influence each other, as do feelings of negative affect and the use of rumination. These findings are consistent with the broaden-and-build theory (Fredrickson 1998, 2001), which posits that one of the mechanisms underpinning the relationship between previous and subsequent affective experiences is the effect of momentary affective valence on the building of healthy resources. Previous findings, based on data collected from two assessments more than a month apart, had already revealed that feeling positive affect and implementing certain coping strategies mutually influence each other (Burns et al. 2008; Fredrickson and Joiner 2002). Consistent with the idea that the building of resources over the long term relies on short-term changes (Fitzpatrick and Stalikas 2008), our results suggest that reciprocal influences between affect and affect regulation strategies can also occur within very short intervals.

Our efforts to clarify the influence of affective valence on the use of such strategies yielded several interesting findings. Consistent with the assertion that a broadening process follows an experience of positive affect, high feelings of positive affect enhanced the subsequent implementation of positive reappraisal, problem-focused coping and appreciation. Low feelings of positive affect also prevented the use of positive reappraisal, suggesting that a lack of positive affect can trigger a narrowing mechanism in some circumstances. Moreover, high feelings of negative affect heightened the subsequent use of rumination, providing support for the idea that the experience of negative affect triggers a narrowing mechanism. A lack of negative affect also appeared to trigger a broadening mechanism, insofar as it prevented the use of rumination. Although the broaden-and-build theory (Fredrickson 1998, 2001) does not specify the level at which affect starts or ceases

to influence human functioning, the beneficial or detrimental nature of the influence exerted by affective experiences on human functioning has been shown to change according to its intensity level (see Gruber et al. 2011, for a review). Further research is therefore needed to clarify this issue, as the present study confirmed that the effects of affective experiences on other aspects of human functioning can be nonlinear.

We also focused on how affect regulation strategies influence affective fluctuation. According to the model proposed by Kuppens et al. (2010), one main component of affective fluctuation is an attractor strength that all individuals ordinarily possess, and which causes affective experiences to return to their baseline after displacement. Consistent with this, in our sample, we generally observed an increase in affective intensity within a few hours of a nonintense affective experience. Conversely, intense affective feelings were followed by a decline in affective intensity within the same time interval. Furthermore, we noticed that the increase was facilitated by the intensive implementation of positive reappraisal, problem-focused coping or appreciation for positive affect, and by intensive use of rumination for negative affect. Conversely, the decline was slowed by the intensive implementation of positive reappraisal, problem-focused coping or appreciation for positive affect, and by intensive use of rumination for negative affect. These findings suggest that, in the short term, intensive implementation of positive reappraisal, problem-focused coping or appreciation is helpful not only for increasing one's level of positive affect when it is dramatically low, but also for maintaining this level when it is agreeably high. Likewise, in the short term, intensive engagement in rumination tends to maintain the level of negative affect when it is high, and clearly raises this level when it is low. Other statistical analyses, including ones allowing us to fit damped-oscillator models (Pettersson et al. 2013), could serve to further investigate intraindividual affective variations over time. Nevertheless, our findings provide initial support for the idea that implementing affect regulation strategies influences the attractor strength that causes affective experience to return to its baseline after displacement.

Our findings have implications for understanding human affectivity, offering clinical advice, and guiding the pursuit of wellbeing. Broadly speaking, they suggest that positive and negative affect are not merely pleasant or unpleasant states that disappear as rapidly as they appeared, or that are unrelated to other components of human functioning. Instead, momentary experiences of positive and negative affect appear to contribute to more stable phenomena, by influencing not only future affective experiences, but also the building of resources. More specifically, affective valence seems to influence resource enhancement via the broadening impact that positive affect has on cognition and behaviour, and the narrowing impact that negative affect has on it. Importantly, many individuals who seek psychotherapy have difficulty going beyond their habitual maladaptive ways of thinking or acting, or making changes. Inducing positive affect by encouraging these individuals to contemplate a past or future positive experience, for instance, could serve to broaden the scope of their thoughts and actions. Although this broadening mechanism may be short-lived, many psychotherapeutic traditions espouse the idea that major outcomes are achieved through a succession of smaller ones (Fitzpatrick and Stalikas 2008). By the same token, inducing negative affect may prove useful when a person's attention needs to be directed to a specific neglected or impending problem. Finally, our findings have implications for guiding the pursuit of wellbeing. One of the main issues here is how to lastingly sustain a high level of wellbeing once it has been attained, a central issue in the pursuit of well-being (Lyubomirsky et al. 2005). Our results suggest that the implementation of certain affect regulation strategies represents a tool by which the decrease in affective wellbeing that naturally follows its rise can be slowed. The

implementation of these strategies is all the more efficient because it can be facilitated by the initial increase in affective wellbeing.

The ideas discussed above must be treated with caution, as the present study had several limitations. First, the factorial structure of the instruments we used was not validated. This limitation is inherent to experience sampling methods. The need to construct assessments to which quick responses can be made, owing to a high assessment frequency, constrains the number of items that can be included in each assessment. This need led us to measure each strategy with one item only, thus preventing us from assessing their internal consistency. Moreover, even if we had measured each strategy with several items, we would not have been able to determine whether the common part of the variance explained by a number of items was related to interindividual differences or to intraindividual ones (e.g., changes in the situations encountered; Cattell 1944). For example, two different strategies could load on the same factor because they were used simultaneously in reaction to particular situations. Second, we focused on affective fluctuations within the space of a few hours. While this interval was sufficient for us to make some initial observations, affective fluctuation cannot be restricted to such a limited timeframe. Third, the present study assessed neither the events our participants encountered nor their personality, both factors that contribute to affective fluctuation. A person's current affective experience is determined by a myriad of influences interacting with each other, including previous affective experiences, personal resources, events and personality. The relationships between these main determinants will need to be the subject of future comprehensive studies. It would be particularly interesting to consider personality, as the present study examined phenomena that occur at the population level, laying the foundations for deeper differential analyses.

To conclude, we found that positive or negative affect felt at a particular time was related to experiences of positive and negative affect a few hours later. This affective continuity over time appeared to depend on the influence that positive and negative affect exerted on particular resources, namely the ability to implement affect regulation strategies. Momentary experiences of high positive affect seemed to broaden the scope of cognition and behaviour, whereas momentary experiences of high negative affect appeared to narrow it. By impacting affective experience, the use of affect regulation strategies modified the affective changes that ordinarily take place in the space of a few hours.

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