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RESEARCH PAPER

Savouring the Present to Better Recall the Past

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Abstract
So far, there is evidence showing that the use of specific emotion regulation strategies in response to negatively-valenced stimuli shapes the way people subsequently remember them. However, still little is known about the potential effects of savouring positive events on the associated memories. The aim of the current study was to test whether upregulating positive emotions in response to daily positive events could make participants' memories more salient and positively-valenced over time. To do so, we conducted an ecological momentary assessment study in order to identify the occurrence of positive events and provide participants with different emotion regulation strategies in real-time. To explore memory phenomenology, a surprise recall task for each event was performed one week after. Compared to the control condition, the manipulation of savouring led to recall the events with greater salience (i.e., more vivid, coherent, accessible, full of sensory details, first-person recalled memories) which, in turn, led to retrieve the memory more positively. Furthermore, the findings indicated that each strategy uniquely affected different phenomenological dimensions of memory. Together, we suggest that differences in the use of savouring strategies might impact memory, leading to the recall of events with higher salience and to the maintenance of their positivity over time.

Keywords Savouring · Positive emotions · Emotion regulation · Memory

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1 Introduction

Autobiographical memory (AM) encompasses personally experienced past events (Robinson, 1986), ranging from emotionally intense episodes to marginal ones (Conway, 1987). Interestingly, people's memories do not perfectly overlap with experienced past events; rather, each memory is an inaccurate copy of an experience, being the result of a subjective reconstruction over time (Conway, 1996; Conway & Pleydell-Pearce, 2000). Likewise, there are memories which are more detailed, vivid and accessible than others. As a growing body of literature has indicated, the characteristics of a specific event can shape the associated memory, thus leading to AMs with different phenomenological features. Although several factors have been identified, valence and arousal have been suggested as two key aspects affecting the encoding and subsequent recall of AMs (for a review, see Holland & Kensinger, 2010). While the experience of intense negative emotions leads to memories that are richer in details (Berntsen, 2002; Mickley & Kensinger, 2009; Reisberg & Heuer, 2004; Storbeck & Clore, 2005), the experience of positive emotions enhances one's focus on positive self-schemas, thus promoting a general analysis of an event (Clore & Storbeck, 2006; Clore et al., 2001; Levine & Bluck, 2004), with a greater recall of sensorial and peripheral information (D'Argembeau et al., 2003; Levine & Bluck, 2004; Talarico et al., 2004, 2009). Furthermore, highly arousing events have been shown to lead to more durable, detailed and self-perceived accurate memories (Anderson et al., 2006; Cahill & McGaugh, 1995; Phelps & Sharot, 2008).

Recently, emotion regulation has been suggested as a further factor affecting memory. Emotion regulation is the process that enables individuals to influence their ongoing emotional states and reach desirable goals (Gross, 1998; Gross & Thompson, 2007). So far, many studies have explored the association between the regulation of negative emotions and memory. For example, the use of cognitive reappraisal (i.e., changing the interpretation and meaning of a negative stimulus) is associated with a greater recall of details, expressive suppression (i.e., the attempt to inhibit the expression of negative emotions) with less detailed memories and rumination (i.e., rehashing about one's experienced negative emotion, its causes and consequences) with a greater emotional involvement with the recalled memory (Colombo et al., 2021b; Dillon et al., 2007; Hayes et al., 2011; Richards & Gross, 2000; Richards et al., 2003; Vanderveren et al., 2020; Watkins & Teasdale, 2001). As for positive emotions, whether the use of strategies to maintain and/or upregulate positive states influences memory is still an open question.

Savouring has been defined as "*the capacity to attend to, appreciate and enhance the positive experiences in one's life*" (Bryant & Veroff, 2017, p. XI), which entails the ability to use different emotion regulation strategies to pursue this goal (Quoidbach et al., 2015).[1] Experiencing positive events does not imply feeling positive emotions. Rather, people differ in the ability to engage in cognitive, attentional, or behavioural strategies to relish the positive feelings coming from a positive experience (Bryant, 2003). Following Gross' extended model (2015), Quoidbach et al. (2015) proposed five different strategies of savouring: (1) situation selection, that is, choosing and engaging in situations that are expected to produce pleasurable emotions; (2) situation modification, that is, the active attempt to modify a situation in order to increase its impact on one's positive feelings; (3)

[1] In the present study, we will use the term "savouring" as an umbrella term that encompasses different positive emotion regulation strategies (behavioural, cognitive, attentional) whose aim is to relish the positive emotions produced by a positive experience.

attentional deployment, that is, mindfully savouring a positive experience as well as focusing the attention on the positive details of the event; (4) cognitive change, that is, reappraising a positive situation in order to boost the associated positive emotions; and (5) response modulation, that is, the verbal (e.g., sharing) or non-verbal (e.g., smiling) expression of a positive emotion to amplify its intensity.

Since savouring strategies amplify the intensity of ongoing positive emotions and enhances one's focus on the details of a pleasant stimulus (Bryant & Smith, 2015; Bryant & Veroff, 2007; Quoidbach et al., 2015), individual differences in the deployment of savouring strategies might also make people remember events differently. In this sense, savouring has been suggested as a "memory building" process that, by directing one's attention on positive experiences and its pleasurable aspects, may facilitate the formation of more vivid and accessible memories (Bryant & Veroff, 2007) which, in turn, might also facilitate the recall of the associated positive emotions and overall positivity (Bohn & Berntsen, 2007; Kensinger, 2009; van Schie et al., 2019). For instance, Jose et al. (2020) demonstrated that individuals with a strong inclination for savouring exhibit enhanced abilities to recognize and relish positive situations in daily life. However, their study did not delve further into the specific impact of savouring on memory. Another study found that savouring pleasant experiences was associated with an increased tendency to reminisce nostalgically about the associated memories (Biskas et al., 2019). Yet, the assessment of savouring abilities and positive events was retrospective, and further memory properties, such as vividness and memory details, were not explored. Finally, Chun et al. (2017) showed that savouring a future event (i.e., anticipation) enhances the positive emotions derived from its recall later on, but "real-time" use of savouring strategies and their impact on memory were not investigated. In summary, although the literature suggests a connection between savouring and memory, there is much left to explore in order to fully understand the reciprocal interplay among savouring skills, daily positive events and memory phenomenology, as well as how this process unfolds in naturalistic settings. Previous studies have attributed various adaptive functions to positive reminiscence, such as establishing and maintaining personal identity, serving as a source of positive experiences that boost self-esteem and elicit pleasant emotions, or functioning as a coping mechanism for dealing with negative experiences (Bryant, 2003; Bryant et al., 2005; Jose et al., 2012; Quoidbach et al., 2010; Speer & Mauricio, 2017; Tam et al., 2021). Given the significance of positive reminiscence as an emotion regulation strategy contributing to emotional well-being, it becomes paramount to further investigate and disentangle the underlying mechanisms of this process.

The main aim of the current study was to investigate the potential effects of savouring positive emotions on AMs. More specifically, we explored whether the manipulation of savouring strategies during the experience of daily positive events could affect the recall of the associated memories. To achieve this, we conducted a smartphone-based ecological momentary assessment (EMA) study to capture daily positive events in real-life. Participants received two randomized notifications per day, asking whether a positive event was currently being experienced. If so, they were randomly assigned to either a control or experimental condition in which specific instructions to upregulate the ongoing positive emotions were provided. Based on Quoidbach et al. (2015)'s model, four different narratives (i.e., experimental conditions) were developed and randomly delivered: situation modification, attentional deployment, cognitive change, and behavioural modulation. The category "situation selection" was excluded because the participants had to report ongoing events (i.e., the situation had already been spontaneously selected). To investigate the effects of savouring on AM, we administered a surprise memory task one week after each event and asked participants to retrospectively describe and rate its positivity. Five memory

dimensions were assessed: accessibility (i.e., the ease of retrieval of a memory); coherence (i.e., the recall of a memory through a coherent narrative); sensory details (i.e., the retrieve of the sensorial information associated with a memory); visual perspective (i.e., the recall of a memory from a first-field perspective); and vividness (the visual clarity and intensity of a memory). These dimensions were combined to define memory salience: that is, more accessible, coherent, vivid, emotionally intense and detailed memories.

We hypothesized that fostering savouring by providing individuals with specific instructions could help positive events maintain their salience and positive intensity over time. Our main hypotheses were as follows:

(1) Since savouring amplifies the intensity of ongoing positive emotions (Bryant, 2021; Quoidbach et al., 2015) and one's focus on the details of a positive situation (Bryant & Smith, 2015; Bryant & Veroff, 2007), we hypothesized that participants receiving one of the four savouring instructions (vs. the control condition) would report memories with (a) higher salience and (b) higher recalled positivity
(2) Since retrieving more salient memories is likely to boost the recall of the associated positive emotions (Kensinger, 2009; van Schie et al., 2019), we hypothesized that participants receiving one of the four savouring instructions (vs. the control condition) would report memories with higher recalled positivity because of higher memory salience (i.e., mediation model).

In addition, and to gain a broader understanding of the association between savouring and memory, the secondary objective of the present investigation was to disentangle the unique effect of each strategy on different dimensions of memory: accessibility, coherence, sensory details, visual perspective, and vividness. Given the exploratory nature of these secondary analyses, we did not formulate specific hypotheses.

2 Method

2.1 Participants

The sample size was determined using power analysis. We used the *simr* package (Green & Macleod, 2016) available in R (R Core Team, 2020) to compute these analyses, as the models we expected to perform were linear mixed-effects models. Based on responses from 20 initial participants, the number of observations per individual was estimated to be 3 for the power analysis calculation. For the most complex models we expected to perform (i.e., linear mixed-effects models with five predictors), moderate to strong effect sizes (i.e., $\beta = 0.40$) had no less than 95% of power, with a significance level of 0.05, at a sample size starting at $n = 97$. The final sample included 97 participants encountering more than one positive event during the one-week EMA phase (79 f / 18 m), with a mean age of 25.75 (min: 18; max: 61; $SD = 9.21$).

2.2 Experimental Design and Material

This study was composed of two phases, each of which lasted one week.

2.2.1 EMA Phase

In order to collect daily positive events, the first part of the study relied on the use of an EMA design. The study's initial instructions were as follows:

> 'During the next days, you will receive a series of notifications at random times throughout the day inviting you to answer a few questions about what you are currently doing. Specifically, in this study we are interested in daily positive events. Each survey will ask you whether or not you are currently experiencing a specific, significant positive event. By "specific positive event" we refer to something specific that is currently happening to you (e.g., a birthday party, a beer with friends, a date with a romantic partner, a warm bath...), that takes place in a specific spatial location (e.g., at home, at the restaurant, at the cinema...) and in a defined time period (i.e., something with a clear beginning and a clear end), and that makes you feel pleasant emotions (happiness, excitement, calmness, pride, etc.). Also, it has to be a "significant event", i.e. this event has to be significant to you in a way that it is likely to affect your mood as well as influence your behaviours and/or thoughts.'

Participants received two semi-randomized prompts a day inquiring whether they were currently experiencing a specific and significant positive event. If not, the assessment stopped. Oppositely, participants were randomly assigned to either a control or experimental condition. The condition assignment was a within-subjects factor: that is, each time participants indicated the occurrence of a positive event, they were randomly reassigned to a new condition. In all conditions, participants were first asked to provide a written description of the event and rate its positivity on a 1–7 scale. In the control condition, no further information was provided after recording the event. In the experimental conditions, participants randomly received specific instructions to upregulate their ongoing positive emotions. Following Quoidbach et al. (2015)'s model, four different narratives were developed and randomly delivered: situation modification, attentional deployment, cognitive change and behavioural modulation.

The first experimental condition was situation modification, defined as the effort to enhance pleasant emotions by modifying the situation or its components. The instructions were as follows: *'Sometimes we are not really taking the most out of a positive situation. In the next few minutes, try to modify the situation you are experiencing (or part of it) in order to enhance its positive emotional impact on you. Try to take specific actions that could improve the quality of the experience. If you are celebrating your birthday, for instance, you could offer a free drink to your friends. If you are having dinner with a special person, you could share a dessert with him/her. If you are watching your favourite TV series on your sofa, you could prepare a tasty sandwich or just wrap yourself up with the softest blanket you have in your home. Notice how little changes in the situation you are experiencing could further improve the quality of this moment and your positive emotions'*.

The second experimental condition was attentional deployment, characterized by the effort to focus one's attention on pleasant details and sensory feelings. The participants were provided with the following instructions: '*Sometimes we are not really paying attention to the positive things that happen to us. Our mind is elsewhere. In the next few minutes, try to focus all your attention to the positive event you are experiencing. Pay attention to what you are feeling by sharpening all your senses: the rhythm of your*

breath, your body sensations or the sounds around you. Remember that most of our daily pleasures can be experienced through many different senses. If you pay attention to it, you'll notice that your favourite sandwich not only tastes or looks good, but also has a distinctive smell, texture, and even sounds when it crunches under your teeth. Try to fully immerge yourself into the positive experience you are living now. Try to take the most out of your current feelings and sensations'.

The third experimental condition was cognitive change, involving the attempt to infuse positive meaning into the positive event and reappraise it as a special moment. The instructions were as follows: *'Sometimes we take the positive things in our life for granted. We don't fully appreciate how fortunate we are and we don't completely relish positive events. In next few minutes, try to reflect on the positive experience you are living right now. Think about how lucky you are to live this moment and about the positive outcomes on your mood, thoughts and feelings. Notice how your situation could be different or even worse, or imagine what your day would be without this positive event. Think about how lucky you are to feel so good and to have positive events happening in your life'*).

The last experimental condition was behavioural modulation, which refers to the attempt to express one's positive emotions on the outside. The instructions were the following: *'Sometimes we are keeping our positive emotions to ourselves and we don't share our positive mood with others. We don't allow ourselves to fully express how good we feel out of modesty, shyness or fear of ridicule. However, sharing happiness is an important way to amplify our positive feelings. In next few minutes, try to show your positive emotions physically in a way that an external observer, sitting next to you, would be able to understand that you're currently feeling great. Make sure to smile, laugh, do a joke, and – if the context allows it –even jump for joy'*).

2.3 Memory Recall Phase

During the second week of the study, an automatic email-based survey was triggered 7 days after the occurrence of each episode reported in the EMA. The participants were asked to describe the positive event and to retrospectively rate its positivity using the same 1–7 scale as in the EMA survey. To verify the accuracy of participants' recollections of the event (i.e., whether participants could identify which event was recorded in the EMA the week before), we conducted a manual comparison between the momentary and retrospective descriptions of the situations. No record needed to be excluded.

To assess the characteristics of the retrieved events, we administered the short form of the Memory Experience Questionnaire (MEQ) (Luchetti & Sutin, 2016; Sutin & Robins, 2007). The MEQ is a 31-item self-report questionnaire that assesses 10 different phenomenological dimensions of a recalled memory. For the aim of the current study, we only considered five subscales related to how much the memory was seemingly well-remembered: accessibility (i.e., the ease of retrieval of a memory); coherence (i.e., the recall of a memory through a coherent narrative); sensory details (i.e., the retrieval of sensorial information associated with a memory); visual perspective (i.e., the recall of a memory from a first-field perspective); and vividness (the visual clarity and intensity of a memory).

The different memory-related subscales we retained showed good internal consistency at both the between- (accessibility: $\alpha = 0.89$; coherence: $\alpha = 0.78$; sensory details: $\alpha = 0.80$; visual perspective: $\alpha = 0.88$; vividness: $\alpha = 0.79$) and within-individual levels (accessibility: $\alpha = 0.79$; coherence: $\alpha = 0.71$; sensory details: $\alpha = 0.62$; visual perspective: $\alpha = 0.86$; vividness: $\alpha = 0.78$), as well as strong positive correlations between each other (mean

inter-item correlation = 0.674). In other words, the most vivid memories also tended to be the most coherent, accessible, full of sensory details, first-person recalled memories.

The performance of parallel analyses using the R package *psych* (Revelle, 2020) even suggested that one principal component could be extracted from these 5 dimensions, accounting for 69% of their total variance. Therefore, we combined these 5 dimensions into a single indicator that we labelled 'memory salience'. We did it by performing a principal component analysis on the 5 dimensions, fixing the number of principal components to retain at 1 and estimating component scores ($\alpha = 0.88$).

The other five subscales of the MEQ were neglected for theoretical reasons. First, the *sharing* subscale (i.e., the extent to which a recalled event has been shared with other people; e.g., '*I rarely tell others about this memory*') was neglected because it does not relate to the memories' content. Second, the *time perspective* (i.e., the memory for the day and year when the event took place; e.g., '*My memory for the year when the event took place is vague*') and *distancing* subscales (i.e., the tendency to psychologically distance oneself from a memory; e.g., '*I feel like the person in this memory is a different person than who I am today'*) were neglected because they are not relevant for the recall of recent daily positive events (e.g., having a hot shower, having a drink with a friend). Third, the *emotional intensity* and *valence* subscales (i.e., the positivity of the event; e.g., '*The overall tone of the memory is positive'*) were neglected because they were redundant with the variable related to the event's positivity that we already assessed both at the time of occurrence and during the recall. Although the choice to neglect five subscales was theoretically driven, it might be interesting to note that, when a principal component analysis was performed on all ten subscales, three of these five subscales loaded in a non-negligible fashion on a second dimension (i.e., distancing, sharing, and emotional intensity).

2.4 Procedure

Potential participants were recruited through online advertisements and fliers. The study was described as a two-week free training to improve resilience and positive emotional regulation. To avoid potential biases, the autobiographical recall phase was not mentioned at the beginning of the study, so participants were unaware of the actual aim of the investigation. Participants might have been more likely to concentrate on the details of the events described in the EMA if they were aware of the recall phase.

To participate in the study, participants accessed an online survey by scanning a QR code. In this online survey, they provided demographic information (sex and age) and an email address to receive the daily surveys on their mobile phones. All participants were informed about the possibility of leaving the study at any time and for any reason.

During the first part of the study, participants received two semi-randomized notifications per day (between 10:00 am and 4:00 pm and between 4:00 pm and 10:00 pm) through the data collection platform Qualtrics. While participants were not given a specific time limit to complete the survey, the link stopped working once the following assessment was sent. In the second phase of the study, an email containing the autobiographical recall task was sent 7 days after the occurrence of each event through the data collection program Qualtrics, with a reminder sent on the following day in case of no response.

The total number of events reported in the EMA and correctly recalled was 339, distributed across the conditions as follows: 74 events in the control condition, 64 events in the situation modification condition (SM), 70 events in the attentional deployment condition (AD), 71 events in the cognitive change condition (CC) and 60 events in the

response modulation condition (RM). On average, each participant reported and correctly recalled 3 events ($M = 3.49$, $SD = 1.58$; $min = 2$, $max = 8$), with a mean baseline positivity of 5.28 ($SD = 1.19$). The number of events reported and correctly recalled did not significantly differ between individuals based on sex ($t = -1.245$, $p = 0.225$) or age ($r = 0.017$, $p = 0.868$). Similarly, sex ($t = -0.239$, $p = 0.813$) and age ($r = -0.157$, $p = 0.122$) did not significantly predict between-individual differences in memory salience. Finally, the positivity of the event reported in the EMA did not significantly differ according to age, neither between-individuals ($r = -0.086$, $p = 0.400$) nor within-individuals across all the conditions ($H(4) = 5.994$, $p = 0.200$). By contrast, it significantly varied between individuals based on sex ($t = 2.501$, $p < 0.01$, $d = 0.639$), with female participants reporting more intense positive events than male participants.

This study was approved by the ethics committee of *BLINDED* (certificate number: CD/57/2019), and informed consent was obtained from all participants.

2.5 Data Analysis

All analyses were performed using R (R Core Team, 2020). The dataset and R code used in the analyses are contained in an open-access file available at https://osf.io/xcy9k/?view_only=3edda8d87b734ed8bf20a2daa0d6d82a.

All the analyses reported below involved linear mixed-effects models fitted with maximum likelihood estimation. We chose linear mixed-effects models over more traditional mixed ANOVAs because the former type of models allows to analyse the interaction between continuous and categorical variables. The examination of such interactions was required to determine whether our effects of interest were modified by age.

Three characteristics were shared by all these models. First, they all contained one random intercept per participant as well as all possible random slopes per participant, to take into account the hierarchical nature of the data (i.e., several assessment points nested within several individuals). Second, all these models contained in their predictors events' positivity at t0, to control for its putative confounding effect (i.e., more positive events are more likely to be better remembered and recalled). Third, in their predictors, all these models also contained the interaction between our main predictors of interest and sex (dichotomous variable) and age (grand-mean-centered numeric variable), in order to determine whether our main effects of interest could be modified by sex and age.

The data analytic strategy followed can be divided into three steps. The first step was designed to test our first hypothesis: That is, to test whether the experimental induction of savouring increased memory salience and memory positivity at one week. To do so, we performed two linear mixed-effects models including, as predictors, a variable we labeled *savouring* (i.e., a dichotomous variable distinguishing all experimental conditions combined with the control condition), as well as the above-mentioned control variables. The outcome variables were memory salience at t1 for the first model, and memory positivity at t1 for the second model. In addition, and to gain a better understanding of the unique effect of each strategy, we also tested whether each of the four experimental inductions increased memory salience and memory positivity at t1. To reach this goal, two additional linear mixed-effects models were computed using the same control and outcome variables as in the first two models, and including each of the four experimental conditions against the control condition as predictor variable. Tukey's correction was used in these models to correct for multiple comparisons.

Table 1 Mean, standard deviation, and intercorrelations for the variables of interest in the present study

Variable	M	SD	1	2	3	4	5	6	7	8
1. t0 Positivity	5.28	1.19	1	0.45	0.26	0.20	0.17	0.19	0.10	0.27
2. t1 Positivity	5.40	1.19	0.77	1	0.41	0.32	0.30	0.28	0.18	0.39
3. t1 Memory salience	0	1	0.26	0.39	1	0.90	0.87	0.88	0.51	0.92
4. t1 Accessibility	3.95	1.04	0.12	0.27	0.91	1	0.71	0.66	0.26	0.78
5. t1 Coherence	3.88	0.99	0.11	0.26	0.86	0.78	1	0.65	0.38	0.73
6. t1 Sensory details	3.44	0.95	0.23	0.38	0.90	0.77	0.72	1	0.33	0.71
7. t1 Visual perspective	3.75	1.05	0.10	0.1	0.54	0.42	0.33	0.40	1	0.29
8. t1 Vividness	3.59	1.09	0.30	0.46	0.93	0.84	0.81	0.86	0.35	1

M: mean; SD: standard deviation. Correlations below and above the diagonal were computed at the between-individual and within-individual levels, respectively. With a threshold set at $p < 0.05$, correlations at the between-individual level were statistically significant when they exceeded the absolute value of 0.22, while correlations at the within-individual level were statistically significant when they exceeded the absolute value of 0.16

The second step aimed at exploring our second hypothesis, namely whether savouring increased events' positivity at t1 via increased memory salience at t1. To this end, we computed one multilevel mediation analysis through the *mediation* R package (Tingley et al., 2014), using 1000 bootstraps. In the mediation model, the supposed outcome variable was event positivity at t1, the supposed mediator variable was memory salience at t1, and the supposed predictor variables was savouring. Once again, to gain a better understanding of the unique effect of each ER strategy, additional multilevel mediation analyses were performed, taking into consideration only those strategies that significantly predicted memory positivity at t1 according to step 1. They all contained event positivity at t1 as the supposed outcome variable and memory salience at t1 as the mediator variable. However, they differed from each other in their supposed predictor variable. This predictor was attentional deployment for the first model and cognitive change for second one (i.e., the two strategies that significantly predicted memory positivity at t1).

The third step was exploratory. It was designed to gain a better understanding of the unique impact of our experimental inductions on each component of memory salience. Therefore, five last linear mixed-effects models were computed. All these models contained the same predictor variables, namely each of the four experimental conditions against the control condition and the above-mentioned control variables. By contrast, the outcome variable differed across models: memory accessibility, memory coherence, memory sensory details, memory visual perspective, and memory vividness at t1. Once again, Tukey's correction was used in these models to correct for multiple comparisons. At first glance, the choice to analyse each component of memory salience separately seems incompatible with our initial choice to gather them in a single dimension of memory salience. However, the single dimension of memory salience we examined explained 69% of the variance in our five memory-related variables, suggesting that these variables possessed unique sources of variance in addition to their shared source of variance. Accordingly, these supplementary analyses are complementary rather than opposite to our initial analyses.

Table 2 Mean and standard deviation (between parentheses) of each variable of interest as a function of the condition

	CNTR	Savouring	SM	AD	CC	RM
t0 Positivity	5.23 (1.03)	5.30 (1.23)	5.30 (1.27)	5.56 (1.12)	5.17 (1.24)	5.15 (1.26)
t1 Positivity	5.18 (1.05)	5.47 (1.22)	5.38 (1.03)	5.63 (1.17)	5.46 (1.35)	5.38 (1.32)
t1 Memory salience	−0.27 (1.04)	0.08 (0.98)	0.09 (1.06)	0.16 (0.89)	−0.01 (0.94)	0.04 (1.03)
t1 Accessibility	3.68 (1.14)	4.03 (1.00)	3.96 (1.06)	4.14 (0.94)	3.93 (0.98)	4.07 (1.03)
t1 Coherence	3.68 (0.95)	3.94 (1.00)	3.99 (1.07)	4.07 (0.87)	3.87 (0.99)	3.81 (1.08)
t1 Sensory detail	3.26 (1.03)	3.49 (0.92)	3.48 (1.00)	3.51 (0.92)	3.43 (0.90)	3.55 (0.89)
t1 Visual perspective	3.45 (1.17)	3.84 (1.00)	3.99 (1.03)	3.73 (1.00)	3.77 (0.91)	3.87 (1.07)
t1 Vividness	3.34 (1.10)	3.66 (1.07)	3.67 (1.11)	3.79 (0.94)	3.64 (1.04)	3.52 (1.22)

CNTR: control; Savouring: combined experimental conditions; SM: situation modification: AD: attentional deployment; CC: cognitive change; RM: response modulation

Table 3 Linear mixed-effects model using savouring (combined experimental conditions) as well as each of the experimental inductions to predict memory salience and positivity at t1

	t1 Memory salience			t1 Memory positivity		
	b	SE	p	b	SE	p
Predictors						
	Savouring versus CNTR					
Intercept	−1.305***	0.283	<0.001	2.755	0.323***	<0.001
Savouring	0.463***	0.131	0.001	0.294	0.122*	0.018
t0 Positivity	0.180***	0.043	<0.001	0.485	0.053***	<0.001
	Strategies versus CNTR					
Intercept	−1.323***	0.284	<.001	2.768***	0.321	<0.001
SM	0.545***	0.162	0.001	0.205	0.155	0.187
AD	0.522***	0.157	0.001	0.363*	0.148	0.016
CC	0.352*	0.164	0.032	0.360*	0.153	0.020
RM	0.476**	0.165	0.004	0.261	0.157	0.097
t0 positivity	0.183***	0.043	<0.001	0.481***	0.053	<0.001

CNTR: control; Savouring: combined experimental conditions; SM: situation modification: AD: attentional deployment; CC: cognitive change; RM: response modulation. *p < .05, ** p < .01, ***p < .001

Table 4 Multilevel mediated analyses predicting event positivity at t1 via memory salience

	b	CI 95%		p
Savouring versus CNTR				
Indirect effect	0.127***	0.052	0.22	0.000
Direct effect	0.170	−0.064	0.41	0.172
Total effect	0.297*	0.049	0.55	0.022
AD versus CNTR				
Indirect effect	0.134**	0.051	0.24	0.002
Direct effect	0.232	−0.053	0.51	0.110
Total effect	0.367*	0.069	0.65	0.012
CC versus CNTR				
Indirect effect	0.089*	0.004	0.19	0.040
Direct effect	0.256	−0.037	0.57	0.106
Total effect	0.345*	0.044	0.66	0.024

In mediation model 1 (savouring versus contrl), the predictor was a dichotomous variable distinguishing all experimental conditions combined from the control condition. In Mediation 2 (AD versus control) and 3 (CC versus control), the predictor was a dichotomous variable distinguishing each experimental condition from the control condition

SAVOURING: combined experimental conditions; CNTR: control condition: AD: attentional deployment; CC: cognitive change. *$p < 0.05$, **p < 0.01, ***$p < 0.001$

3 Results

3.1 Descriptive Statistics

Descriptive statistics are set out in Tables 1 and 2.

Hypothesis 1 The effect of savouring on memory positivity and salience.

The results of the linear mixed-effect models we performed are set out in Table 3.

Compared to the control condition, the memories of the events in the savouring condition were more salient ($b = 0.463$, $SE = 0.131$, $p < 0.001$)[2] and more positively recalled one week after ($b = 0.294$, $SE = 0.122$, $p < 0.05$).

When exploring the effect of each experimental condition in comparison to the control one, the results show that the induction of all strategies appeared to produce more salient memories (SM: $b = 0.545$, $SE = 0.162$, $p < 0.001$; AD: $b = 0.522$, $SE = 0.157$, $p < 0.001$; CC: $b = 0.352$, $SE = 0.164$, $p < 0.05$; RM: $b = 0.476$, $SE = 0.165$, $p < 0.01$). However, the effect

[2] This unstandardized regression coefficient, as well as the other unstandardized regression coefficients reported, can be interpreted as follows. On average, within-individuals, the DV (here memory salience) was 0.463 unit greater in the experimental condition than in the control condition. To grasp the size of this effect, this 0.463 mean difference can be compared to the standard deviation of the DV (i.e., SD = 1 for memory salience; see Table 1). Therefore, this 0.463 mean difference suggests that, as compared with the control condition, the experimental condition increased memory salience to a degree of approximately one half standard deviation, which corresponds to a moderate effect size.

of CC was no more significant after correction for multiple comparisons ($p = 0.099$). By contrast, only the manipulation of AD ($b = 0.363$, $SE = 0.148$, $p < 0.05$) and CC ($b = 0.360$, $SE = 0.153$, $p < 0.05$) appeared to predict enhanced memory positivity at t1. As in the previous analysis, the effect of CC was no longer significant after correction for multiple comparisons ($p = 0.062$).

Notably, the effect of AD on memory salience was significantly moderated by sex ($b = -0.690$, $SE = 0.340$, $p < 0.05$). Specifically, this effect was positive and significant only for women. For men, it was slightly negative and nonsignificant.

Hypothesis 2 The effect of savouring on memory positivity via memory salience.

The results of the multilevel mediation analysis are reported in Table 4. They suggest that approximately 41%[3] of the effect of savouring on memory positivity was mediated by the effect of savouring on memory salience ($b = 0.127$, CI 95% [0.052, 0.22], $p < 0.001$).

Table 4 also contains the results of the multilevel mediation analyses in which AD and CC were examined separately. Memory salience at t1 significantly mediated the effect of the induction of each strategy on memory positivity at t1. More specifically, approximately 37% of the effect of AD on memory positivity at t1 was mediated by the effect of AD on memory salience ($b = 0.134$, CI 95% [0.051, 0.24], $p < 0.001$), and 26% of the effect of CC on memory positivity at t1 was mediated by the effect of CC on memory salience ($b = 0.089$, CI 95% [0.004, 0.19], $p < 0.05$). Consistent with the previous findings, the mediation by memory salience of the effect of AD on memory positivity was significant only for women.

3.2 Exploratory Analyses: Differential Effects of Savouring on Memory Phenomenology

The results of the exploratory analyses are reported in Table 5.

Memory accessibility and visual perspective were significantly enhanced by all savouring strategies, while the SM condition was the only one that positively impacted on all phenomenological dimensions at t1. The delivery of AD instructions was associated with more accessible, coherent, first-person perspective, and vivid memories, while RM positively impacted accessibility, coherence, memory sensory details, and visual perspective. Finally, CC significantly predicted three memory characteristics: accessibility, first-field perspective and vividness. Importantly, the above-mentioned effects which did not exceed $b = 0.42$ became nonsignificant after correction for multiple comparisons.

Besides, some of the significant effects were again significantly moderated by sex. Specifically, the effect of AD on accessibility ($b = -0.873$, $SE = 0.76$, $p < 0.05$) and vividness ($b = -0.530$, $SE = 0.378$, $p < 0.05$), as well as the effect of SM on coherence ($b = -0.735$, $SE = 0.351$, $p < 0.05$), sensory details ($b = -0.683$, $SE = 0.307$, $p < 0.05$), and vividness ($b = -0.721$, $SE = 0.360$, $p < 0.05$), were positive and significant only for women. For men, they were slightly negative and nonsignificant.

[3] This percentage was obtained by dividing the indirect effect by the total effect, as it is commonly made in mediation analyses.

Table 5 Linear mixed-effects model using each of the four experimental conditions against the control one to predict the five phenomenological dimensions of memory

Predictor	t1 Accessibility			t1 Coherence			t1 Sensory details			t1 Visual perspective			t1 Vividness		
	b	SE	p	b	SE	p	b	SE	p	b	SE	p	b	SE	p
Intercept	2.831***	0.318	<00.001	2.968***	0.304	<0.001	2.424***	0.259	<0.001	2.751***	0.274	<0.001	2.010***	0.317	<0.001
SM vs. CNTR	0.422*	0.178	0.019	0.563***	0.175	0.001	0.330*	0.156	0.036	0.591***	0.164	0.001	0.472**	0.180	0.009
AD vs. CNTR	0.610***	0.171	0.001	0.543***	0.168	0.001	0.236	0.150	0.118	0.369*	0.157	0.020	0.468**	0.174	0.009
CC vs. CNTR	0.374*	0.178	0.037	0.284	0.174	0.104	0.046	0.157	0.768	0.469**	0.165	0.005	0.394*	0.181	0.031
RM vs. CNTR	0.546**	0.180	0.003	0.349*	0.176	0.049	0.384*	0.159	0.016	0.467**	0.167	0.006	0.326	0.183	0.076
t0 Positivity	0.145**	0.049	0.004	0.114*	0.048	0.020	0.161***	0.040	<0.001	0.099*	0.042	0.020	0.242***	0.049	<0.001

CNTR: control; SM: situation modification; AD: attentional deployment; CC: cognitive change; RM: response modulation. *$p<0.05$, **$p<0.01$, ***$p<0.001$

4 Discussion

So far, a growing body of literature has shown that the emotional underpinnings of an event and the strategies deployed to deal with ongoing emotional states are likely to affect the way people remember it. While the effects of negative emotion regulation on memory has been extensively investigated (e.g., Dillon et al., 2007; Hayes et al., 2011; Richards & Gross, 2000; Richards et al., 2003), the link between savouring positive experiences and AMs has been less studied. The available investigations in the field of positive emotion regulation mainly rely on the retrospective assessment of personal events, the use of trait questionnaires to assess savouring, and the exploration of a reduced number of memory properties (Biskas et al., 2019; Chun et al., 2017; Jose et al., 2020). In the present investigation, we aimed to address these gaps by utilizing an ecological approach, which involved investigating naturalistic positive events, manipulating savouring strategies in real life, and assessing their influence on subsequent memory. Our hypothesis was that the manipulation of savouring would lead to retrieve more salient memories which, in turn, would increase the likelihood to keep their positive intensity over time.

Overall, our results support the hypothesis that upregulating the pleasant feelings experienced during a positive event can affect its subsequent recall, specifically indicating that savouring leads to the retrieval of memories with higher salience and positivity. The ability to savour positive situations might therefore not only have short-term effects in terms of enhanced positive emotions and well-being (Colombo et al., 2021a; Livingstone & Srivastava, 2012), but also long-term outcomes in terms of memory. Importantly, all conditions required participants to write the event down (i.e., record it in the survey by describing it), while only the experimental conditions provided instructions specifically targeting the upregulation of positive emotions. This suggests that our findings can´t be solely explained by an increase in the elaboration of the events but rather by the experimental induction of savouring.

Notably, different findings were observed in relation to the two main variables of interest: memory salience and memory positivity.

Regarding the former, our findings showed that the experimental manipulation of emotion regulation predicted more accessible, coherent, vivid, emotionally intense, and detailed memories (i.e., higher memory salience), regardless of the strategy considered. These results might suggest that it is savouring, rather than the specific cognitive (CC), behavioural (SM, RM) or attentional (AD) strategy deployed to relish a positive situation, which increases the salience of the associated memory. As suggested by Dillon et al. (2007), two possible explanations might be provided to these results. On the one hand, the "arousal hypothesis" suggests that emotion regulation affects memory by influencing emotional arousal, so that events with higher emotional intensity are associated with more durable, detailed, and accurate memories (Anderson et al., 2006; Cahill & McGaugh, 1995; Phelps & Sharot, 2008). In this sense, we may hypothesize that our manipulation successfully enhanced the intensity of participants' positive emotional experience, thus resulting in more salient memories at the time of recall. On the other hand, the "stimulus elaboration hypothesis" suggests that emotion regulation might influence memory via effects on stimulus encoding, as different strategies might encourage different levels of elaboration (Dillon et al., 2007). Since savouring has been shown to be associated with an increased ability to attend to and relish a positive event through the enhancement of one's attention to the details (Bryant & Smith, 2015; Bryant & Veroff, 2007; Jose et al., 2020), we may hypothesize that our manipulation triggered a deeper elaboration of the event at the time of its

encoding, thus resulting in memories with higher salience. This hypothesis is in line with the concept of Active Memory Building proposed by Bryant and Veroff (2007), defined as '*a way of savouring in which people search for, notice, and highlight those aspects of positive experiences they find most enjoyable*' (Bryant & Veroff, 2007, p. 93). According to the authors, savouring a pleasant experience does not only involve the amplification of the associated positive emotions but also a more focused attention on its features and details which, in turn, leads to the creation of more reliving, vivid, and easily recalled memories. Although in their study Dillon et al. (2009) found evidence for the latter hypothesis, the design of our investigation does not allow us to conclude whether savouring influences memory via effects on arousal or stimulus encoding.

Besides, different results were observed in relation to memory positivity. The comparison of savouring versus the control condition predicted enhanced memory positivity at t1, which was mediated by enhanced memory salience. However, when we considered each strategy alone, only AD and CC significantly predicted memory positivity, which was enhanced via higher memory salience at the time of recall. In other words, our results suggest that these two strategies did not directly affect the positivity of a recalled event but instead enhanced the salience of the associated memory and indirectly increased the overall recalled positivity. It is noteworthy that, while memory salience was a complex and multifaceted construct assessed through a questionnaire and involving the ability to visually imagine, re-experience, and access a memory, memory positivity was assessed with a single item, in which participants were invited to retrospectively rate the positive valence of an event (i.e., the cognitive appraisal one week after its occurrence). Furthermore, while SM (i.e., taking an action to modify a situation) and RM (i.e., expressing the emotions with the body) can be considered as behavioural strategies, AD and CC rely on cognitive processes (attention and reappraisal, respectively). It might be the case that, even though the use of behavioural strategies enhances the emotional intensity of a positive experience and the salience of the subsequent memory, it does not have any effect on its cognitive appraisal in the long run. Conversely, some cognitive processes need to be deployed during the experience of an event in order to keep its positive intensity over time, such as focusing one's attention on the positive moment or positively reinterpreting the meaning of the situation. Accordingly, AD and CC may trigger a deeper elaboration of a positive experience, thus resulting in higher perceived positivity at the time of recall.

AD specifically aims to direct one's attention to a pleasant emotional state and the associated sensations and feelings (Quoidbach et al., 2015). A growing body of literature has demonstrated that enhancing focused attention on a perceptual stimulus positively affects various cognitive processes, such as sustained and selective attention, disengagement from potential distractors, and self-regulatory processes (Lutz et al., 2008; Zeidan et al., 2010). These, in turn, lead to better encoding (Bonamo et al., 2015), working memory (Chambers et al., 2008; Zeidan et al., 2010), and episodic memory performance (Brown et al., 2016; Crawley, 2015). In this sense, it might be the case that our AD instructions helped participants bring and focus their attention on the positive experience, making its positive valence more salient in memory over time. Differently, CC involves an active process of changing the meaning of a stimulus in order to shape the associated emotional state (Troy et al., 2018), implying a deeper conceptual analysis of a situation (Richards et al., 2003). Previous studies have shown that cognitive reappraisal not only improves memory performance (i.e., more detailed memories) (Dillon et al., 2007; Hayes et al., 2011; Richards & Gross, 2000; Richards et al., 2003) but also promotes a positive reframing of a negative stimulus, remembered as more positive than it actually was (Colombo et al., 2021a, 2021b; Rusting & DeHart, 2000; Wisco & Nolen-Hoeksema, 2010). Similarly, our results seem to suggest

that CC might induce a more positively-valenced mental representation of an event, thus helping to maintain its positivity in memory over time.

In an attempt to gain a deeper understanding of the effects of savouring on memory, we also explored the unique impact of each strategy on the five memory dimensions considered in the present investigation. Our results collectively suggest that the accessibility and first-field perspective of a memory were consistently enhanced when delivering instructions to upregulate positive emotions, regardless of the type of manipulation. In other words, the events in the experimental conditions were retrieved with less efforts and recalled from a first-field perspective, as typically observed with more intense emotional episodes (Berntsen & Rubin, 2006; D'Argembeau et al., 2003). However, some dimensions were uniquely affected by the type of strategy deployed: memory coherence through SM and AD, sensory information through SM and RM, and vividness through SM, AD, and RM.

Finally, it is worth noting that several results were influenced by gender, as many of the effects of savouring on memory were only significant among female participants. Importantly, women significantly outnumbered men in the sample, which might account for some of the null findings. Yet, an alternative explanation could be considered. A growing body of literature has explored gender differences in emotional expression, reactivity, and regulation (Chaplin, 2015; Goubet & Chrysikou, 2019), suggesting that gender differences in positive emotion regulation might exist. The socialization hypothesis posits that differences in emotional experiences between genders may arise from societal beliefs and expectations regarding male and female roles (Grossman & Wood, 1993). Due to established gender stereotypes and societal expectations, women are more inclined to implement emotion-focused strategies, as well as to seek and express emotions, especially positive ones (Eagly & Wood, 1982; Kring & Gordon, 1998; LaFrance et al., 2003). Accordingly, women have been shown to use amplifying strategies in response to positive events (i.e., savouring) to a greater extent than man (Bryant & Veroff, 2007; Kim & Bryant, 2017). One possible hypothesis could be that, being more skilled at identifying positive experiences, expressing positive emotions, and savouring them, women might benefit more from the savouring manipulation due to practice effects. However, this explanation warrants further exploration by future studies recruiting a more gender-balanced sample.

In the same vein, further research is need to address the limitations of the present study. First, we only collected positive daily events and their associated memories one week after their occurrence, so our results can't be generalized to more salient life events and longer-term recalls. Additionally, the positivity of the episodes and associated memories was assessed through a single item, which might not have completely captured the complexity of participants' appraisals. Second, although the instructions were developed based on prior research on positive emotion regulation strategies (Quoidbach et al., 2015) and revised by experts in the field, they were not validated before the study began. We also did not assess whether the instructions provided to the participants were actually deployed at the time of the event, and we did not control for the spontaneous use of savouring strategies during each event. Third, individual differences in savouring skills might have also introduced a selection bias. For instance, people who tend to savour positive events more often might show a lower threshold for positively-valenced events and report a higher number of daily positive experiences, as corroborated by Jose et al. (2020). Therefore, future studies might be interested in investigating whether these effects remain consistent when participants are instructed to report neutral events while being provided with instructions to make them more positive. Finally, when it comes to participants who reported multiple events, only the first memory recall notification was genuinely a "surprise", as they likely anticipated similar notifications for the

other episodes reported in the EMA. The introduction of the "surprise" element aimed primarily at mitigating biases during the event assessment phase rather than the recall phase. Disclosing information about the recall task might have led participants to concentrate more on the details of the events reported in the EMA, potentially influencing subsequent memory retrievals. While the study's design prevented biases during assessment, the lack of unexpectedness after the first recall task could have affected the recall of the memories. For instance, participants might have anticipated subsequent notifications by reminiscing about the events reported in the EMA, potentially impacting how they remembered them. Although conditions were randomized to guarantee that the first recall belonged to a different condition, more studies are needed to confirm the results observed in the present study.

Despite the aforementioned limitations, this study provides novel insights on how savouring affects AM, which might also have potential implications for emotional well-being research. AM is an essential component of well-being (McAdams, 1996) and one's life narrative (Pascuzzi & Smorti, 2017), since recalling personal events is a process through which people try to coherently reconstruct the past in order to provide a sense of continuity to the Self (Barclay, 2009; Conway, 1996). Furthermore, reminiscing about the past has been recognised as a powerful strategy that guides future goal-oriented behaviours (Cowan et al., 2021) and enhances emotional well-being in the present through the re-experience of pleasant memories (Bryant, 2021; Bryant et al., 2005; Quoidbach et al., 2015). The present study confirms previous evidence regarding the link between savouring and AM, suggesting that "savorers" might be more prone to vividly retrieve and enjoy positive memories.

Owning more reliving and detailed memories of past positive experiences may represent a crucial source of one's emotional well-being, fostering pleasant emotions (Bryant et al., 2005; Speer et al., 2014; Westermann et al., 1996), buffering against stress (Speer & Mauricio, 2017), and bolstering self-identity (Bluck et al., 2005). In this sense, depression has been shown to be characterized by a greater, faster, and more detailed recall of negative rather than positive memories (Farina et al., 2019; Gupta & Kar, 2012; Hitchcock et al., 2017; Lemogne et al., 2006; Young et al., 2012), while also presenting impaired use of strategies to upregulate positive emotions (Carl et al., 2013). The present study might suggest the existence of a link between impaired savouring skills and reduced positive memory recall. Although more studies are needed to confirm this hypothesis, our findings point towards the importance of boosting "*the capacity to attend to, appreciate and enhance the positive experiences in one's life*" (Bryant & Veroff, 2017, p. XI) to encourage more vivid positive memories and promote emotional well-being.

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Declarations

Conflict of interest The authors report there are no competing interests to declare.

Informed Consent This study was approved by the ethics committee of Jaume I University (Spain) (certificate number: CD/57/2019), and informed consent was obtained from all the participants.

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