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The Potential of Positive Technology
Against the Burden of Coronavirus

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Virtual Reality Meets COVID-19:
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Mental Time Travel: The role of Positive Rumination

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Abstract. According to a long tradition of research, people are used to mentally time travel: That is, to recreate memories from the past and envision future scenarios. To date, a growing body of evidence has revealed that people's estimations about past and future emotional states are inaccurate. Nevertheless, the mechanisms underlying these biases are still understudied, and the potential role of response style to positive affect (PA) has not been explored yet. Here, we implemented a two-week Ecological Momentary Assessment (EMA) design to monitor PA in 84 healthy individuals, who were asked to forecast and recall their mood before and at the end of the study. According to the results, participants with high levels of emotion-focused positive rumination showed higher accuracy in forecasting future PA, whereas participants with high self-focused positive rumination overestimated future PA and were highly accurate in retrospectively recalling experienced PA. Altogether, we suggest that more accurate or positively biased estimations of past and future states may in part be the consequence of an individual's predisposition to ruminate on positive experiences and self-qualities.

Keywords. Recall bias, affective forecasting, mental time travel, cognitive bias.

1. Introduction

According to a long tradition of research, people are used to mental time travel, i.e. to recall episodes from the past and forecast future scenarios (1). While positive reminiscence has been proved to be an effective strategy to increase positive emotions (2) and happiness (3), affective forecasting has been suggested as a future-oriented strategy (4) that drives decisions (5) and enhances emotional well-being (6).

Interestingly, people's ability to forecast and recall positive emotional states is often imprecise (7–9). So far, several individual factors have been associated with the presence of these biases, such as personality traits (10,11), emotional intelligence (12), or psychopathology (13,14). Besides, an additional factor contributing to inaccurate emotional estimations might be represented by response styles to positive affect (PA) (15). Whereas dampening is the attempt to reduce the intensity and duration of ongoing positive emotions (16), positive rumination refers to recurrent thoughts about one's positive experiences and personal strengths that allow to maintain and prolong positive emotions (17). Notably, an intense over-focus on positive events, pleasant emotions and self-qualities might influence the mental representation of future and past affective states,

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thus leading habitual positive ruminators to have an optimistic, yet biased, past- and future-oriented disposition.

The aim of the current study was to explore PA forecasting and recall biases and their association with response styles to PA. We hypothesize that habitual positive ruminators will show more accurate or positively biased future and past PA estimations.

2. Methods

2.1. Sample

91 undergraduate students were recruited via online advertisements at Jaume I University (Spain). In order to control for the confounding effect of depression and anxiety on forecasting and recall biases (18), we excluded participants with a score above 14 on the Patient Health Questionnaire (PHQ-9) and the Generalized Anxiety Disorder (GAD-7), i.e. participants with moderately/severe clinical conditions. 6 participants were therefore excluded from the study. One further participant was excluded due to missing data. The final sample was composed of 71 females and 13 males ($n=84$), and mean age was 20.77 years ($SD=2.25$). This was a secondary analysis of data from a previous study investigating forecasting abilities in relation to resilience and well-being.

2.2. Measures

Anticipatory and retrospective affect estimations: Participants were administrated the Spanish adaptation (19) of the Positive and Negative Affect Schedule (PANAS) (20). Only the PA subscale was considered within the analyses. In the case of forecasted affect, the instructions provided to participants were “Indicate the extent you think you will feel this way over the next two weeks”, whereas the instructions for affect retrospective estimation were “Indicate the extent you have felt this way over the past two weeks”. Both forecasted PANAS-PA ($\alpha=.907$) and recalled PANAS-PA ($\alpha=.911$) showed good internal consistency.

Response style to positive affect: The Response to Positive Affect (RPA) scale was adopted to assess participants’ habitual use of three strategies in response to positive mood: Emotion-focused positive rumination, i.e. recurrent thoughts about positive mood and pleasant somatic experiences; self-focused positive rumination, i.e. recurrent thoughts about the Self and personal goals; and dampening, i.e. the attempt to decrease the intensity and duration of positive emotions (15). Good internal consistency was observed for the three subscales (emotion-focused positive rumination: $\alpha=.764$; self-focused positive rumination: $\alpha=.827$; dampening: $\alpha=.839$).

Experienced positive affect: Participants were prompted three times per day to rate momentary PA (“To what extent are you experiencing positive emotions?”) on a 0-100 scale.

2.3. Procedures

After checking for the inclusion criteria, participants were invited to sign the informed consent. Repeated daily assessments were collected by means of Qualtrics, a web-based platform to create and automatically send customized surveys by email. In the present study, three semi-randomized daily assessments were sent (between 9:30 - 14:00; 14:00 - 18:30; and 18:30 - 23:00) over two weeks. Participants were given sixty minutes to complete the evaluation. At the end of the study, participants completed the psychological scales. This study was approved by the ethics committee of the Jaume I University.

2.4. Data analysis

Forecasted and recalled PA refers to the PANAS-PA subscales administrated at the beginning and at the end of the study. Experienced PA was the mean of the 42 possible PA-EMA assessments. To have the same range of scores for forecasted (PANAS: 1-to-5 Likert scale) and experienced PA (EMA: 0-100 scale), PANAS-PA scores were

transformed to Percent of Maximum Possible (POMP) Scores (21,22), which express raw scores in terms of the maximum possible score and can range between 0 and 100.

To investigate the effect of time on affect estimations, an ANOVA analysis was performed using one within-subject factor (PA estimations) with three levels (forecasted PA, experienced PA and recalled PA). To explore the effect of PA response styles on PA affect estimations, three separate ANCOVAs analyses were conducted using one within-subject factor (PA estimations) and three levels (forecasted PA, experienced PA and recalled PA). In three different models, we explored the impact of PA response style by including each of three possible styles as covariate (positive rumination - self focused, positive rumination – emotion focused, dampening).

3. Results

A repeated measures ANOVA showed that mean PA differed significantly across time (Mauchly's Test of Sphericity: $\chi^2(2) = 3.65$, $p = .161$; $F(2,166) = 22.87$, $p < .001$). Paired comparisons with a Bonferroni correction showed a significant difference between forecasted ($M=49.97$, $SD=18.47$) and experienced PA ($M=55.65$, $SD=18.56$; $p < .05$), between forecasted and recalled PA ($M=42.02$, $SD=16.70$; $p < .001$), and between experienced and recalled PA ($p < .001$). In other words, participants both forecasted and recalled lower levels of PA than what experienced.

ANCOVAs analyses were conducted to explore the presence of a statistically different effect of time on affect scores controlling for PA response style. A significant effect was observed for emotion-focused positive rumination ($F(1,82)=4.77$, $p < .05$) and self-focused positive rumination ($F(1,82)=11.05$, $p < .001$) (**Figure 1**), but not dampening ($F(1,82)=1.87$, $p = .175$). Forecasted PA significantly correlated with emotion-focused positive rumination (forecasted PA: $r = .213$, $p = .05$), whereas both forecasted ($r = .361$, $p < .001$) and recalled PA ($r = .272$, $p < .05$) were positively associated with self-focused positive rumination.

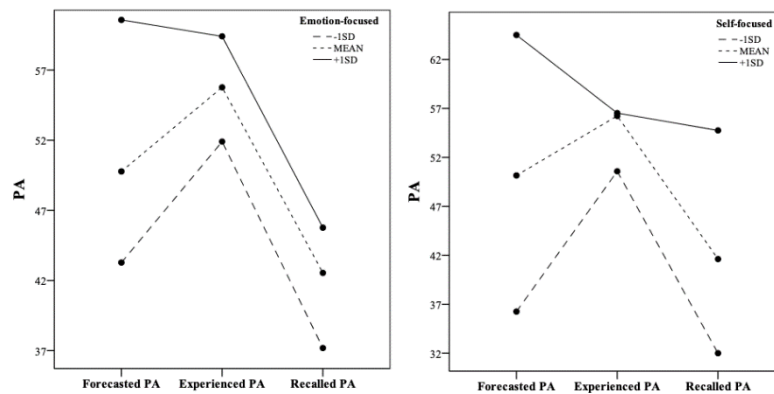


Figure 1. Estimated mean levels of forecasted, experienced and recalled PA controlling for positive rumination.

4. Discussion

In the current study, we explored the ability to estimate future and past positive affective states in a sample of undergraduate students, and we investigated the potential association between PA response style and biased PA estimations.

According to the results, participants were generally inaccurate in estimating PA levels. However, a significant effect of strategy use in response to positive states was observed. More specifically, participants with high levels of emotion-focused rumination showed higher accuracy in forecasting future PA, whereas participants with high levels of self-focused rumination overestimated future PA and were highly accurate in retrospectively recalling PA levels. These results suggest that more accurate or positively

biased estimations of positive affective states may in part be the consequence of an individual's predisposition to use positive rumination.

The act of ruminating is the process of continuously and repetitively thinking about the same thoughts (23). While self-focused rumination refers to an individual's emphasis on the Self, personal qualities and life goals, emotion-focused rumination implies a specific focus on positive emotional states (15). Accordingly, intense positive rumination could lead to more optimistic and positively biased expectations about the future, while consolidating the memory for the positive experiences happened in the past. The presence of a more optimistic past- and future-oriented disposition in habitual positive ruminators is coherent with previous findings, revealing lower depressive symptoms and higher self-esteem in individuals showing high rates of positive rumination (15).

The results of the current study have to be considered in light of some limitations. Further research is needed to confirm the present findings, which involved a relatively small sample composed of undergraduate students. Furthermore, experimental studies are needed to disentangle causal rather than correlational conclusions.

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