

# Understanding emotion and emotional scarring in recurrent depression

Gerard D. van Rijsbergen<sup>a</sup>, Steven D. Hollon<sup>b</sup>, Hermien J. Elgersma<sup>a</sup>, Gemma D. Kok<sup>a</sup>,  
Jack Dekker<sup>c,d</sup>, Aart H. Schene<sup>e,f</sup>, Claudi L.H. Bockting<sup>a,g,\*</sup>

<sup>a</sup>Department of Clinical Psychology, University of Groningen, Groningen, The Netherlands

<sup>b</sup>Vanderbilt University, Department of Psychology, Nashville, TN, USA

<sup>c</sup>Research Department, Arkin Mental Health Institute, Amsterdam, The Netherlands

<sup>d</sup>Department of Clinical Psychology, VU University, Amsterdam, The Netherlands

<sup>e</sup>Department of Psychiatry, Academic Medical Center, University of Amsterdam, Amsterdam, The Netherlands

<sup>f</sup>Department of Psychiatry, Radboud University Medical Center, Nijmegen, The Netherlands

<sup>g</sup>Department of Clinical Health Psychology, Utrecht University, Utrecht University, Utrecht, The Netherlands

## Abstract

**Background:** A single-item assessment of sad mood after remission from MDD is predictive of relapse, yet the mechanisms that play a role in depressive relapse remain poorly understood.

**Methods:** In 283 patients, remitted from recurrent depression (DSM-IV-TR criteria; HAM-D<sub>17</sub> score  $\leq 10$ ), we examined emotional scarring, that is, whether the number of previous depressive episodes was associated with higher levels of sad mood as assessed with a 1-item Visual Analogue Mood Scale (VAMS). We then fitted a cross-sectional multivariate regression model to predict sad mood levels, including the Dysfunctional Attitude Scale Version-A, cognitive reactivity (Leiden Index of Depression Sensitivity), Ruminative Response Scale, and Everyday Problem Checklist.

**Results:** Patients with greater numbers of prior episodes experienced higher levels of sad mood after remission. In multivariate regression, intensity of daily stress and dysfunctional beliefs were associated with the VAMS (Adj.  $R^2 = .091$ ) although not over and above depressive symptomatology (Adj.  $R^2 = .114$ ). Cognitive reactivity was not associated with sadness.

**Conclusions:** Our finding that patients with more previous MDEs reported higher levels of sad mood while remitted could be indicative of emotional scarring. Dysfunctional beliefs and intensity of daily stress were associated with sad mood but not over and above residual symptoms. Thus, illness related characteristics especially are associated with sad mood after remission. More negative affect after remission could result in lower stress tolerance or more stress intensity could result in negative affect. Future studies should examine premorbid sadness in a longitudinal cohort, and should study the exact pathway from stress, affect, and cognition to relapse.

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## 1. Introduction

Emotional states or affective experiences have been characterized as highly dynamic constructs [1–3]. Within these dynamics, several authors have recently suggested some stability in the form of core affect [4,5]. The presence of negative affect itself, but also of affective inertia (the predictability of a current affective state by a previous state) has been related to the onset of affective disorders including Major Depressive Disorder (MDD) up to 2.5 years (for

affective inertia) [6] and 10 years later (for negative affect) [7]. Being one of the core symptoms of MDD [8], sad mood after remission is predictive of an early return of the disorder [9,10]. Besides being sad at one moment, reactivity of mood has also been found to predict relapse in depression [11], even up to 5.5 years [12].

Although the number of previous MDEs is among the most consistent risk factors for relapse in depression [13–15], the influence of previous MDEs on sad mood levels after remission remains unexplored. Possibly, sad mood levels after remission are the result of emotional scarring due to a previous depressive episode. Whereas *set point* theory [16] suggests that disturbances in affect are followed by return to baseline levels in the long run (i.e., the set point), more recent studies suggest that life events including unemployment,

\* Corresponding author at: University of Groningen, Department of Clinical Psychology, Grote Kruisstraat 2/1, 9712 TS Groningen, The Netherlands. Tel.: +31 50 3636479.

E-mail address: [C.L.H.Bockting@uu.nl](mailto:C.L.H.Bockting@uu.nl) (C.L.H. Bockting).

divorce, and widowhood lead to a new equilibrium instead [17,18]. In one study, the affective set point was not yet reached up to eight years post-event [17]. These new set points potentially reflect an emotional scar as a result of prolonged exposure to stress or negative affect, similar to what occurs in MDD. Alternatively, patients with higher levels of sad mood before the onset of the first episode might have a poor prognosis for the course of depression. The current study will be among the first to examine the association between sad mood and the number of previous depressive episodes.

Given the importance of monitoring sad mood after remission from MDD to detect relapse, we have recently focused on the assessment of sad mood using a single-item Visual Analogue Mood Scale (VAMS). In these studies we demonstrated that a VAMS was a predictor of time to relapse. Each centimeter increase in sad mood as indicated by the patient on the VAMS by placing a mark on a 10-centimeter line would result in increased risk of relapse by a factor 1.15 over a period of 5.5 years [9]. Moreover, the VAMS had excellent diagnostic accuracy in the classification of a current depressive episode, both in terms of discriminative power and diagnostic accuracy [19]. Despite these promising results, it remains to be established whether sadness is related to other well-known potentially modifiable vulnerability factors, which will be the focus of the current study.

Relapse prevention interventions focus on potentially modifiable risk factors for relapse that are known to negatively influence the course of depression. These potentially modifiable risk factors include dysfunctional beliefs, cognitive reactivity, rumination and daily stress [14,20–22]. Recent cognitive theories suggest that dysfunctional beliefs are mood state dependent [23–25], and their degree of activation by mild sadness caused by stressors signals vulnerability for depression (i.e., cognitive reactivity) [26]. However, the evidence for the mood state dependence of dysfunctional beliefs is highly mixed, since it was found that dysfunctional beliefs also predict relapse in depression without activation [12,21,27]. Moreover, the experience of sadness or daily stress, without taking cognition into account, was found to predict relapse in depression directly [9,10,14,28]. Therefore, it remains unclear whether belief activation (or the presence of dormant beliefs) is crucial in the causal chain from stress or negative affect to relapse in depression. Given that negative affect and the intensity and frequency of daily stress are related [29–32], it could be that patients with higher sadness after remission experience more stressors or are more affected by daily stressors due to reduced stress tolerance. Alternatively, higher negative affect also could be the direct result of stressors (and all could be true).

The aim of the current study is to increase our understanding of the role of cognition, stress, and emotion in the pathway to depressive relapse. We will 1) examine whether patients with a higher number of previous MDEs experience higher levels of sad mood after remission, as suggested by the emotional scarring hypothesis; 2) study potentially modifiable correlates of sadness assessed after remission, including dysfunctional beliefs, cognitive

reactivity, rumination, and the intensity and frequency of daily stress, whilst also including illness related variables (i.e., residual depressive symptoms, age of onset, number of previous depressive episodes, and last episode severity); and finally 3) attempt to replicate previous findings on the predictive validity of the VAMS by assessing whether baseline sadness (VAMS) predicts depressive symptomatology three months later.

## 2. Method

This study uses data from a research portal where patients with a remitted recurrent depression can participate in studies that specifically focus on the course and treatment of recurrent depression. The data from two randomized controlled trials, for readability referred to as Study A and Study B, were analyzed. Study A focused on Preventive Cognitive Therapy (PCT) in groups as an addition or alternative to Antidepressant Medication (ADM) versus ADM alone in the prevention of relapse in recurrent depression [33]. Study B examined the effectiveness of an internet adaptation of PCT added to Treatment-As-Usual (TAU) versus TAU alone in the prevention of relapse in recurrent depression [34]. Both protocols were approved by the Medical Ethical Committee for Mental Health Institutions and all patients provided written informed consent prior to participation.

### 2.1. Participants

In both studies, patients were included who had a) experienced at least two lifetime Major Depressive Episodes (MDEs), of which the last MDE was no longer than two years ago; b) current remission of the last MDE for at least two months, both defined according to the Diagnostic and Statistical Manual of Mental Disorders (DSM–IV) and assessed with the Structured Clinical Interview for DSM–IV Disorders (SCID-I) [35], administered by trained psychologists and researchers; and c) a current score of  $\leq 10$  on the 17-item Hamilton Depression Rating Scale (HAM-D<sub>17</sub>). Exclusion criteria were: current mania, hypomania, a history of bipolar illness, any psychotic disorder (current and previous), organic brain damage, current alcohol or drug abuse, predominant anxiety disorder, and recent electroconvulsive therapy. Both studies included remitted patients, but differed to the extent that Study A only included patients who a) were currently on ADM for at least six months, and b) did not receive psychotherapy more frequent than twice per month. In Study B, there were no restrictions with respect to both type and frequency of current care (i.e., psychotherapy, ADM, specialty care, no care).

### 2.2. Measures

#### 2.2.1. Relapse in MDD

SCID-I interviewers attended regular consensus meetings to enhance inter-rater agreement. Potential relapses during follow-up were assessed for all patients using the SCID-I.

Within the current manuscript the following assessment points were used: T<sub>2</sub> (after 3 months) and T<sub>6</sub> (after 15 months) from Study A and T<sub>2</sub> (after 3 months), T<sub>5</sub> (after 12 months), and T<sub>9</sub> (after 24 months) from Study B.

### 2.2.2. Visual Analogue Mood Scale (VAMS)

Patients were asked to rate their current mood on a telephone-assisted version of a Visual Analogue Mood Scale (VAMS) previously used in mood induction procedures [12,36]. By telephone, patients received the following instruction: ‘Please rate your current mood on a scale of 0 to 100, on which 0 indicates ‘happy’, and 100 indicates ‘sad’ and their answer was noted by the interviewer.

### 2.2.3. Inventory of Depressive Symptomatology – Self Report (IDS-SR)

The Dutch translation of the 30-item IDS-SR [37] was used to assess levels of depressive symptomatology. The IDS-SR is a self-report measure on which patients rate their symptoms on a scale of zero to three. The IDS-SR rates all DSM-IV core symptom domains including mood, cognitive and psychomotor symptoms, but also commonly associated symptoms including anxiety. The IDS-SR had an excellent internal consistency in a previous study ( $\alpha = .92$ ) [38].

### 2.2.4. Everyday Problem Checklist (EPCL)

We used the Dutch translation of the Everyday Problem Checklist to assess the occurrence of 114 daily stressors in the three months preceding the measurement point. Based on the manual [39], we created two scores: the frequency and the intensity of daily stress. The frequency of daily stress was the sum of all items that were experienced, and ranged from 0 to 114. The intensity of daily stress reflects the impact of stressors and was calculated by dividing the total intensity of all items by the frequency, resulting in a score with a range of 0 (‘no impact’) to 3 (‘major impact’). In the current study, the reliability across all items was excellent ( $\alpha = .92$ ).

### 2.2.5. Dysfunctional Attitude Scale – Version A (DAS-A)

In the current study the Dutch adaptation [40] of the DAS-A [41] was used to assess dysfunctional beliefs. On the DAS-A patients rated their agreement with all 40-items on a seven-point scale that ranged from ‘totally agree’ to ‘totally disagree’. The DAS-A demonstrated excellent reliability in a previous study ( $\alpha = .86$ ) [42], and had a reliability of  $\alpha = .95$  in the current study.

### 2.2.6. Leiden Index of Depression Sensitivity (LEIDS)

The LEIDS is a self-report questionnaire that aims to measure cognitive reactivity to sad mood independent of mood induction [43]. After imagining a mildly depressed mood, patients rated all 34-items on a scale that ranged from one ‘not applicable’ to five ‘strongly applicable’. An exemplary item is ‘When I feel sad, I feel I can afford fewer mistakes’. The LEIDS was found to be significantly associated ( $r = .43$ ) with changes in dysfunctional beliefs following mood induction [43]. Cronbach’s alpha in the current study was .90.

### 2.2.7. Ruminative Response Scale (RRS)

Rumination was assessed using the validated Dutch adaptation of the RRS, the RRS-NL [44]. Patients rated their agreement on a scale that ranged from ‘almost always’ to ‘almost never’. The five-item subscale brooding was used, as this aspect of rumination appears to specifically reflect dysfunctional and maladaptive thinking and is related to depression later in time [45]. In the current study, Cronbach’s alpha for the total RRS was .91, and .74 for the brooding subscale.

### 2.2.8. Personality Diagnostic Questionnaire 4+ (PDQ-4+)

The PDQ-4+ [46] is a self-report personality questionnaire with 99 true/false items that directly correspond to personality disorders in the DSM-IV. For the current study we used the total PDQ-4+ score, which reflects overall continuous levels of personality pathology. The psychometric properties of the PDQ-4+ appear to be reasonable, with adequate internal consistency in a recent study (Cronbach’s alpha between .49 and .75) [47]. Lower internal consistencies of the PDQ-4+ have also been attributed to the nature of PDs [48,49]. Cronbach’s alpha for the total overall dimensional score was .92 in the current study.

## 2.3. Procedure

The procedure for both studies was similar. Upon entry in the studies, patients were followed for two years. During the baseline and follow-up telephone interviews, the VAMS was administered first, followed by the SCID-I and then the HAM-D<sub>17</sub> interview. In the same week, the IDS-SR, DAS, LEIDS, RRS, and EPCL were administered online, which patients could access through a personalized hyperlink. The PDQ-4+ was administered at baseline in both studies (T<sub>0</sub>). Patient recruitment for the respective studies started in 2009 (Study A) and 2010 (Study B), with the VAMS being administered before every SCID-I interview since March 2012. This implies that, depending on the moment of inclusion, the time from inclusion up to the assessment of the first VAMS differed between patients and could be zero (first VAMS at inclusion for patients included after March 2012) up to 24 months (first VAMS at final assessment point).

## 2.4. Data analysis

After inspection of VAMS scores we found that the VAMS showed a modest deviation from the normal distribution. Therefore the VAMS scores were square root transformed, which improved normality. For reasons of clarity and interpretation, descriptives reflect untransformed data. All analyses were performed using SPSS version 20.0. Multiple imputation by chained equations was used to account for 9.8 % of the data that were missing. Following suggestions from Bodner [50], we used 12 imputations to account for missing data. The 12 imputations were combined according to Rubin’s rules.

First, we examined evidence for emotional scarring in recurrent depression. We therefore correlated the number of

Table 1

Patient demographic and clinical characteristics (Total sample: N = 283, including 216 patients from Study B and 67 patients from Study A).

Characteristic	<i>N</i> <sub>Total</sub>	Total sample	Study A	Study B	<i>p</i>
Female (%)	283	72.4	65.7	74.5	> .10
Age	283	47.1 (10.6)	47.9 (10.0)	46.8 (10.8)	> .10
Married or cohabiting (%)	279	65.6	62.7	65.3	> .10
Patients on antidepressants (%)	283	62.9	100.0	51.4	< .001
Current psychotherapy (%)	262	26.3	20.9	22.7	> .10
Median previous MDEs (IQR)	283	4.0 (2.0)	4.0 (3.0)	4.0 (2.0)	.04
Age of first onset	279	28.6 (12.4)	27.2 (12.6)	29.1 (12.4)	.272
Severity last MDE <sup>a</sup>	283				.043
Mild (%)		21.5	14.9	23.6	
Moderate (%)		52.7	50.7	53.2	
Severe (%)		25.8	34.3	23.1	
Total inclusion HAM-D <sub>17</sub>	283	3.2 (2.9)	2.8 (2.8)	3.4 (2.9)	> .10
Visual Analogue Mood Scale (VAMS)	277	30.2 (22.3)	33.2 (26.1)	29.2 (21.0)	> .10
Depressive symptomatology (IDS-SR)	235	16.3 (10.4)	14.6 (9.7)	16.9 (10.6)	> .10
Frequency of daily hassles (EPCL)	217	35.3 (16.0)	30.5 (13.6)	37.0 (16.5)	.008
Intensity of daily hassles (EPCL)	217	1.2 (0.5)	1.1 (.4)	1.2 (.5)	> .10
Dysfunctional attitudes (DAS)	228	127.3 (33.8)	118.7 (28.2)	130.4 (35.2)	.021
Cognitive reactivity (LEIDS)	223	101.4 (17.6)	101.9 (18.4)	101.3 (17.4)	> .10
Brooding (RRS)	219	11.0 (3.1)	10.4 (2.7)	11.2 (3.2)	> .10
Continuous personality score (PDQ-4 <sup>+</sup> )	281	23.3 (12.1)	21.4 (10.5)	23.9 (12.6)	> .10

Note. Descriptive characteristics represent mean (SD) unless stated otherwise. MDE = Major Depressive Episode, IQR = Interquartile range, HAM-D<sub>17</sub> = 17-item Hamilton Depression Rating Scale, PD = Personality Disorder.

<sup>a</sup> Last MDE severity is based on the number of SCID-I depression symptoms (5 symptoms corresponds to mild, 6–7 symptoms corresponds to moderate, whereas 8–9 symptoms corresponds to severe depression).

previous MDEs with the VAMS score. In addition, in order to quantify the difference between a group with a relatively high and low number of previous MDEs, a post-hoc median split was used to divide the sample according to the median in  $\leq 4$  versus  $> 4$  previous MDEs, followed by ANOVA to assess differences in sadness based on the median split. The data comprised of the first assessment point for each patient including a VAMS. First complete assessment points were collapsed across patients and do therefore not represent a specific time point.

Second, we examined whether the following potentially modifiable and illness-related variables were associated with the VAMS in multiple regression with the VAMS as the dependent variable. We included all potentially modifiable variables (i.e., dysfunctional beliefs, cognitive reactivity, rumination, and the intensity and frequency of daily stress) and illness-related variables (i.e., age of first episode onset, number of previous depressive episodes, and last episode severity) examined in the current study while also controlling for age and gender. In a second model, we also controlled for residual depressive symptomatology and dimensional personality pathology in order to examine whether the associations found in the previous model might be (partially) explained by these variables. For the multiple regression, 13 patients who had relapsed at the time the VAMS was assessed were excluded because we were interested in correlates of sad mood after remission.

Finally, we attempted to replicate previous findings concerning the predictive validity of the VAMS in an independent dataset. To prevent any intervention effects, only patients in the control groups from both studies (AD

alone in Study A, TAU alone in Study B) were selected, resulting in a subsample of 67 patients who filled out the VAMS at T<sub>0</sub>. As we were interested in the course of depressive symptomatology, patients with a relapse at T<sub>2</sub> were not excluded (and all patients were remitted at T<sub>0</sub>). We used linear regression analysis with the VAMS<sub>T0</sub> as the independent variable and the IDS-SR<sub>T2</sub> as the dependent variable with and without controlling for T<sub>0</sub> depressive symptomatology (IDS-SR).

### 3. Results

#### 3.1. Preliminary analyses

Before combining the datasets from both studies, we first examined potential differences between both studies (data presented in Table 1). Patients of Study A did not differ meaningfully from those of Study B on the most important outcome measures. There were significantly fewer patients with two MDEs in Study A than in Study B (12% in Study A, 24% in Study B). Moreover, patients in Study A also more often had a severe (compared to mild) previous MDE than in Study B (34.3% severe compared to 14.9% mild in Study A, 23.1% severe compared to 23.6% mild in Study B;  $\chi^2(1, N = 134) = 4.09, p = .043$ ).

As there are some indications that ADM use might affect patients' emotional experiences (Price et al., 2009), we also examined whether patients with versus without ADM use differed on the included clinical measures (dysfunctional beliefs, cognitive reactivity, brooding, intensity/frequency of daily stress, continuous personality pathology, VAMS,

Table 2  
Multivariate regression model ( $n = 270$ ) with VAMS levels after remission as dependent variable.

Variable	B	SE (B)	<i>t</i>	<i>p</i>	FMI
Constant	1.20	1.27	.941	.347	.12
Age	.019	.016	1.153	.249	.06
Gender	-.003	.335	-.010	.992	.06
Number of previous depressive episodes	.083	.057	1.459	.145	.03
Age of first onset	-.001	.014	-.054	.957	.05
Last episode severity	-.109	.204	-.538	.591	.05
Cognitive reactivity	.005	.012	.464	.643	.21
Dysfunctional beliefs	.015	.005	2.799	.006	.22
Brooding	-.106	.067	-1.583	.116	.34
Intensity of daily stress	1.069	.396	2.700	.008	.26
Frequency of daily stress	-.001	.011	-.104	.917	.26

Note. The VAMS is square-root transformed. VAMS = Visual Analogue Mood Scale, FMI = Fraction Missing Information.

IDS-SR, inclusion HAM-D<sub>17</sub>), which was not the case for any of the measures (all  $ps > .05$ ). Since the trials were highly similar on the most important measures, we subsequently merged the data.

### 3.2. Patients

The demographic and clinical characteristics of all patients ( $N = 283$ ) are depicted in Table 1. Most patients were female (72.4 %) and were remitted ( $M_{HAM-D17} = 3.24$ ,  $SD = 2.86$ ) from a median of 4 previous depressive episodes (IQR = 2.0). More than 75% of all patients had a moderate or severe previous MDE.

### 3.3. Emotional scarring in recurrent depression

We first examined whether we could find an association between the VAMS and the number of previous MDEs, which could be indicative of emotional scarring. First, there was a modest, but significant, positive association between the number of previous MDEs and the VAMS score ( $r_s = .15$ ,  $p = .018$ ). Following a post-hoc median-split, we found that remitted patients with more than four previous MDEs scored significantly higher on the VAMS ( $M_{>4 \text{ episodes}} = 33.39$ ,  $SD = 22.87$ ) than remitted patients with four or fewer previous MDEs ( $M_{\leq 4 \text{ episodes}} = 25.62$ ,  $SD = 19.39$ ;  $F(1, 268) = 5.36$ ,  $p = .025$ ).

### 3.4. Associations between vulnerability factors of relapse and sadness

All potentially modifiable and illness-related variables examined in the current manuscript were entered in multiple regression (Table 2). The overall model was statistically significant ( $F(10, 259) = 3.69$ ,  $p < .001$ ), and was able to account for 12.4 % of the variance in the VAMS score ( $R^2 = .124$ , Adj.  $R^2 = .091$ ). As can be seen in Table 2, higher VAMS levels after remission were associated with higher levels of dysfunctional beliefs ( $\beta = .22$ ) and a higher experienced intensity of daily stress ( $\beta = .22$ ).

Table 3  
Prediction of depressive symptomatology at T<sub>2</sub> (IDS<sub>T2</sub>) using the baseline VAMS, with and without controlling for baseline depressive symptomatology (IDS<sub>T0</sub>) ( $n = 67$ ).

Variable	B	SE (B)	<i>t</i>	<i>p</i>	FMI
<i>Step 1</i>					
Constant	10.53	4.23	2.49	.014	.27
VAMS	1.83	.77	2.37	.019	.25
<i>Step 2</i>					
Constant	4.92	4.07	1.21	.227	.11
VAMS	1.36	.78	1.75	.083	.31
IDS <sub>T0</sub>	.52	.18	2.80	.005	.22

Note. The VAMS is square-root transformed. VAMS = Visual Analogue Mood Scale, IDS<sub>T0</sub> = Baseline Inventory of Depressive Symptomatology Self Report, FMI = Fraction Missing Information.

The addition of levels of depressive of symptomatology and dimensional personality pathology to the model increased explained variance to 15.3 % ( $R^2 = .153$ , Adj.  $R^2 = .114$ ), which was a significant increase ( $F_{\text{change}}(2, 257) = 4.39$ ,  $p = .026$ ). In this second model, only having more residual depressive symptomatology itself was associated with higher VAMS levels ( $\beta = .22$ ,  $p = .018$ ) whereas endorsing more dysfunctional beliefs and having experienced more previous episodes were associated with higher VAMS levels at the level of a non-significant trend ( $p = .089$  and  $p = .096$  respectively).

### 3.5. Replication of the predictive validity of the VAMS

Finally, we examined whether we could replicate the predictive validity of the VAMS as has been demonstrated in a previous study [9]. We were able to replicate our previous findings since the baseline VAMS was a significant predictor of depressive symptomatology three months later ( $B = 1.83$ ,  $SE = .77$ ,  $p = .02$ , semi-partial  $r = .32$ ,  $FMI = .25$ ), see Table 3. After controlling for baseline depressive symptomatology, the extent of prediction by the VAMS decreased, but still evidenced a nonsignificant trend ( $p = .08$ ).

## 4. Discussion

In the current study, we attempted to increase our understanding of emotions and emotional scarring in recurrent MDD. We found two potentially modifiable variables that were significantly associated with relatively higher levels of sad mood in a multivariate model: a higher perceived intensity of daily stress and higher levels of dysfunctional beliefs. However, after controlling for depressive symptomatology and personality pathology, only residual depressive symptomatology (and not the potentially modifiable variables) was associated with sad mood. Our findings could imply that, after remission, the influence of daily stress and dysfunctional beliefs on sad mood are largely an epiphenomenon of MDD. However, given that we only have cross-sectional data and found that levels of sad mood appear to be influenced by the number of previous MDEs, we cannot rule out that sad mood itself might be a consequence of the disorder. Still, we were

able to replicate that sad mood levels predicted depressive symptomatology three months later at a trend-level after correction for current levels of depressive symptomatology. Surprisingly, and not in line with recent cognitive models [26], cognitive reactivity was not associated with sad mood. Patients with higher levels of sad mood after remission did not report more frequent stressors, but instead appeared to be affected more by the stressors they encountered. Preventive interventions might reduce negative affect through modifying the impact of daily stress, which has already been demonstrated indirectly [14]. Alternatively, preventive interventions also might alter affective experiences themselves [51]. Future studies should examine the pathway from stressors to negative affect to depressive relapse or whether negative affect might result in intolerance of subsequent stressors.

The potentially modifiable variables that we examined in relation to sad mood could determine levels of positive affect as well. Positive affect appears to be important in depression since it was found that patients with a current episode of recurrent MDD who responded with a drop of negative affect in response to increases in positive affect during the course of the day had a better prognosis, and responded better to treatment [52]. In the current study we did not include several variables (life-events, coping, and emotion regulation) that might be related to sad mood, including genetic factors, which were able to explain 18% of variance in momentary negative affect in a previous study [53].

Finally, we found that patients with a greater number of previous depressive MDEs reported higher levels of sad mood after remission. The mean difference of 7.8 points on the VAMS between patients with  $\leq 4$  and  $> 4$  episodes appears to be clinically relevant, as we previously found that every one-point increment on the VAMS increased risk of relapse by a factor 1.15 [9]. This finding implies that scarring by previous episodes could have occurred. Alternatively, our findings could also be explained by higher levels of sadness before the very first episode onset in our sample, which increased the risk for developing a higher numbers of depressive episodes. In contrast with the scarring hypothesis, a previous study demonstrated in adolescent girls that premorbid negative emotionality (i.e., temperamental emotional arousal and intensity) increased with the onset of MDD, but returned to premorbid levels again after remission of the MDE [54].

Strengths of our study include our large sample of remitted patients hence limiting mood state effects of depression, and the use of well validated questionnaires and interviews. Several limitations of the current study have to be taken into account. First, we combined patients from two different RCTs. Although this increased our sample size and patients were very similar on most characteristics, they did differ with respect to the number of previous MDEs, previous MDE severity, and dysfunctional belief levels which might have influenced the strength of the associations we found. Second, personality pathology was only assessed at baseline ( $T_0$ ). Patients' initial levels of personality pathology might no longer reflect

personality pathology 3–24 months later, which might explain the absence of association with the VAMS. However, this does not appear to be very likely, since personality pathology is relatively stable, with fluctuations being inherent to the disorder itself [55,56]. Third, cognitive reactivity was assessed using a self-report questionnaire and not by a mood-induction procedure. Finally, due to the nature of our design, we are not able to examine whether the potentially modifiable correlates of the VAMS are in fact determinants of sadness or concomitants. Future studies should attempt to more closely examine the temporal sequence of these variables to both positive affect, negative affect, and relapse in depression using experience sampling methods.

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## Conflict of interest

None of the authors declares any conflict of interest

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