



## Mindfulness trait and the potential mediating role of emotional regulation strategies in bipolar disorder

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**Título:** Mindfulness Rasgo y el potencial papel mediador de las estrategias de regulación emocional en el trastorno bipolar.

**Resumen:** En este estudio transversal se investiga la asociación entre los principales síntomas del Trastorno bipolar (TB) y las dificultades asociadas a las estrategias de regulación emocional (ERE) adaptativas y desadaptativas. Además, este estudio examina los efectos mediadores de las ERE con el *mindfulness* rasgo y el TB. **Método.** Veinticuatro adultos con TB completaron la Escala de Conciencia de Atención Plena (MAAS), el Inventario de Depresión de Beck (BDI-II), la Escala de Autoevaluación de Manía de Altman (ARSM), el Inventario de Ansiedad Rasgo (STAI-R), y el Cuestionario de Regulación Emocional Cognitiva (CERQ). **Resultados.** El análisis de regresión múltiple mostró cómo la depresión se relacionaba significativamente y positivamente con la autoculpabilización, mientras que la ansiedad rasgo estaba positivamente asociada con la autoculpabilización y el catastrofismo. En segundo lugar, el análisis de mediación mostró un efecto de mediación significativo para la autoculpabilidad en la relación entre *mindfulness* y depresión ( $a*b = -.15$ ; ICB 95% [-.36, -.03]) y entre *mindfulness* y ansiedad rasgo ( $a*b = -.09$ ; ICB 95% [-.27, -.01]). **Conclusiones.** Nuestros resultados informan del papel de la auto-culpabilidad y el catastrofismo en el TB y de cómo éstas podrían mediar significativamente entre el *mindfulness* rasgo y el TB. Estos resultados sugieren que una práctica de meditación enfocada en el catastrofismo y la autoculpabilidad puede ser especialmente útil para reducir los síntomas en los pacientes bipolares.

**Keywords:** *Mindfulness*. Trastorno bipolar. Regulación emocional. Depresión. Ansiedad. Autoculpabilización. Catastrofismo.

**Abstract:** This cross-sectional study investigates the association between the main symptoms of Bipolar disorder (BD) and emotional regulation difficulties in adaptive and maladaptive emotional regulation strategies (ERS). In addition, this study examines the possible mediating effects of ERS with dispositional *mindfulness* and bipolar symptoms. **Method.** Twenty-four adults diagnosed with BD completed the Mindful Attention Awareness Scale (MAAS), the Beck Depression Inventory (BDI-II), the Altman Mania Self-Assessment Scale (ARSM), the Trait Anxiety Inventory (STAI-R), and the Cognitive Emotional Regulation Questionnaire (CERQ). **Results.** First, multiple regression analysis showed how depression was significantly positively related to self-blame, whereas trait anxiety was positively associated with self-blame and catastrophizing. Second, the results of the mediation analysis have shown a significant mediation effect for the self-blame in the relationship between *mindfulness* and depression ( $a*b = -.15$ ; BCI 95% [-.36, -.03]) and between *mindfulness* and trait anxiety ( $a*b = -.09$ ; BCI 95% [-.27, -.01]). **Conclusions.** Our results report the role of self-blame and catastrophizing in BD and how these might significantly mediate between dispositional *mindfulness* and symptoms of depression and anxiety. These results suggest that a meditation practice focused on reducing catastrophizing and self-blame may be especially helpful for symptoms of depression and anxiety in bipolar patients.

**Keywords:** Mindfulness. Bipolar disorder. Emotional regulation. Depression. Anxiety. Self-blame. Catastrophizing.

### Introduction

Bipolar disorder (BD) is a chronic condition characterized by recurrent episodes of depression, mania, and hypomania, with difficulties in emotional regulation and high comorbidity with, among others, anxiety disorders (Bojic & Becerra, 2017). Despite the widespread use of conventional pharmacological treatments, episodic relapse is common (Kishi et al., 2021). Risk factors for relapse include difficulties in emotional regulation due to the tendency to experience more intense emotional cycles than usual (Eisner et al., 2017). In this regard, the relationship between emotional regulation difficulties and the presence of psychopathology has been consistently shown to coexist with a significant increase in disorganized responses to emotional cycles that led to a significant increase in *maladaptive* responses to emotional stimuli and a decrease in *adaptive* responses to regulate intense emotional experiences (Miola et al., 2022).

Among the maladaptive Emotional Regulation Strategies

(ERS), *self-blame* refers to thoughts of blaming oneself for what one has experienced (De Prisco et al., 2022); *Rumination* or thought concentration refers to the feelings and thoughts associated with the adverse event (Bojic & Becerra, 2017); *Catastrophizing* refers to thoughts that explicitly emphasize the terror of the experience by emphasizing the seriousness of the event/emphasizing the severity of the situation (Ruiz, 2014). *Positive reappraisal* refers to thoughts of creating positive meaning for the event regarding personal growth. *Refocusing on planning* refers to thinking about what steps to take and how to handle the adverse event (Garfelfski et al., 2016).

*Mindfulness* has been defined as an intentional way of paying attention to what is happening and observing the phenomena that appear in the field of consciousness with pure attention, sustained, and equanimous (Segovia, 2018). However, the alternative framework Radford et al. (2014) proposed that emotion regulation also involves understanding, awareness, and acceptance of emotional distress rather than just control. Thus, the emphasis of *mindfulness* on observation and description of one's experience promotes emotional awareness and acceptance of all emotions, including unpleasant ones (Kabat-Zinn, 2021).

In this regard, one psychological factor that may act as a protective mechanism for BD patients and their emotional

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regulation deficit is dispositional *mindfulness* or *trait mindfulness* (Roemer et al., 2015). *Trait mindfulness* is the enduring dispositional tendency that facilitates disconnection from automatic thoughts and unhealthy habits or behavioral patterns (Brown & Ryan, 2003). There is a previous rich literature on *mindfulness* through which it has been observed that greater *trait mindfulness* can optimize self-regulatory processes that are important for psychological well-being, such as greater mental flexibility and resilience, reduced mental rumination and wandering, as well as lower levels of impulsivity, stress, and anxiety (Bojic & Becerra, 2017; Carpenter et al., 2019; Sala et al., 2020). Thus, this psychological disposition has been related to several benefits related to the emotional well-being of BD patients, such as a negative relationship between its effects on anxiety and depression (Burgos et al., 2022) and positive concerning psychological well-being (Desrosiers et al., 2013).

The mechanisms by which dispositional *mindfulness* might benefit people with BD have not yet been established. However, evidence suggests that individuals with higher dispositional *mindfulness* would do better in *mindfulness* training for better emotional regulation than those with lower *trait mindfulness* (Banfi & Randall, 2022). In this sense, ERS may link certain *mindfulness* levels and mood symptomatology, especially in BD patients, due to their higher use of maladaptive ERS compared to the general population (Desrosiers et al., 2013). Indeed, BD patients report less emotional clarity and difficulties accepting emotional responses to believe in their ability to regulate emotion effectively (Bojic & Becerra, 2017). These difficulties have been repeatedly associated with depressive tendencies (Van Rheenen, 2015).

Similarly, other studies have proposed theoretical models where certain ERS mediate the relationship between *mindfulness* and affective symptomatology. For example, Desrosiers et al. (2013) evaluated a mediational model, where less anxious and depressive symptomatology was related to a more significant presence of *mindfulness*. This relationship is mediated through specific regulatory mechanisms. These authors found that worry mediated the relationship between *mindfulness* and anxiety symptoms, while rumination and reappraisal mediated the relationship between *mindfulness* and depressive symptoms.

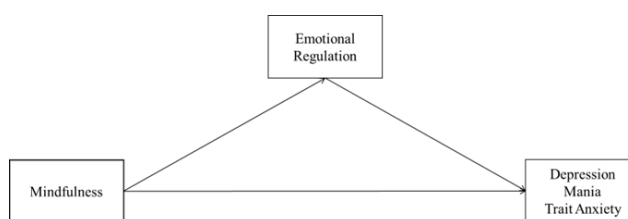
Specifically, several studies suggest that *mindfulness* practice is associated with healthy ERS, reducing the intensity of *distress* effects, increasing emotional recovery, reducing negative self-referential processing, and increasing the ability to engage in goal-directed behaviors (Roemer et al., 2015). Regarding *mindfulness* practice, previous literature has reported that emotion regulation mediates the dispositional effect *mindfulness* has on bipolar patients (Burgos et al., 2022). In this regard, some studies analyzing the efficacy of *mindfulness-based intervention* (MBI) treatment protocols have shown improvement in maladaptive ERS such as worry, rumination, and reappraisal (Hanssen et al., 2019; Painter et al., 2019).

Given the above and given that the effect of dispositional *mindfulness* on BD may occur through its effects

on emotion regulation, the present study aims to explore whether difficulties in emotional regulation in BD mediate the relationship between the effects of dispositional *mindfulness* and the characteristic symptomatology of BD (depression, mania, and anxiety). Specifically, the first objective seeks to explore the ERS that are related to BD. In contrast, the second specific objective focuses on determining the ERS that could mediate between *mindfulness* and BD symptomatology (see Figure 1).

**Figure 1**

Conceptual diagram illustrating the mediational model between *mindfulness* and the characteristic symptomatology of bipolar disorder (depression, mania, and trait anxiety), mediated by the emotional regulation strategies.



Based on preliminary evidence concerning BD-related ERS from the CERQ questionnaire (Garnefski & Kraaij, 2007), it is proposed:

*Hypothesis 1.a.* Maladaptive ERS such as rumination, self-blame, and catastrophizing are positively related to symptoms of depression, mania, and trait anxiety.

*Hypothesis 1. b.* Adaptive ERS, such as positive reappraisal and putting into perspective, harbor a negative relationship with depressive symptoms, mania, and trait anxiety.

*Hypothesis 2.* ERS mediates *mindfulness* and symptoms of depression, mania, and trait anxiety.

## Method

### Participants

Participants were selected among the members of the BAO. *Inclusion criteria* were being at least eighteen years old, following pharmacological treatment and psychiatric supervision, having a diagnosis of BD and being in a period of total remission, in which and during the last two months, no signs or symptoms characteristic of the disorder according to the DSM-5 (APA, 2013). *Exclusion criteria* were neurological/neurodegenerative disease, history of severe head injury with loss of consciousness, pregnancy, history of habitual drug use, significant change in medication two months prior to the study, or having a psychotic disorder or personality disorder.

The complete sample of participants consisted of a total of 24 people diagnosed with BD with an age range of 29 - 60 years ( $M = 44.17$ ,  $SD = 8.54$ ), of which 14 (58%) were men and 10 (42%) women. The sample distribution concerning the type of BD is distributed in 18 (75%) people with BD-type I, three with BD-type II (12.50%), and three with cyclo-

thymia (12.50%). Regarding the pharmacological treatment followed, seven (29.16%) people followed a treatment based on mood stabilizers (FSS), either lithium and/or anticonvulsants, eight (33.33%) followed a treatment based on FSS together with antidepressants, three (12.50%) FSS plus antipsychotics, three FSS (12.50%) together with anxiolytics. In comparison, three (12.50%) people are treated with FSS together with antipsychotics and anxiolytics.

### Design and procedure

The present study used a cross-sectional design with a single group of participants belonging to the BAO. Participants were selected following the data previously collected by psychologists, psychiatrists, and neurologists working in BAO. The final sample consisted of 24 people.

### Instruments

The psychological variables analyzed in a standardized manner were as follows:

For the application of the inclusion and exclusion criteria, results of the *MINI International Neuropsychiatric Interview* (MINI; Sheehan et al., 1998) were screened. This is a short, structured interview that explores the primary psychiatric disorders of Axis I of the DSM-5 and ICD-11. It is divided into 17 diagnostic sections, including bipolar disorders. For emotional episodes of BD, the test shows sensitivity indices between .94 and .86 and specificity indices between .79 and .92. Its adaptation to the Spanish population was performed by Ferrando et al. (2015) and has shown good psychometric properties ( $\alpha = .85$ ).

Dispositional *mindfulness* was assessed through the *Mindful Attention Awareness Scale* (MAAS; Brown & Ryan, 2003), a unidimensional psychometric instrument that measures the frequency with which we are aware of our daily experiences. It focuses on the presence or absence of awareness of what is happening in the present moment. It is composed of 15 items scored on a Likert scale from 1 to 6 (1 = "almost always" and 6 = "almost never"), with a maximum score of 90 points. The higher the score, the greater the awareness of what is happening in the present moment. It can be applied to clinical and general populations and does not require subjects to be familiar with meditation techniques. Its adaptation to the Spanish population (Barajas & Garra, 2014) presents good psychometric properties ( $\alpha = .88$ ; current study  $\alpha = .86$ ).

The *Cognitive Emotion Regulation Questionnaire* (CERQ; Garnefski & Kraaij, 2007) is a 36-item self-report questionnaire consisting of nine conceptually different ERS by which people respond to specific adverse events or situations. These ERS are measured on a five-point Likert-type scale, from 1 (almost never) to 5 (almost always). For the present study, five of the scales that make up this instrument are used. The *self-blame* dimension refers to those thoughts directed towards oneself and about what happened. *Rumination*

refers to thinking about the feelings and thoughts associated with the adverse event. *Catastrophizing* refers to those thoughts that emphasize the worst of an experience. *Positive reappraisal* refers to those thoughts that adhere to a positive meaning of the events in terms of personal growth. *Putting in perspective* refers to thoughts that minimize the event's severity or emphasize its relativity compared to other events. Its adaptation to the Spanish population (Chamizo et al., 2020) presents good psychometric properties, with levels  $a = .89$  and  $w = .96$ .

The *State-Trait Anxiety Inventory-R* (STAI-RR; Spielberger et al., 1982) is a self-report instrument with a total of 20 items, measuring the frequency with which anxiety reactions are experienced, evaluated on a Likert scale with four alternative responses, from "almost never" (0) to "almost always" (3). Total scores range from 0 to 30. This questionnaire measures individual differences in trait anxiety and consists of 20 items. In Spanish population samples (Buena-Casal et al., 2017), high levels of internal consistency have been found ( $\alpha = .93$ ).

The *Beck Depression Inventory-II* (BDI-II; Beck et al., 1996) is a well-established self-report instrument comprising 21 items designed to assess the severity of depressive symptomatology in adults and adolescents. For each item, the person must choose, from a set of four alternatives ordered from least to most severe, the statement that best describes his or her state during the past two weeks. Each item is scored from 0 to 3 depending on the alternative chosen, being able to obtain a total score of between 0-63 points. The validity and reliability ( $\alpha = .89$ ) of the BDI-II are well established (Sanz et al., 2005).

The *Altman Self-Rating Mania Scale* (ASRM; Altman et al., 1997) is a self-administered scale that measures manic mood in the past week. It has a total of five statements, scored in increasing order of severity from 0 to 4, with a range of total scores from 0 to 20 points. The higher the score, the greater the severity. The Spanish adaptation was used (Alvarez et al., 2005), showing adequate reliability ( $\alpha = .84$ ).

### Data analysis

First, an exploratory analysis was carried out to check the adequacy of the data to the multivariate normal distribution using the Royston test. In addition, a descriptive analysis of the data was performed, including the indices of central tendency, deviation and, finally, an analysis of bivariate correlations between the variables included in the study. Prior to the mediation analysis and for the testing of *hypotheses 1.a* and *1.b*, a stepwise multiple regression analysis was performed for each of the dependent variables (depression, mania and trait anxiety). Those factors of emotional regulation that were significant in each regression model were subsequently included in the mediational analysis.

For the testing of *hypothesis 2*, a mediation analysis was conducted using the PROCESS macro (Hayes, 2013) for SPSS. The estimation of the models is based on the nonpar-

ametric *bootstrapping* procedure. (Hayes & Rockwood, 2019). This way, an empirical confidence interval was estimated without assuming the normality assumption. In order to test for indirect effects, 95% confidence intervals were estimated based on 10,000 *bootstrap* samples. Indirect effects are considered significant if the estimated *Bootstrap* intervals do not include the value zero. Complementarily, the adjusted coefficient of determination was reported for the set of variables in each model. Following Fairchild and McDaniel (2017), as a measure of effect size for the indirect effects, we will use the mediated ratio (hereafter TE/PM). This ratio represents the proportion in which, out of the total effect, the relationship is mediated by the indirect effects. Through statistical power analysis we estimate the minimum sample size to

achieve a power of .80, with a large effect size, and a two-tailed contrast with a significance level of  $p = .05$ .

### Results

The exploratory analysis indicates a misfit of the data to the multivariate normal distribution, contrasted by Royston's test ( $R = 14.93; p = .01$ ), which justifies the application, in the estimation of the mediational models, of a nonparametric method by bootstrapping. *Table 1* shows the descriptive statistics and the correlation between the variables included in the mediation models.

**Table 1**

Means, standard deviations, and correlations with confidence intervals for the variables included in the mediation models.

Variable	M	SD	1	2	3	4	5	6	7	8
1. Depression	12.75	12.39								
2. Mania	2.88	2.56	-.01							
			[-.41, .40]							
3. Trait Anxiety	25.29	11.16	.74**	.03						
			[.47, .88]	[-.38, .43]						
4. Self-blame	10.92	4.01	.65**	-.20	.60**					
			[.33, .83]	[-.56, .22]	[.25, .81]					
5. Rumination	12.42	3.22	.29	.09	.33	.52**				
			[-.13, .62]	[-.33, .47]	[-.09, .65]	[.15, .76]				
6. Positive reappraisal	13.33	4.60	-.30	-.11	-.25	-.00	.17			
			[-.62, .12]	[-.49, .30]	[-.59, .17]	[-.40, .40]	[-.25, .54]			
7. Putting in perspective	12.58	4.45	.10	-.06	.07	.25	.47*	.45*		
			[-.31, .48]	[-.45, .35]	[-.34, .46]	[-.17, .59]	[.09, .74]	[.05, .72]		
8. Catastrophizing	9.12	4.34	.53**	-.02	.59**	.51*	.36	-.05	.14	
			[.16, .77]	[-.42, .39]	[.25, .80]	[.14, .76]	[-.05, .67]	[-.44, .36]	[-.28, .52]	
9. Mindfulness	58.21	15.34	-.64**	-.15	-.82**	-.40	-.03	.36	.09	-.64**
			[-.83, -.31]	[-.52, .27]	[-.92, -.63]	[-.69, .00]	[-.43, .38]	[-.05, .66]	[-.32, .48]	[-.83, -.32]

Note. M and SD are used to represent the mean and standard deviation, respectively. Values in brackets indicate the 95% confidence interval for each correlation.

\* indicates  $p < .05$ . \*\* indicates  $p < .01$ .

The exploratory analysis indicates an inadequacy of the data to the multivariate normal distribution, contrasted by Royston's test ( $R = 14.93; p = .01$ ), which justifies applying a nonparametric *bootstrapping method* in the estimation of the mediational models. Statistical power analysis indicates that a minimum sample size of 20 participants is needed to achieve a power of 0.80. These same results have been reported by Fritz and MacKinnon (2007). Regarding *Hypothesis 1. a*, the results of the multiple regression analysis show that the *depression* variable is significantly and positively related to self-blame. These results indicate that high levels of depression

are associated with a greater presence of self-blame. As for the variable *mania*, no significant relationship was found in any of the variables included in the regression model. As for the *trait anxiety* variable, a significant and positive association was found with self-blame and catastrophism. In this sense, higher levels of self-blame and catastrophism are related to a greater presence of trait anxiety (see Table 2). The results of the multiple regression analysis for each excluded variable are shown in the supplementary material. No statistically significant results were found for *Hypothesis 1. b* (see supplementary Figure 1).

**Table 2**

Multiple linear regression endpoint models results on maladaptive emotional regulation variables.

Maladaptive emotional regulation <sup>1</sup>	$\beta$	se	$t$	$p$	IC 95%		VIF	R <sup>2</sup>
					I <sub>inferior</sub>	I <sub>superior</sub>		
Depression							1.00	.39*
Self-blame	2.00	.50	3.98	.01*	.96	3.04		
Trait anxiety							1.35	.32*
Self-blame	1.10	.52	2.14	.04*	.03	2.17		
Catastrophism	1.00	.48	2.10	.05*	.01	1.99		

1. The results of the final model are shown. VIF: Variance inflation factor. Values above 10 indicate collinearity problems. R<sup>2</sup>: adjusted coefficient of determination. \* $p < .05$

Regarding *Hypothesis 2*, the results of the mediation analysis have shown a significant effect for the variable *self-blame* both in the relationship between *mindfulness* and depression ( $a*b = -.15$ ; BCI 95% [-.36, -.03]), and in the relationship between *mindfulness* and trait anxiety ( $a*b = -.09$ ; BCI 95% [-.27, -.01]).

Mediation analysis for the *depression* variable with the independent variable *mindfulness* shows a significant indirect effect on the variable *self-blame* ( $a*b = -.15$ ; BCI 95% [-.36, -.03]), with significant direct effects ( $c' = -.36$ ;  $p < .1$ ; 95% CI [-.62, -.01]), significant total effects ( $c = -.51$ ;  $p < .01$ ; 95%

CI [-.79, -.24]), and a TE/PM = .29, indicating a mediated effect percentage of 29% of the total. This maladaptive ERS also shows a significant indirect effect for the *trait anxiety* variable ( $a*b = -.09$ ; BCI 95% [-.27, -.01]), with significant direct effects ( $c' = -.52$ ;  $p < .01$ ; CI 95% [-.74, -.30]), significant total effects ( $c = -.60$ ;  $p < .01$ ; CI 95% [-.78, -.42]), and a TE/PM effect size = .16, indicating a mediated effect percentage of 16% of the total. These indirect effects were not shown to be significant with respect to the catastrophising variable (see Table 3).

**Table 3**

Results of the mediation model for the dependent variables depression and trait anxiety.

Dependent variable	Mediator	Indirect effects		Direct effects	Total effects	TE/PM
		a*b	BCI	c'	c	
Depression	Self-Blame	-.15 <sup>1</sup>	[-.36, -.03]	-.36*	-.51*	.29 <sup>1</sup>
Anxiety	Self-Blame	-.09 <sup>1</sup>	[-.27, -.01]	-.52*	-.60*	.16 <sup>1</sup>
	Catastrophism	-.01	[-.12, .15]	-.52*	-.60*	.02

Note: BCI: bias-corrected bootstrapping confidence interval; TE/PM: ratio-measured effect size. 1. Significant results based on the BCI. \*  $p < .05$

## Discussion

By virtue of the importance that ERS acquire in the etiology of BD, the present study aims to explore the mechanisms of emotional regulation that appear to be enhanced or mitigated as a function of different levels of trait *mindfulness* and their interaction with BD symptomatology. Although studies relate *mindfulness* and emotional regulation to BD symptomatology, the mechanism through which *mindfulness* and emotional regulation are related to BD symptomatology is unclear (Parmentier et al., 2019). The mechanism through which trait *mindfulness* could be acting to improve symptomatological well-being in BD remains poorly explored. This is why the feasibility of a mediational model has been analyzed based on the existing preliminary evidence (Carruthers et al., 2022; Desrosiers et al., 2013; Garland et al., 2015; Hayes & Rockwood, 2019).

Regarding the results obtained around maladaptive ERS (*Hypothesis 1.a*), some of them have turned out to be significantly related to BD symptomatology, as we expected. Specifically, the hypothesis is confirmed that *self-blame* is associated with depression and stable trait anxiety while *catastrophizing* appears only associated with trait anxiety. We found no evidence of ER strategies associated with *manic* symptomatology, so the effects are only partially consistent with preliminary evidence. The results show an increased likelihood of engaging in these emotional regulation processes in response to adverse events, associated with increased depressive and anxious symptomatology. Overall, these results show how self-blame and catastrophizing could contribute to the increased effects of psychological *distress* in people with BD. In line with these results, different findings show how self-blame and catastrophizing emerge as risk factors for depressive and anxious psychopathology. These two

strategies have allowed for more severe psychological distress in people with BD (Chan et al., 2015; Zahn et al., 2015) and how they have made it possible to discriminate between clinical and non-clinical populations (Garnefski et al., 2002).

Concerning adaptive ERS, such as reappraisal or putting into perspective and BD symptomatology, *Hypothesis 1.b* is not confirmed, so the results are inconsistent with preliminary evidence (Van Rheenen et al., 2015). However, recent review studies have questioned the differences in using these strategies between people with BD and control subjects (Dodd et al., 2019).

*Hypothesis 2* proposes that both *self-blame* and *catastrophizing*, related to BD symptoms, could represent how *mindfulness* could mitigate the effects on affective symptomatology. The results are partially consistent with this hypothesis. On the one hand, depressive symptomatology is negatively related to *mindfulness* through its interaction with self-blame, so the impact of *mindfulness* on this strategy is related to an improvement in depressive symptoms. On the other hand, the effects of catastrophizing lose their significance when this variable is introduced into the multiple mediation model, together with self-blame, for trait anxiety.

Thus, in this way, *self-blame* becomes the only significant variable in the mediational model for both depression and anxiety. *Mindfulness*, therefore, could be associated with reducing symptoms of depression and anxiety by combating those repetitive thoughts that involve attributing blame for what happened to oneself. In this sense, self-blame has emerged in different studies associated with BD symptomatology. (Hassani & Kia, 2016; Wolkenstein et al., 2014). These results find partial support in previous studies.

Theoretically, cognitive vulnerability models (Alloy et al., 2018) assume that dysfunction to inhibit mood-congruent stimuli represents an essential component of emotional

dysregulation in BD. Thus, in people with BD, attentional control of mood relevant stimuli requires more significant effort, evidencing the critical role it plays in emotional dysregulation in BD (García-Blanco et al., 2013). Therefore, the role of *mindfulness* in the improvement of affective symptomatology in BD could be related to attentional control via executive functions through the effect that it could cause by producing a reprocessing of the outgoing emotional information at that moment (Teper & Inzlicht, 2013).

As shown in the scientific literature, *self-blame* and catastrophising feedback into a negative affective state (Green et al., 2011; Hassani & Kia, 2016; Wolkenstein et al., 2014) is present as an emotional regulation mechanism in BD. In this sense, studies with neuroimaging through the application of *mindfulness-based* interventions have shown preliminary evidence in the improvement of processing and ERS, via executive functions, through an increase of activation in cortical regions related to these functions (Howells et al., 2012, 2014; Ives-Deliperi et al., 2013). In this sense, *mindfulness* implies an attentional control strategy, and those people with a higher degree of dispositional *mindfulness* show a more flexible and efficient attentional orientation. (Sørensen et al., 2018).

In this line, we agree with previous literature recommending for maladaptive ERS the practice of sitting or formal *mindfulness* exercises from the *Mindfulness-based for Stress Reduction program* (MBSR, Kabatt-Zinn, 1990) or the *Mindfulness-based Cognitive Therapy program* (MBCT; Segal et al., 2018) that focus on emotions, as well as the self-compassion meditations of the protocol of *Mindfulness and Self-Compassion program* (Germer & Neff, 2019).

As certain ERS are related to worse affective symptomatology in people with BD previous literature has shown

how *mindfulness* could lessen the impact of these strategies to improve the present affective tone (Hassen et al., 2019). In our study, however, the small sample size could delimit or bias specific characteristics in this model. Moreover, the exploratory and cross-sectional nature of the study does not allow us to determine potential causal mechanisms that account for the results obtained. These limitations support the caution that should be exercised regarding the conclusions of this study.

The results of this research point to the need to explore the deficits in ERS present in people with BD, even in periods of euthymia, so that an adequate assessment would allow predicting, as a prodrome, the existence of depressive episodes or anxious symptoms, with the intended effect on the course of the disease. On the other hand, mediating mechanisms between *mindfulness* and symptoms of depression and anxiety in BD would make it possible to adjust the different treatments. Finally, in future studies, it is necessary to replicate the results obtained with larger samples and specify whether different types of BD are related to specific ER strategies.

## Complementary information

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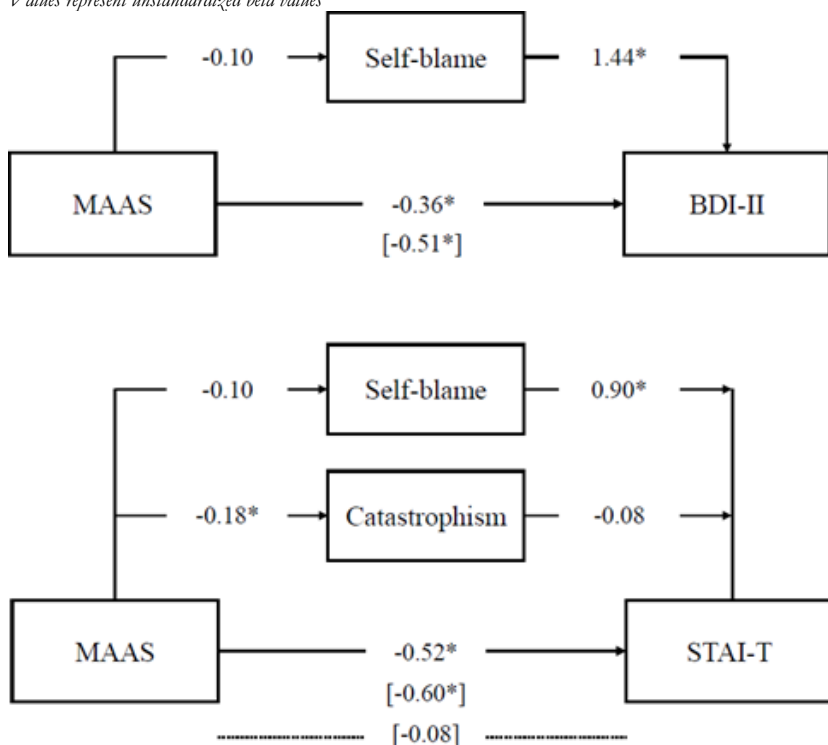
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## Supplementary material

### Supp. Fig. 1

Graphical depiction of mediation analyses. The direct effects are represented by solid lines, total effects are represented in bracket and the total indirect effects are represented by dotted lines. Values represent unstandardized beta values



\* 95% bias-corrected bootstrapped CI range did not span zero. MAAS: Mindful AttentionAwareness Scale. STAI-T: Trait Anxiety Inventory.