Emotion dysregulation in bipolar disorder compared to other mental illnesses: a systematic review and meta-analysis

Corresponding author:
Eduard Vieta;
Email: evieta@clinic.cat

Michele De Prisco[1,2,3,4,5,6] , Vincenzo Oliva[1,2,3,4,5,7] , Giovanna Fico[1,2,3,4,5] , Joaquim Radua[1,4,5,8,9,10] , Iria Grande[1,2,3,4,5] , Natalia Roberto[1,2,3,4,5] , Gerard Anmella[1,2,3,4,5] , Diego Hidalgo-Mazzei[1,2,3,4,5] , Michele Fornaro[6] , Andrea de Bartolomeis[6] , Alessandro Serretti[7] , Eduard Vieta[1,2,3,4,5] and Andrea Murru[1,2,3,4,5]

[1]Departament de Medicina, Facultat de Medicina i Ciències de la Salut, Universitat de Barcelona (UB), c. Casanova, 143, 08036 Barcelona, Spain; [2]Bipolar and Depressive Disorders Unit, Hospìtal Clinic de Barcelona. c. Villarroel, 170, 08036 Barcelona, Spain; [3]Institut d'Investigacions Biomèdiques August Pi i Sunyer (IDIBAPS), c. Villarroel, 170, 08036 Barcelona, Spain; [4]Institute of Neurosciences (UBNeuro), Barcelona, Spain; [5]Centro de Investigación Biomédica en Red de Salud Mental (CIBERSAM), Instituto de Salud Carlos III, Madrid, Spain; [6]Section of Psychiatry, Department of Neuroscience, Reproductive Science and Odontostomatology Federico II University of Naples, Naples, Italy; [7]Department of Biomedical and Neuromotor Sciences, University of Bologna, Bologna, Italy; [8]Imaging of Mood- and Anxiety-Related Disorders (IMARD) Group, IDIBAPS, Barcelona, Spain; [9]Early Psychosis: Interventions and Clinical-Detection (EPIC) Lab, Department of Psychosis Studies, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, UK and [10]Centre for Psychiatric Research and Education, Department of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden

Abstract

People with bipolar disorder (BD) often present emotion dysregulation (ED), a pattern of emotional expression interfering with goal-directed behavior. ED is a transdiagnostic construct, and it is unclear whether it manifests itself similarly in other conditions, such as major depressive disorder (MDD) or borderline personality disorder (BPD), or has specific features in BD. The present systematic review and meta-analysis explored ED and adopted emotion regulation (ER) strategies in BD compared with other psychiatric conditions. PubMed/MEDLINE, EMBASE, Scopus, and PsycINFO databases were systematically searched from inception to April 28th, 2022. Studies implementing validated instruments assessing ED or ER strategies in BD and other psychiatric disorders were reviewed, and meta-analyses were conducted. Twenty-nine studies yielding multiple comparisons were included. BD was compared to MDD in 20 studies ($n = 2451$), to BPD in six studies ($n = 1001$), to attention deficit hyperactivity disorder in three studies ($n = 232$), to anxiety disorders in two studies ($n = 320$), to schizophrenia in one study ($n = 223$), and to post-traumatic stress disorder in one study ($n = 31$). BD patients did not differ from MDD patients in adopting most adaptive and maladaptive ER strategies. However, small-to-moderate differences in positive rumination and risk-taking behaviors were observed. In contrast, patients with BPD presented an overall higher degree of ED and more maladaptive ER strategies. There were insufficient data for a meta-analytic comparison with other psychiatric disorders. The present report further supports the idea that ED is a transdiagnostic construct spanning a continuum across different psychiatric disorders, outlining specific clinical features that could represent potential therapeutic targets.

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Introduction

Emotion dysregulation (ED) is defined as a pattern of emotional experience or expression that interferes with appropriate goal-directed behavior (Thompson, 2019). The erratic changes in an individual's emotions can complicate their effective regulation, contributing to the development of ED (Cole, Ramsook, & Ram, 2019), which is a transdiagnostic dimension observed in many mental illnesses (Beauchaine & Cicchetti, 2019) with different degrees of pervasiveness (Aldao, Nolen-Hoeksema, & Schweizer, 2010). For instance, people diagnosed with major depressive disorder (MDD), anxiety and eating disorders (D'Agostino, Covanti, Monti, & Starcevic, 2017), or schizophrenia spectrum disorders (Liu, Chan, Chong, Subramaniam, & Mahendran, 2020) may present reduced emotional awareness, while people diagnosed with borderline personality disorder (BPD), attention deficit hyperactivity disorder (ADHD), or bipolar disorder (BD) may display inadequate emotional reactivity or intense emotional expression (D'Agostino et al., 2017). Specifically, people diagnosed with BD often show

difficulties in facial emotion recognition (Ulusoy, Gülseren, Özkan, & Bilen, 2020) or emotional experience (Carolan & Power, 2011) and are more likely to feel emotions more intensely (Muhtadie, Johnson, Carver, Gotlib, & Ketter, 2014) compared to the general population. It appears that ED may be influenced by deficits in social cognition, like the ability to correctly perceive emotional information from others or the ability to make predictions about their attitudes or behaviors (Rowland et al., 2013b). Emotional intelligence, a domain of social cognition, is also often impaired in people with BD who seem to have more difficulties in perceiving, using, understanding, and managing emotions (Varo et al., 2022). Emotion regulation (ER) is the ability of an individual to monitor, appraise, or adjust emotional reactions (Gross, 2015) through the implementation of a range of strategies that can be labeled as adaptive (i.e. cognitive reframing, adaptive coping, and acceptance) or maladaptive (i.e. negative and positive rumination, negative focus, risk-taking behavior, suppression, and dampening) (Dodd, Lockwood, Mansell, & Palmier-Claus, 2019). ER requires complex interactions between cortical (i.e. prefrontal and orbitofrontal cortex) and subcortical regions (i.e. amygdala and hypothalamus) (Green & Malhi, 2006) that appear to be altered in patients with BD (Bigot et al., 2020). Two studies (Kjærstad et al., 2022; Njau et al., 2020) reported a neurobiological heterogeneity in BD during the activation of these neural networks, defining two groups of patients. One of these groups showed higher amygdala activation, while the other exhibited a lower activation of both amygdala and prefrontal cortex during the experience of negative emotions. Depending on these clusters underlining different modalities of neuronal activity, people may preferably rely on specific ER strategies rather than others (Kjærstad et al., 2022), which further contributes to the high heterogeneity of the construct. In our recent meta-analysis (De Prisco et al., 2022), individuals with BD were shown to adopt more maladaptive ER strategies and fewer adaptive ones than healthy controls and first-degree relatives, with the highest and strongest disparities found in ruminative and risk-taking behaviors. Whether these differences are characteristics of BD or are due to a common psychopathological burden shared by many psychiatric disorders requires further investigation. Indeed, studies focusing on differences in ED between BD and MDD reported mixed results, and higher levels of overall ED were described in both the former (Oymak Yenilmez et al., 2021) and the latter (Becerra et al., 2013). As ED appears to be a transdiagnostic dimension and a potential target for personalized interventions, it is important to define the extent to which certain features are specific to BD or shared with other psychiatric disorders.

Given its complexity, several scales have been developed offering quick and useful clinical instruments to begin exploring this dimension, each one measuring specific aspects of ED. For example, following the operationalization proposed in a previous systematic review (Dodd et al., 2019), the Cognitive Emotion Regulation Questionnaire (CERQ) (Garnefski & Kraaij, 2007) is used to capture both maladaptive (i.e. rumination and negative focus) and adaptive (i.e. cognitive reframing and acceptance) ER strategies, the Emotion Regulation Questionnaire (ERQ) (Gross & John, 2003) is employed to measure the levels of suppression and adaptive coping, while the Response Style Questionnaire (RSQ) (Nolen-Hoeksema, 1991) is designed to measure the degree of negative rumination, risk-taking behavior, and adaptive coping. Other scales focus strictly on maladaptive strategies, such as the Ruminative Response Scale (RRS)

(Treynor, Gonzalez, & Nolen-Hoeksema, 2003) and the Response to Positive Affect (RPA) scale (Feldman, Joormann, & Johnson, 2008), which specifically assess negative rumination and positive rumination and dampening, respectively. Finally, the Difficulties in Emotion Regulation Scale (DERS) (Gratz & Roemer, 2004) provides an overall assessment of ED while also allowing for a more targeted description of the difficulties in using specific strategies (i.e. risk-taking behavior, adaptive coping, and acceptance).

The present study aims to identify the ED characteristics and ER strategies that discriminate between individuals with BD from individuals diagnosed with any other psychiatric disorder when using these validated measurement scales.

Methods

The present systematic review and meta-analysis was conducted according to the Meta-analysis of Observational Studies in Epidemiology (MOOSE) (Stroup et al., 2000) and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021). This systematic review and meta-analysis protocol was registered on the International Prospective Register of Systematic Reviews (PROSPERO) (https://www.crd.york.ac.uk/PROSPERO/; protocol CRD42021293357).

Eligibility criteria and study outcomes

Inclusion criteria were as follows: (i) original studies providing quantitative data on ER and/or ED, (ii) measured with a validated scale, (iii) in people diagnosed with BD, and (iv) compared with clinical groups (people diagnosed with psychiatric disorders other than BD). Psychiatric diagnoses had to be made according to the Diagnostic and Statistical Manual for Mental Disorders (DSM) (APA, 1994, 2000, 2013) or the International Classification of Diseases (ICD) (WHO, 2004) diagnostic criteria. No sample size or language restrictions were applied. Both observational and interventional studies were eligible for inclusion, but we only considered baseline data. In the case of overlapping populations across multiple studies, we included the largest one with the most representative data relevant to our objectives. Exclusion criteria were as follows: (i) Studies that assessed ER and/or ED through behavioral measures or cognitive tasks of both explicit (e.g. affective picture viewing task and emotional film clips task) and implicit (e.g. affective go/no-go task and emotional stroop test) types; (ii) reviews; (iii) case reports and case series (not reliable control group); and (iv) studies conducted on animals (population not considered by our criteria).

Search strategy

We systematically searched the PubMed/MEDLINE, EMBASE, Scopus, and PsycINFO databases from inception until April 28th, 2022. Search strings are provided in online Supplementary Materials S1. The references of each included study, textbooks, and other material were hand-searched to identify potential additional studies not captured by the original search string.

Study selection and data extraction

Studies of potential interest were independently screened by two authors (M.D.P. and V.O.). A third author (A.M.) was consulted

whenever a consensus could not be reached. Data extraction included (when available): author(s), publication year, geographical region and country, study design, diagnostic criteria, and (semi)structured interview adopted, setting of the study, type of validated scale, outcome type (primary or secondary), type of control group, number of cases and controls, mean and standard deviation (S.D.) of the outcome for cases and controls, mean age of cases and controls, % of females among cases and controls, duration of illness among people with BD, % of people diagnosed with BD-I, % of euthymic, depressed, or (hypo)manic patients, % of patients taking psychotropic medication, psychiatric or other medical comorbidities, and mean score obtained by cases and controls at symptom severity scales. WebPlotDigitizer was used to extract numerical variables from graphs whenever needed (https://automeris.io/WebPlotDigitizer/). In cases where the information was unavailable, we contacted the authors twice to request the necessary data.

Methodological quality appraisal

The risk of bias in the included studies was independently assessed by two authors (M.D.P. and V.O.), and any disagreement was resolved by a third author (A.M.). The Newcastle-Ottawa Scale (NOS) (Stang, 2010) was adopted to grade the quality of observational studies, and the scores obtained at the NOS were converted to 'Agency for Healthcare Research and Quality' (AHRQ) standards as described elsewhere (Sharmin et al., 2017).

Statistical analyses

We performed the analyses using RStudio R version 4.1.2 (R Core Team, 2020) and conducted the meta-analysis through the metafor R-package (Viechtbauer & Viechtbauer, 2015) using a random-effect model (restricted maximum-likelihood estimator) (Harville, 1977). Effect sizes were calculated as standardized mean differences (S.M.D.) with their confidence intervals (CI) and represented by Hedge's g. We conducted sensitivity analyses by removing one study at a time from the analysis (leave-one-out analysis), by considering only good-quality studies according to AHRQ standards (high quality), and by including in the analyses only those studies that compared euthymic-only or depressed-only patients in both groups. Because we ran many statistical tests due to the large number of scales and subscales considered, we also conducted a sensitivity analysis using a more conservative significance level corrected for the number of total tests: this correction was done with the '*p*.adjust()' function of the stats R-package (R Core Team, 2020) using the Bonferroni method. We performed cumulative analyses to evaluate the repercussions of the studies published over the years on the effect size. We assessed heterogeneity by using the Cochran's Q test (Cochran, 1950) and τ^2 and I^2 statistics (Higgins et al., 2019), and this was graphically evaluated by adopting the graphical display of study heterogeneity (GOSH) method (Olkin, Dahabreh, & Trikalinos, 2012); additionally, we estimated prediction intervals (Borenstein, Higgins, Hedges, & Rothstein, 2017). When the Cochran's Q test presented a $p < 0.05$ and the I^2 statistic showed a value >50% and the analysis included more than three studies, we conducted a subgroup analysis according to a priori defined subgroups, whenever available (i.e. BD-type, the current mood-state, and the type of outcome according to the original study).

Results

A total of 3239 studies were identified across different sources, and after a semi-automatic duplicate removal, 1813 studies underwent further screening. Of these, 1667 were excluded at the title/abstract level, 112 after the full-text evaluation, and five could not be retrieved. Altogether, 29 studies were included in the present research, and 22 (yielding 145 comparisons) were eligible for performing a meta-analysis. Among the latter, 18 studies (100 comparisons) compared people diagnosed with BD to people diagnosed with MDD, while four studies (45 comparisons) compared patients with BD to patients with BPD. The PRISMA flow-chart is shown in Fig. 1. Details on the studies included in the systematic review and meta-analysis are presented in Table 1 and in online Supplementary Materials S1. Details on the excluded studies are presented in online Supplementary Materials S1.

Main analyses

The main results of the meta-analyses conducted are presented in Table 2 and Fig. 2, organized according to overall ED measures, maladaptive ER strategies, and adaptive ER strategies, as in previous systematic reviews (De Prisco et al., 2022; Dodd et al., 2019). Overall, people with BD significantly differed from people with MDD in adopting more positive rumination and risk-taking behaviors. On the other hand, people with BPD relied less on adaptive ER strategies and exhibited higher levels of self-blaming and catastrophic thinking than people with BD.

Additional details on the main analyses are provided in online Supplementary Materials S1.

Subgroup analyses

Subgroup analyses were conducted only for comparisons with high heterogeneity and according to (i) the BD-type; (ii) the current mood-state; and (iii) the type of outcome according to the original study.

Studies comparing BD and MDD and exploring differences in the total DERS score as a primary outcome presented a significant and opposite effect size with reduced heterogeneity (test for subgroup difference: $Q_M = 7.26$; p value = 0.01).

Studies comparing BD and BPD and exploring differences in the '*clarity*' subscale of the DERS as a primary outcome presented a significantly lower effect size and reduced heterogeneity (test for subgroup difference: $Q_M = 5.59$; p value = 0.02).

No significant differences were observed according to the BD-type or current mood state.

Additional details on the subgroup analyses are provided in online Supplementary Materials S1.

Sensitivity analyses

Sensitivity analyses were conducted (i) removing one study at a time; (ii) considering good-quality studies only; (iii) considering only those studies that compared euthymic-only or depressed-only patients in both groups; (iv) considering a more conservative significance level. GOSH plots were graphically inspected to further evaluate outliers and heterogeneity.

In studies comparing BD and MDD, the following comparisons became significant after the leave-one-out sensitivity analysis: (i) '*reflective pondering*' subscale of the RRS, by removing the study (Aslan & Baldwin, 2021), (ii) '*putting into perspective*'
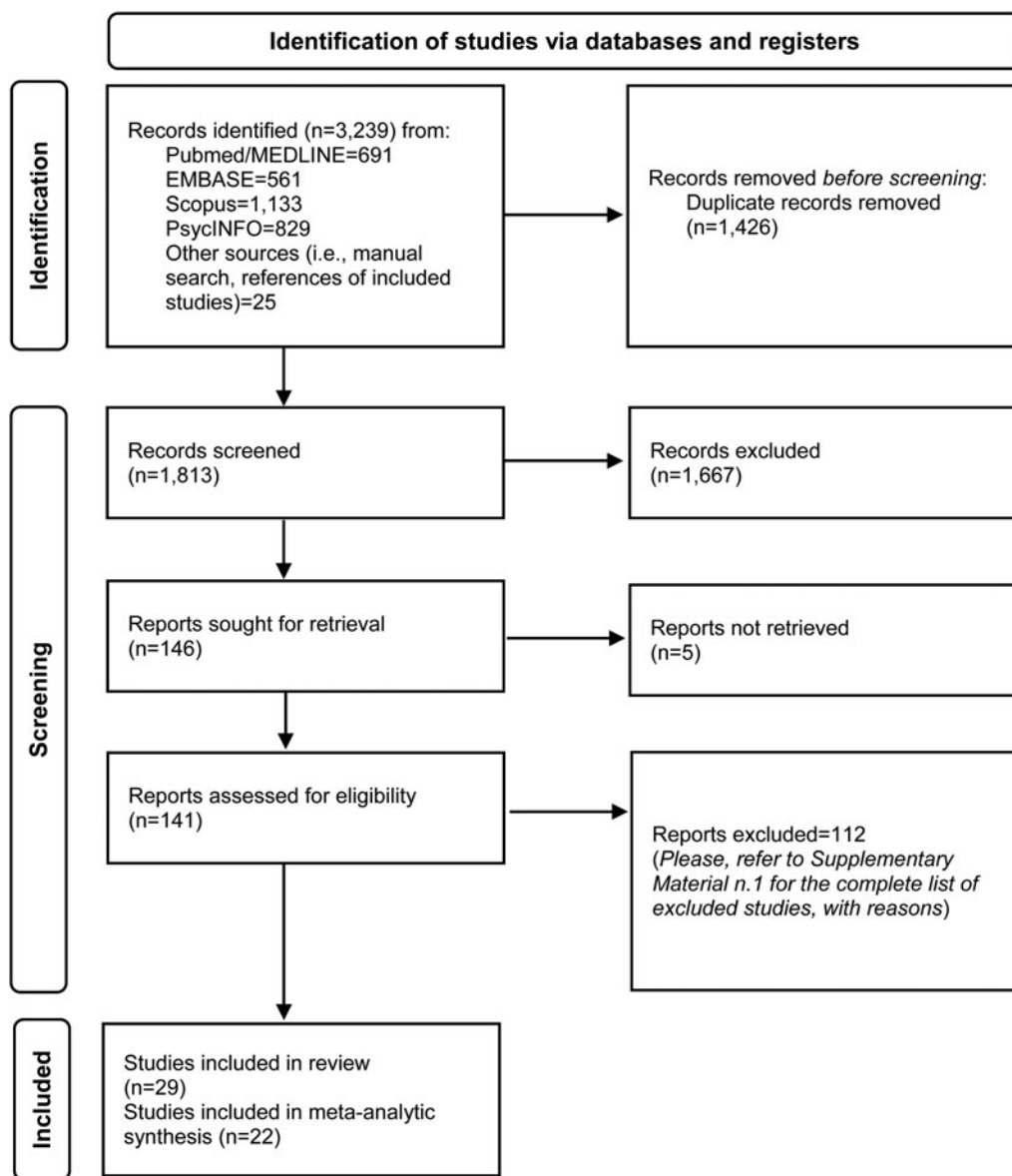
Figure 1. PRISMA flowchart, 2020 edition, adapted.

subscale of the CERQ, by removing the study (Wolkenstein, Zwick, Hautzinger, & Joormann, 2014), and (iii) 'goals' subscale of the DERS, by removing the study (Oymak Yenilmez et al., 2021), all passing from a small to a small-to-moderate effect size; (iv) 'awareness' subscale of the DERS, by removing the study (Musket, Hansen, Welker, Gilbert, & Gruber, 2021), passing from a small-to-moderate to a moderate effect size. On the contrary, by removing the studies ([Becerra et al., 2013], [Becerra, Bassett, & Harms, 2016], or [Weintraub, Van de Loo, Gitlin, & Miklowitz, 2017]) in the comparison relative to the 'clarity' subscale of the DERS, the overall effect became nonsignificant with an effect size comparable in magnitude.

In studies comparing BD and BPD and exploring differences of the 'clarity' subscale of the DERS, the overall effect became insignificant by removing the study (Bayes, Parker, & McClure, 2016), with an effect size comparable in magnitude.

In good-quality studies comparing BD and MDD and exploring differences of the 'clarity' subscale of the DERS, the

overall effect became nonsignificant. In good-quality studies comparing BD and MDD and exploring differences of the 'reflective pondering' subscale of the RRS, the overall effect became significant.

In studies comparing BD and MDD and exploring differences in the 'clarity' subscale of the DERS and by solely considering only those studies that compared euthymic-only or depressed-only patients in both groups, the overall effect was not significant.

In studies comparing BD and MDD, differences found in the 'clarity' subscale of the DERS were no longer significant when using a more conservative significance level.

In studies comparing BD and BPD, differences found in the 'positive refocusing', 'positive reappraisal', and 'refocus on planning' subscales of the CERQ and 'clarity' subscale of the DERS were no longer significant when using a more conservative significance level.

Inspecting the GOSH plots in studies comparing BD and MDD, the following results were found (each referring to the

Table 1. Characteristics of the studies included in the systematic review and meta-analysis

Author, year, country	Study design	Description of the study and population characteristics	Mood state and affective symptomatology	Diagnostic criteria	Scales adopted	Emotion regulation strategy type considered	Quality of the study (NOS)
Ambrosi et al. (2017), USA	Cross-sectional	Population included: 36 inpatients with BD, 40 patients with MDD; Outcome (primary): to investigate via fMRI the functional connectivity between insula and amygdala and to explore their contribution to the functional networks involved in emotion regulation; Other: patients were mostly on medication at the time of assessment. Substance use was diagnosed in both patients with BD (55.5%) and MDD (52.5%)	BD: depressed (100%) PHQ-9: 17 ± 5.7 MDD: depressed (100%) PHQ-9: 17.9 ± 7.2 PHQ-9 scores were not significantly different between the two groups ($p = 0.55$).	DSM-IV (SCID-I)	DERS	Overall emotion dysregulation (DERS-TOT)	7/GOOD
Ariana Kia and Hasani (2014), Iran	Cross-sectional	Population included: 25 patients with BD, 50 patients with MDD; Outcome (primary): determine the role of cognitive emotion regulation strategies, anxiety, and impulsivity in developing and maintaining the affective symptomatology; Other: adopted CERQ short version	BD: NA MDD: NA	DSM-IV (SCID-I)	CERQ (short version)	Negative rumination (CERQ-3); Negative focus (CERQ-1,2,4); Cognitive reframing (CERQ-5,6,7,9); Acceptance (CERQ-8)	4/POOR
Aslan and Baldwin (2021), United Kingdom	Cross-sectional	Population included: 50 patients with BD, 50 patients with MDD, 50 HCs; Outcome (primary): exploring the differences between groups in terms of rumination, emotion regulation and cognitive functions; Other: people with current psychotic symptoms, alcohol or substance abuse, or major neurological disease were excluded	BD: depressed (100%) MDD: depressed (100%)	DSM-5 (SCID-5)	ERQ; RRS	Negative rumination (RRS-1,2); Suppression (ERQ-2); Cognitive reframing (ERQ-1)	5/FAIR
Batmaz, Kaymak, Kocbiyik, and Turkcapar (2014), Turkey	Cross-sectional	Population included: 140 outpatients with BD-I, 166 outpatients with MDD, and 151 HCs; Outcome (primary): to distinguish unipolar and bipolar depression in terms of metacognitions and emotional schemas; Other: people with a comorbid axis-I psychiatric condition, uncontrolled medical condition, with substance use, history of head-trauma, pregnant, or taking psychiatric treatment in the last 12 weeks were excluded	BD: depressed (100%) MADRS: 31.98 ± 5.36 MDD: depressed (100%) MADRS: 33.08 ± 4.47 MADRS scores were not significantly different between the two groups ($p > 0.05$)	DSM-IV	LESS	Overall maladaptive emotion regulation strategies (LESS-2,3); Adaptive coping (LESS-1)	4/POOR

Bayes et al. (2016), Australia	Cross-sectional	Population included: 83 patients with BD, 53 patients with BPD, and 54 patients with both BD and BPD; Outcome (primary): to explore the differences between the emotion regulation strategies among groups; Other: people who were experiencing psychotic symptoms, diagnosed with current substance abuse, with comorbid organic conditions, or who were not fluent in English were excluded	BD: NA BPD: NA	DSM-IV (MINI)	CERQ; DERS	Overall emotion dysregulation (DERS-TOT); Negative rumination (CERQ-3); Negative focus (CERQ-1,2,4); Risk-taking (DERS-3); Cognitive reframing (CERQ-5,6,7,9); Adaptive coping (DERS-2,5); Acceptance (CERQ-8; DERS-1,4,6)	5/FAIR
Becerra et al. (2013), Australia	Cross-sectional	Population included: 48 patients with BD, 50 patients with MDD, and 50 patients with anxiety disorders; Outcome (primary): exploring the differences in emotion regulation difficulties; Other: people with BD were euthymic (34) or mildly depressed (14)	BD: euthymic (71%), mildly depressed (29%) MDD: NA Anxiety disorders: NA	ICD-10	DERS	Overall emotion dysregulation (DERS-TOT); Risk-taking (DERS-3); Adaptive coping (DERS-2,5); Acceptance (DERS-1,4,6)	4/POOR
Becerra et al. (2016), Australia	Cross-sectional	Population included: 24 patients with BD-I, 38 patients with MDD, and 38 HCs; Outcome (primary): exploring the differences in emotion regulation difficulties; Other: people who were pregnant, with a score on the Spielberger State/Trait Anxiety Inventory of more than 50, with a score on the MADRS of more than 5, and a score on the YMRS of more than 4, were excluded	BD: euthymic (100%) MDD: remitted (100%)	DSM-IV (MINI)	DERS	Overall emotion dysregulation (DERS-TOT); Risk-taking (DERS-3); Adaptive coping (DERS-2,5); Acceptance (DERS-1,4,6)	5/FAIR
Das et al. (2014), Australia	Cross-sectional	Population included: 16 outpatients with BD, 14 outpatients with BPD, and 13 HCs; Outcome (primary): fMRI to investigate the functional connectivity between and within brain networks subserving social cognition or emotion regulation; Other: people with BD were mostly on medication at the time of the assessment. Patients with neurological illnesses, substance abuse, lifetime head injury, or poor English proficiency were excluded	BD: euthymic (100%) DASS-depression: 4.38 ± 4.77 BPD: euthymic (100%) DASS-depression: 9.71 ± 6.73 DASS-depression scores were significantly lower in BD ($p < 0.05$)	DSM-IV	DERS	Overall emotion dysregulation (DERS-TOT); Risk-taking (DERS-3); Adaptive coping (DERS-2,5); Acceptance (DERS-1,4,6)	4/POOR
Fletcher, Parker, and Manicavasagar (2013), Australia	Cross-sectional	Population included: 193 patients with BD-I (86) or BD-II (107), 93 patients with MDD, and 90 HCs; Outcome (primary): exploring the different coping styles in clinical and nonclinical groups	BD: NA ISS-depression: 76.72 ± 63.67 MDD: NA ISS-depression: 65.8 ± 59 ISS depression scores were significantly higher in BD-II ($p =$	DSM-IV (MINI)	CERQ; RPA; RSQ	Negative rumination (CERQ-3; RSQ-1); Positive rumination (RPA-1,3); Negative focus (CERQ-1,2,4);	4/POOR

Table 1. (*Continued.*)

Author, year, country	Study design	Description of the study and population characteristics	Mood state and affective symptomatology	Diagnostic criteria	Scales adopted	Emotion regulation strategy type considered	Quality of the study (NOS)
			0.04), but no difference was found between BD (I and II together) and MDD ($p = 0.16$)			Risk-taking (RSQ-3); Dampening (RPA-2); Cognitive reframing (CERQ-5,6,7,9); Adaptive coping (RSQ-2); Acceptance (CERQ-8)	
Fletcher, Parker, Bayes, Paterson, and McClure (2014), Australia	Cross-sectional	Population included: 24 outpatients with BD-II and 24 outpatients with BPD; Outcome (primary): to explore the differences between their emotion regulation strategies; Other: people who were currently experiencing psychotic symptoms, diagnosed with current substance abuse, or with comorbid psychiatric (except for anxiety) or organic conditions were excluded	BD: NA QIDS-SR: 9.4 ± 5.7 BPD: NA QIDS-SR: 13.4 ± 11.3 QIDS-SR scores were significantly lower in BD ($p = 0.02$)	DSM-IV (MINI)	CERQ; DERS	Negative rumination (CERQ-3); Negative focus (CERQ-1,2,4); Risk-taking (DERS-3); Cognitive reframing (CERQ-5,6,7,9); Adaptive coping (DERS-2,5); Acceptance (CERQ-8; DERS-1,4,6)	6/GOOD
Fowler, Madan, Allen, Oldham, and Frueh (2019), USA	Cross-sectional	Population included: 341 inpatients with BD and 381 inpatients with BPD; Outcome (primary): to explore the extent of emotion dysregulation in the two groups; Other: substance use was diagnosed in both patients with BD (62%) and BPD (73%)	BD: NA BPD: NA	DSM-IV (SCID-I)	DERS	Overall emotion dysregulation (DERS-TOT); Risk-taking (DERS-3); Adaptive coping (DERS-2,5); Acceptance (DERS-1,4,6)	5/POOR
Gilbert, Nolen-Hoeksema, and Gruber (2013), USA	Prospective cohort	Population included: 31 patients with BD-I and 31 patients with MDD; Outcome (primary): to explore the relationships between rumination and dampening with emotional responding and were followed-up for six months to observe the prospective relationships between self-reported amplification and dampening, and symptom severity; Other: people who had any central nervous system disease, alcohol or any other substance use disorder, history of major traumas and head injuries, autoimmune disorders, or cardiovascular diseases or arrhythmia were excluded	BD: euthymic (100%) IDS-C: 4.26 ± 3.31 MDD: remitted (100%) IDS-C: 5.13 ± 2.7 IDS-C scores were not significantly different between the two groups ($p > 0.05$)	DSM-IV (SCID-I)	RPA	Positive rumination (RPA-1,3); Dampening (RPA-2)	4/POOR

Kim et al. (2022), Republic of Korea	Cross-sectional	Population included: 19 patients with BD-I (3) or BD-II (16), 71 patients with MDD, 14 patients with ADHD, and 12 patients with PTSD; Outcome (primary): to complete a clinical assessment to validate the ERQ, Korean version; Other: People diagnosed with schizophrenia spectrum disorders, mood disorders with psychotic features, intellectual disability, or neurocognitive disorders were excluded	BD: euthymic (11%), depressed (73%), (hypo)manic (16%) MDD: remitted (6%), depressed (94%) ADHD: NA PTSD: NA	DSM-5 (SCID-5)	ERQ	Suppression (ERQ-2); Cognitive reframing (ERQ-1)	4/POOR
Kim et al. (2012), Republic of Korea	Cross-sectional	Population included: 157 in- and outpatients with BD-I (68), BD-II (52), or BD-NOS (37), 227 in- and outpatients with MDD, and 65 in- and outpatients with panic disorder; Outcome (primary): to investigate the extension of rumination and its differences among the groups; Other: patients with mood disorders and comorbid anxiety disorders, as well as patients with anxiety disorders and comorbid mood disorders were excluded	BD: euthymic (2%), depressed (45%), (hypo)manic (45%), mixed (8%) HDRS: 11 (7,17) MDD: NA HDRS: 17 (13,21) Panic disorder: NA HDRS: 8 (5.5,11.5) HDRS scores were significantly higher in MDD ($p < 0.05$)	DSM-IV (SCID)	RRS	Negative rumination (RRS-1,2)	6/GOOD
Kjærstad et al. (2016), Denmark	Cross-sectional	Population included: 20 outpatients with BD-I (9) or BD-II (11), 20 outpatients with MDD; Outcome (primary): to explore the ability to downregulate emotional responses with no specific instructions or in a setting involving social-relevant scenarios; Other: people with substance use were excluded	BD: euthymic (100%) HDRS: 5.2 ± 3.1 MDD: remitted (100%) HDRS: 8.1 ± 4.7 HDRS scores were significantly higher in MDD ($p = 0.03$)	ICD-10	CERQ	Negative rumination (CERQ-3); Negative focus (CERQ-1,2,4); Cognitive reframing (CERQ-5,6,7,9); Acceptance (CERQ-8)	3/POOR
Lois et al. (2017), Germany	Cross-sectional	Population included: 21 patients with BD-I, 21 patients with MDD, and 23 HCs; Outcome (primary): performing emotional tasks during fMRI scanning to explore and compare the patterns of functional connectivity during distraction and reappraisal in specific regions of interest; Other: patients with current or lifetime substance use, head trauma history, or with large tattoos with metal-containing color were excluded	BD: euthymic (100%) HDRS: 0.7 ± 1.1 MDD: remitted (100%) HDRS: 0.9 ± 1.4 HDRS scores were not significantly different between the two groups ($p > 0.05$)	DSM-IV (SCID)	CERQ	Negative rumination (CERQ-3)	7/GOOD
Marwaha et al. (2018), United Kingdom	Cross-sectional	Population included: 11 outpatients with BD, 12 patients with BPD Outcome (primary): to explore the differences in affect intensity,	BD: NA BPD: NA	ICD-10	ACS	Negative focus (ACS-1,3,4); Dampening (ACS-2)	4/POOR

Table 1. (Continued.)

Author, year, country	Study design	Description of the study and population characteristics	Mood state and affective symptomatology	Diagnostic criteria	Scales adopted	Emotion regulation strategy type considered	Quality of the study (NOS)
		instability, and control among groups; Other: people who were experiencing an acute episode or diagnosed with substance use disorder were excluded					
Masi et al. (2021), Italy	Cross-sectional	Population included: 49 young patients with bipolar spectrum disorder and 72 patients with ADHD; Outcome (primary): to compare the differences in emotion regulation between the groups; Other: people with a diagnosis of autism spectrum disorder or schizophrenia spectrum and other psychotic disorders, and the presence of comorbid intellectual disability were excluded	BD: NA ADHD: NA	DSM-5 (K-SADS-PL)	RIPoSt-40	Affective instability (RIPoSt-40-1); Positive rumination (RIPoSt-40-4); Negative focus (RIPoSt-40-3); Risk-taking (RIPoSt-40-2)	5/FAIR
Murray et al. (2021), Switzerland	Cross-sectional	Population included: 18 outpatients with BD-I (8), BD-II (8), or BD-NOS (II), 24 outpatients with BPD, 32 HCs; Outcome (primary): to explore the differences in whole-brain neural reactivity to psychosocial stress; Other: people with history of head trauma or any contraindication to MRI were excluded	BD: euthymic (100%) BPD: NA	DSM-IV (SCID-II; MINI; DIGS)	CERQ	Overall maladaptive emotion regulation (Nonadaptive composite scale)	7/GOOD
Musket et al. (2021), USA	Cross-sectional	Population included: 51 outpatients with BD-I, 32 patients with MDD, 30 HCs; Outcome (primary): to explore the differences in difficulties in emotion regulation. Other: people with a lifetime history of neurological disease, severe head trauma, stroke, autoimmune disorder, severe medical illness, and alcohol or substance abuse in the past six months were excluded	BD: euthymic (63%), (hypo) manic (37%) IDS-C: 9.23 ± 5.28 YMRS: 6.76 ± 3.28 MDD: remitted (100%) IDS-C: 5.03 ± 2.79 YMRS: 1.72 ± 1.87 IDS-C and YMRS scores were significantly higher in BD ($p < 0.05$)	DSM-IV (SCID-I)	DERS	Overall emotion dysregulation (DERS-TOT); Risk-taking (DERS-3); Adaptive coping (DERS-2,5); Acceptance (DERS-1,4,6)	6/GOOD
Oymak Yenilmez et al. (2021), Turkey	Cross-sectional	Population included: 85 outpatients with BD-I (64) or BD-II (21), 81 outpatients with MDD, and 86 HCs; Outcome (primary): determining the role of emotion dysregulation and childhood adversities on automatic thoughts and meta-cognition; Other: people who had any central nervous system disease, intellectual disability, alcohol, or any other substance use disorder, history of major traumas and head injuries, or hospitalized in the last six months, were excluded	BD: euthymic (100%) BDI: 15.93 ± 14.16 YMRS: 2.87 ± 4.26 MDD: remitted (100%) BDI: 18.51 ± 13.06 YMRS: 0.48 ± 1.6 BDI scores were not significantly different between the two groups ($p > 0.05$), and YMRS scores were significantly higher in BD ($p < 0.05$)	DSM-IV (SCID-I)	DERS	Risk-taking (DERS-3); Adaptive coping (DERS-2,5); Acceptance (DERS-1,6)	5/FAIR

Perich, Manicavasagar, Mitchell, and Ball (2011), Australia	Cross-sectional	Population included: 90 patients with BD, 36 patients with MDD, and 66 HCs; Outcome (primary): to explore the relationship between mindfulness and psychiatric symptomatology among clinical groups; Other: people with a diagnosis of schizophrenia or schizoaffective disorder, substance abuse disorder, organic brain syndrome, antisocial or borderline personality disorder, or a concurrent significant medical condition impeding their ability to participate were excluded	BD: euthymic (90%), depressed (8%), (hypo)manic (2%) DASS-depression: 15.59 ± 12.65 MDD: remitted (100%) DASS-depression: 7.06 ± 7.78 DASS-depression scores were significantly higher in BD ($p <$ 0.05)	DSM-IV (SCID)	RSQ	Negative rumination (RSQ-1); Risk-taking (RSQ-3); Adaptive coping (RSQ-2)	6/FAIR
Rowland et al. (2013a), Australia	Cross-sectional	Population included: 97 patients with BD-I, 126 patients with schizophrenia, 81 HCs; Outcome (primary): exploring the differences among the groups in adopting adaptive and maladaptive emotion regulation strategies	BD: NA DASS-depression: 11.89 ± 11.18 Schizophrenia: NA DASS-depression: 12.61 ± 10.73 DASS-depression scores were not significantly different between the two groups ($p >$ 0.05).	DSM-IV (DIGS)	CERQ	Negative Rumination (CERQ-3); Negative Focus (CERQ-1,2,4); Cognitive Reframing (CERQ-5,6,7,9); Acceptance (CERQ-8)	6 / GOOD
Sesso et al. (2021), Italy	Cross-sectional	Population included: 44 young in- and outpatients with Bipolar spectrum disorder, 34 patients with ADHD; Outcome (primary): to validate the scale RIPoSt-Y. Other: patients presented severe irritability with temper outbursts, mood lability and instability, low tolerance to frustration and low reactivity threshold, inappropriate expression of emotions with excessive intensity, and slow affective normalization. People with a diagnosis of autism spectrum disorder or schizophrenia spectrum and other psychotic disorders, and the presence of comorbid intellectual disability were excluded	BD: NA ADHD: NA	DSM-5 (K-SADS-PL)	RIPoSt-Y	Affective Instability (RIPoSt-Y-1,3,4); Positive Rumination (RIPoSt-Y-2)	5 / FAIR
Shapero et al. (2015), USA	Cross-sectional	Population included: 31 young patients with BD, 122 young patients with MDD, 228 HCs; Outcome (primary): to identify and differentiate the cognitive styles among the different groups; Other: people with lifetime history of any psychotic disorder or not fluent in English were excluded	BD: euthymic (100%) MDD: remitted (100%)	DSM-IV (SADS-L)	RPA; RRS	Negative Rumination (RRS-1,2); Positive Rumination (RPA-1,3); Dampening (RPA-2)	6 / GOOD
Van Meter and Youngstrom (2016), USA	Cross-sectional	Population included: 23 outpatients with BD-I (11), BD-II (5), or BD NOS (7), and 21 patients with MDD; Outcome (primary): evaluate the	BD: euthymic (87%), depressed (13%) BDI: 9.65 ± 8.59 MDD: remitted (100%)	DSM-IV (MINI)	CERQ	Overall maladaptive emotion regulation (Nonadaptive composite scale);	6 / FAIR

Table 1. (*Continued.*)

Author, year, country	Study design	Description of the study and population characteristics	Mood state and affective symptomatology	Diagnostic criteria	Scales adopted	Emotion regulation strategy type considered	Quality of the study (NOS)
		emotional response after a stimulus; Other: patients were mostly on medications	BDI: 8.86 ± 7.32 BDI scores were not significantly different between the two groups ($p > 0.05$).			Overall adaptive emotion regulation (Adaptive composite scale)	
Weinstock, Chou, Celis-deHoyos, Miller, and Gruber (2018), USA	Cross-sectional	Population included: 30 outpatients with BD-I, 30 outpatients with MDD, 30 HCs; Outcome (primary): exploring the differences among the groups in emotion regulation processes; Other: people with current psychotic symptoms, alcohol or substance abuse, or major neurological disease, were excluded	BD: depressed (100%) QIDS-SR: 17.1 ± 3.2 MDD: depressed (100%) QIDS-SR: 16.3 ± 3.2 QIDS-SR scores were not significantly different between the two groups ($p > 0.05$).	DSM-IV (SCID-I)	AAQ-II; RPA; RSQ	Negative Rumination (RRS-2); Positive Rumination (RPA-1,3); Dampening (RPA-2); Acceptance (AAQ-II, total score)	5 / FAIR
Weintraub et al. (2017), USA	Cross-sectional	Population included: 57 patients with BD, 78 patients with MDD; Outcome (primary): to explore their self-harm behaviors, and their relationship with personality traits; Other: 57% of the total sample was experiencing a mild depressive episode. People diagnosed with schizophrenia or intellectual disability, were excluded	BD: NA MDD: NA	DSM-IV (DIGS)	DERS	Overall emotion dysregulation (DERS-TOT); Risk-taking (DERS-3); Adaptive coping (DERS-2,5); Acceptance (DERS-1,4,6)	6 / GOOD
Wolkenstein et al. (2014), Germany	Cross-sectional	Population included: 42 outpatients with BD-I (26) or BD-II (16), 43 outpatients with MDD, and 39 HCs; Outcome (primary): comparing the habitual use of emotion regulation strategies; Other: patients were mostly on medications. Patients with insufficient knowledge of the German language, with lifetime psychotic symptoms, with current substance use, or with a comorbid diagnosis of personality disorders (A or B) or anorexia nervosa, were excluded	BD: euthymic (100%) HDRS: 3 ± 2.55 MDD: remitted (100%) HDRS: 3.58 ± 2.4 HDRS scores were not significantly different between the two groups ($p > 0.05$)	DSM-IV (SCID-I)	CERQ	Negative rumination (CERQ-3); Negative focus (CERQ-1,2,4); Cognitive reframing (CERQ-5,6,7,9); Acceptance (CERQ-8)	4/POOR

Note: AAQ-II, Acceptance and Action Questionnaire, II; ACS, Affective Control Scale; ACS-1, anger; ACS-2, positive-affect; ACS-3, depression; ACS-4, anxiety; ADHD, attention deficit-hyperactivity disorder; BD, bipolar disorder; BDI, Beck Depression Inventory; BPD, borderline personality disorder; CERQ, Cognitive Emotion Regulation Questionnaire; CERQ-1, self-blame; CERQ-2, blaming others; CERQ-3, rumination; CERQ-4, catastrophizing; CERQ-5, putting into perspective; CERQ-6, positive refocus; CERQ-7, positive reappraisal; CERQ-8, acceptance; CERQ-9, focus on replanning; DASS, Depression Anxiety Stress Scales; DERS, Difficulties in Emotion Regulation Scale; DERS-1, nonacceptance; DERS-2, goals; DERS-3, impulse; DERS-4, awareness; DERS-5, strategies; DERS-6, clarity; DERS-TOT, total score; DIGS, diagnostic interview for genetic studies; DSM, Diagnostic and Statistical Manual of Mental Disorders; ERQ, Emotion Regulation Questionnaire; ERQ-1, reappraisal; ERQ-2, suppression; HDRS, Hamilton Depression Rating Scale; HC, healthy controls; IDS-C, Inventory of Depressive Symptomatology; LESS, Leahy Emotional Schema Scale; LESS-1, adaptive emotional schemas; LESS-2, rigid emotional schemas; LESS-3, negative beliefs about emotions; MADRS, Montgomery-Asberg Depression Rating Scale; MADRS, Montgomery–Åsberg Depression Rating Scale; MDD, major depressive disorder; MINI, The Mini-International Neuropsychiatric Interview; MRI, magnetic resonance imaging; NOS, Newcastle-Ottawa Scale; PHQ-9, Patient Health Questionnaire-9; PTSD, post-traumatic stress disorder; QIDS-SR, Quick Inventory of Depressive Symptoms-Self Report; RIPoSt-40, Reactivity, Intensity, Polarity and Stability Questionnaire; RIPoSt-40-1, affective instability; RIPoSt-40-2, emotional impulsivity; RIPoSt-40-3, negative emotionality; RIPoSt-40-4, positive emotionality; RIPoSt-Y, Reactivity, Intensity, Polarity and Stability Questionnaire, Youth version; RIPoSt-Y-1, affective instability; RIPoSt-Y-2, positive emotionality; RIPoSt-Y-3, emotional reactivity; RIPoSt-Y-4, interpersonal sensitivity; RPA, response to positive affect; RPA-1, emotion focus; RPA-2, dampening; RPA-3, self-focus; RRS, Ruminative Response Scale; RRS-1, reflective pondering; RRS-2, brooming; RSQ, Response Styles Questionnaire; RSQ-1, rumination; RSQ-2, adaptive; RSQ-3, risk-taking; SADS, schedule for affective disorders and schizophrenia; SCID, Structured Clinical Interview for DSM Disorders; YMRS, Young Mania Rating Scale.

Table 2. Meta-analyses results of emotion dysregulation between bipolar disorder and major depressive disorder or borderline personality disorder

Scale adopted	Subscale	Studies, n	BD patients, n	Control, diagnosis	Control, n	S.M.D.	95% CI	p value	95% PI	I^2 (%)	τ^2	Q test p value
Overall measures of emotion dysregulation												
DERS	Total score	6	301	MDD	319	−0.12	−0.46 to 0.23	0.51	−0.93 to 0.70	77.6	0.14	0.01
DERS	Total score	3	440	BPD	448	**−1.22**	**−1.94 to −0.5**	**9.1×10^{-4}**	−2.57 to 0.13	90.7	0.34	0.01
Maladaptive emotion regulation strategies												
Negative rumination												
CERQ	Rumination	5	301	MDD	205	−0.17	−0.63, 0–29	0.47	−1.17 to 0.83	79.3	0.21	0.01
RRS	Brooding	3	238	MDD	399	−0.11	−0.46 to 0.24	0.55	−0.72 to 0.51	70.7	0.07	0.05
RRS	Reflective pondering	3	238	MDD	399	0.10	−0.39 to 0.59	0.69	−0.82 to 1.01	85	0.16	0.01
RSQ	Rumination	2	283	MDD	132	0.47	−0.25 to 1.19	0.20	−0.73 to 1.68	89.4	0.24	0.01
CERQ	Rumination	2	107	BPD	77	−0.18	−0.47 to 0.12	0.24	−0.47 to 0.12	0	0	0.63
Positive rumination												
RPA	Emotion-focus	4	285	MDD	279	**0.46**	**0.27–0.64**	**8.5×10^{-7}**	**0.27–0.64**	0	0	0.60
RPA	Self-focus	4	285	MDD	279	**0.34**	**0.15–0.52**	**2.7×10^{-4}**	**0.15–0.52**	0	0	0.99
Negative focus												
CERQ	Self-blame	4	280	MDD	184	−0.02	−0.21 to 0.17	0.84	−0.21 to 0.17	0	0	0.83
CERQ	Blaming others	4	280	MDD	184	−0.12	−0.31 to 0.07	0.21	−0.31 to 0.07	0	0	0.42
CERQ	Catastrophizing	4	280	MDD	184	0.13	−0.06 to 0.32	0.17	−0.06 to 0.32	0	0	0.87
CERQ	Self-blame	2	107	BPD	77	**−0.80**	**−1.11 to −0.50**	**2.68×10^{-7}**	**−1.11 to −0.50**	0	0	0.83
CERQ	Blaming others	2	107	BPD	77	−0.52	−1.10 to 0.05	0.07	−1.40 to 0.35	65.2	0.11	0.09
CERQ	Catastrophizing	2	107	BPD	77	**−0.60**	**−0.92 to −0.28**	**2.3×10^{-4}**	**−0.94 to −0.25**	6.8	0	0.30
Risk-taking behavior												
DERS	Impulse	5	265	MDD	279	0.02	−0.30 to 0.34	0.90	−0.66 to 0.70	70.3	0.09	0.01
RSQ	Risk-taking	2	283	MDD	132	**0.48**	**0.27–0.69**	**8.11×10^{-6}**	**0.27–0.69**	0	0	0.36
DERS	Impulse	4	464	BPD	472	**−0.76**	**−0.89 to −0.63**	**5.4×10^{-29}**	**−0.89 to −0.63**	0	0	0.51
Suppression												
ERQ	Suppression	2	69	MDD	121	−0.17	−1.04 to 0.71	0.71	−1.62 to 1.29	86.5	0.35	0.01
Dampening												
RPA	Dampening	4	285	MDD	279	0.15	−0.03 to 0.33	0.11	−0.03 to 0.33	0	0	0.55
Adaptive emotion regulation strategies												
Cognitive reframing												
CERQ	Putting into perspective	4	280	MDD	184	0.16	−0.14 to 0.46	0.31	−0.35 to 0.66	47.2	0.04	0.13

(Continued)

Table 2. (*Continued.*)

Scale adopted	Subscale	Studies, n	BD patients, n	Control, diagnosis	Control, n	S.M.D.	95% CI	p value	95% PI	I² (%)	τ²	Q test p value
CERQ	Positive refocusing	4	280	MDD	184	0.16	−0.27 to 0.59	0.46	−0.68 to 1.01	73.9	0.14	0.02
CERQ	Positive reappraisal	4	280	MDD	184	0.03	−0.16 to 0.22	0.75	−0.16 to 0.22	0	0	0.41
CERQ	Refocus on planning	4	280	MDD	184	0.10	−0.26 to 0.46	0.57	−0.56 to 0.77	62.9	0.08	0.07
ERQ	Reappraisal	2	69	MDD	121	0.17	−0.14 to 0.48	0.29	−0.14 to 0.48	0	0	0.53
CERQ	Putting into perspective	2	107	BPD	77	**0.52**	**0.22–0.82**	**6.3×10^{-4}**	**0.22–0.82**	0	0	0.48
CERQ	Positive refocusing	2	107	BPD	77	**0.44**	**0.15–0.74**	**3.4×10^{-3}**	**0.15–0.74**	0	0	0.96
CERQ	Positive reappraisal	2	107	BPD	77	**0.53**	**0.23–0.83**	**5.4×10^{-3}**	**0.23–0.83**	0	0	0.38
CERQ	Refocus on planning	2	107	BPD	77	**0.43**	**0.14–0.73**	**4.3×10^{-3}**	**0.14–0.73**	0	0	0.44
Adaptive coping												
DERS	Goals (reverse)	5	265	MDD	279	−0.05	−0.46 to 0.36	0.82	−0.97 to 0.87	81.6	0.18	0.01
DERS	Strategies (reverse)	5	265	MDD	279	−0.02	−0.36 to 0.32	0.90	−0.75 to 0.70	73.2	0.11	0.01
RSQ	Adaptive	2	283	MDD	132	−0.25	−0.75 to 0.25	0.32	−1.06 to 0.55	78.9	0.1	0.03
DERS	Goals (reverse)	4	464	BPD	472	**0.54**	**0.40–0.67**	**2.8×10^{-15}**	**0.40–0.67**	0.6	0	0.57
DERS	Strategies (reverse)	4	464	BPD	472	**0.79**	**0.65–0.92**	**1.2×10^{-30}**	**0.65–0.92**	0	0	0.05
Acceptance												
CERQ	Acceptance	4	280	MDD	184	0.02	−0.17 to 0.21	0.84	−0.17 to 0.21	0	0	0.79
DERS	Nonacceptance (reverse)	5	265	MDD	279	0.14	−0.20 to 0.48	0.43	−0.59 to 0.86	73.1	0.11	0.01
DERS	Awareness (reverse)	4	180	MDD	198	0.33	−0.08 to 0.74	0.11	−0.47 to 1.14	73.1	0.13	0.01
DERS	Clarity (reverse)	5	265	MDD	279	**0.33**	**0.02–0.64**	**0.04**	−0.32 to 0.98	68	0.08	0.01
CERQ	Acceptance	2	107	BPD	77	0.10	−0.20 to 0.39	0.52	−0.20 to 0.39	0	0	0.49
DERS	Nonacceptance (reverse)	4	464	BPD	472	**0.57**	**0.44–0.71**	**1.1×10^{-17}**	**0.44–0.71**	0	0	0.41
DERS	Awareness (reverse)	4	464	BPD	472	**0.44**	**0.22–0.66**	**1×10^{-4}**	**0.09–0.79**	33.7	0.02	0.18
DERS	Clarity (reverse)	4	464	BPD	472	**0.63**	**0.18–1.09**	**6.4×10^{-3}**	−0.27 to 1.53	80.9	0.16	0.01

Note: BD, Bipolar Disorder; BPD, Borderline Personality Disorder; CERQ, Cognitive Emotion Regulation Questionnaire; CI, confidence intervals; DERS, Difficulties in Emotion Regulation Scale; ERQ, Emotion Regulation Questionnaire; MDD, Major Depressive Disorder; PI, prediction intervals; RPA, response to positive affect; RRS, Rumination Response Scale; RSQ, Response Style Questionnaire; S.M.D., standardized mean difference (represented as Hedge's). Significant results are shown in bold and the exact p-value is given in the relative column. When the prediction intervals are the same as the confidence interval, the p-value is the same. In the two cases where the significant prediction intervals are different from the confidence intervals, their p-value is ≤ 0.01.
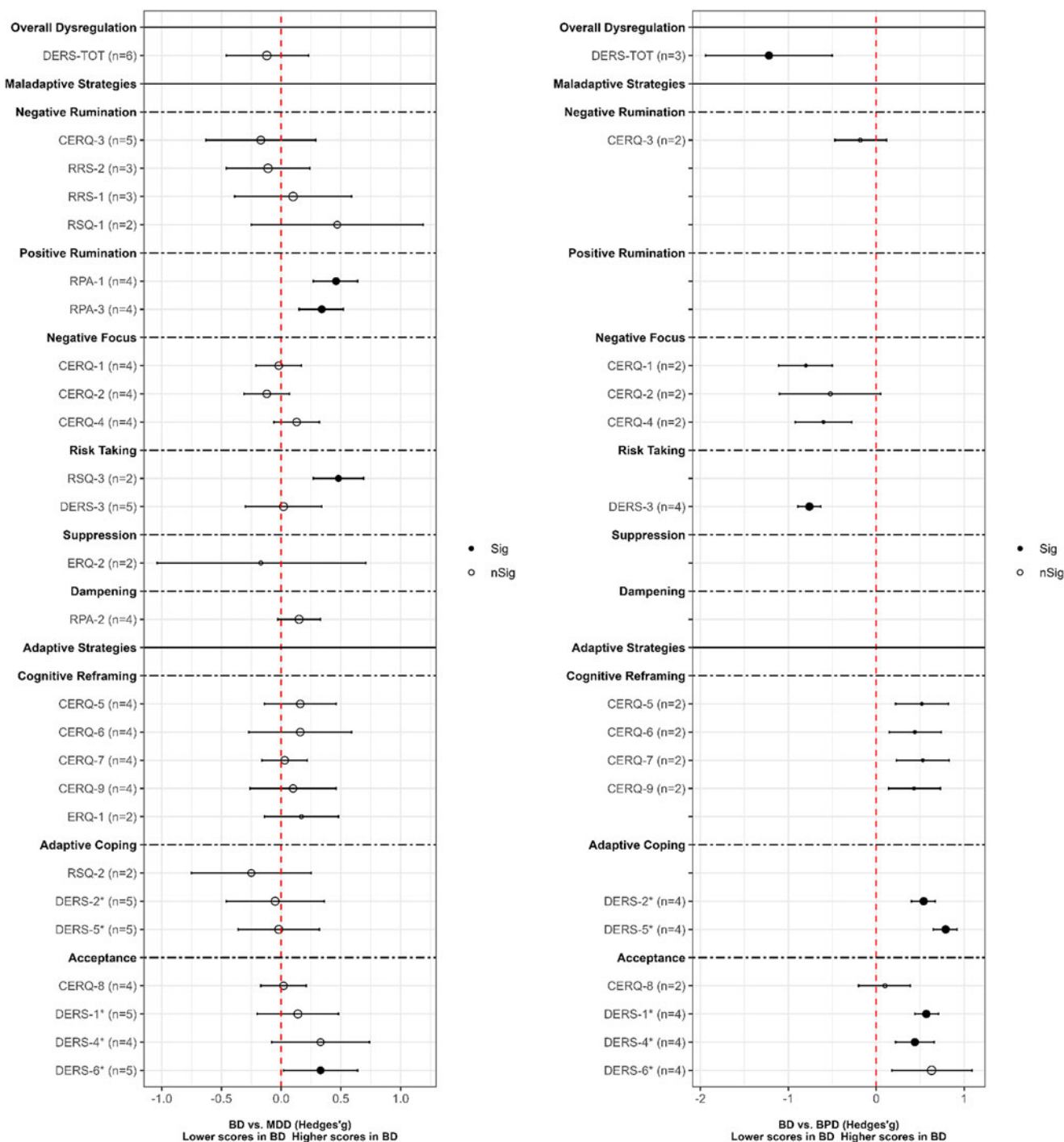
Figure 2. Differences in adopted emotion regulation strategies between people with bipolar disorder and people with major depressive disorder (left) and borderline personality disorder (right). Overall results of the comparisons included in the meta-analysis. *Note*: BD, 'bipolar disorder'; BPD, 'borderline personality disorder'; CERQ, 'cognitive emotion regulation scale'; CERQ-1, 'self-blame'; CERQ-2, 'blaming others'; CERQ-3, 'rumination'; CERQ-4, 'catastrophizing'; CERQ-5, 'putting into perspective'; CERQ-6, 'positive refocusing'; CERQ-7, 'positive reappraisal'; CERQ-8, 'acceptance'; CERQ-9, 'focus on replanning'; DERS, 'difficulties in emotion regulation scale'; DERS-1, 'nonacceptance'; DERS-2, 'goals'; DERS-3, 'impulse'; DERS-4, 'awareness'; DERS-5, 'strategies'; DERS-6, 'clarity'; DERS-TOT, 'total score'; ERQ, 'emotion regulation questionnaire'; ERQ-1, 'reappraisal'; ERQ-2, 'suppression'; MDD, 'major depressive disorder'; RPA, 'response to positive affect'; RPA-1, 'emotion focus'; RPA-2, 'dampening'; RPA-3, 'self-focus'; RRS, 'ruminative response scale'; RRS-1, 'reflective pondering'; RRS-2, 'brooming'; RSQ-, 'response style questionnaire'; RSQ-1, 'rumination'; RSQ-2, 'adaptive'; RSQ-3, 'risk-taking'.

*These items' effect sizes (ES) have been inverted to present graphically coherent results since the scale initially measures the individual's difficulties in adopting that emotion regulation strategy.

The point size is proportional to the total sample size for that particular comparison. The number in parentheses indicates the number of studies considered for that particular comparison.

comparisons related to each mentioned subscale): (i) in the '*putting into perspective*' subscale of the CERQ, subsets including the study (Wolkenstein et al., 2014) presented higher heterogeneity and lower effect size; (ii) in the '*positive refocusing*' subscale of the CERQ, subsets including the study (Ariana Kia & Hasani, 2014) presented higher heterogeneity and effect size; (iii) in the '*refocus on planning*' subscale of the CERQ, subsets including the study (Kjærstad et al., 2016) presented higher heterogeneity and effect size; (iv) in the '*goals*' subscale of the DERS, subsets including the study (Oymak Yenilmez et al., 2021) presented higher heterogeneity and opposite effect size; (v) in the '*non acceptance*' subscale of the DERS, subsets including the study (Oymak Yenilmez et al., 2021) presented higher heterogeneity and opposite effect size; and (vi) in the '*awareness*' subscale of the DERS, subsets including the study (Musket et al., 2021) presented higher heterogeneity and lower effects size.

By inspecting the GOSH plots in the studies comparing BD and BPD and exploring differences in the total DERS score, subsets including the study (Das, Calhoun, & Malhi, 2014) presented higher heterogeneity and effect size.

Additional details on the sensitivity analyses and the GOSH plots are provided in online Supplementary Materials S1.

Characteristics of the studies included in the qualitative synthesis

The following studies reported information about the comparison of BD with other psychiatric conditions; however, it was not possible to perform a meta-analysis on these data. One study (Rowland et al., 2013a) compared BD with schizophrenia using the CERQ. Three studies (Kim, Kim, & Kim, 2022; Masi et al., 2021; Sesso et al., 2021) compared BD with ADHD using the ERQ (Kim et al., 2022), the Reactivity, Intensity, Polarity and Stability questionnaire (RIPoSt-40) (Masi et al., 2021), or the RIPoSt youth version (Sesso et al., 2021). Two studies (Becerra et al., 2013; Kim, Yu, Lee, & Kim, 2012) compared BD with anxiety disorders adopting the DERS (Becerra et al., 2013) or the RRS (Kim et al., 2012). Finally, one study (Kim et al., 2012) compared BD with post-traumatic stress disorder (PTSD) using the ERQ (Kim et al., 2022).

Detailed characteristics of these studies are provided in Table 1 and in online Supplementary Materials S1.

Discussion

The present systematic review and meta-analysis aimed at exploring the differences in terms of adopted ER strategies and ED characteristics among people diagnosed with BD compared with people diagnosed with other psychiatric disorders. Overall, BD patients were quite similar to patients with MDD in both overall ED and adopted ER strategies, although they showed more positive rumination and risk-taking behaviors. Patients with BD exhibited a lower degree of ED when compared with BPD patients, as they adopted more adaptive ER strategies and fewer maladaptive ones.

Specifically, no significant differences were found in almost all BD-MDD comparisons. Previous studies focusing on neuroimaging correlates of ER and ED found that patients with MDD compared to healthy controls presented altered connections between the amygdala and both lateral (Johnstone, Van Reekum, Urry, Kalin, & Davidson, 2007) and medial (Perlman et al., 2012) prefrontal cortex during reappraisal, and similar changes were also

outlined in studies comparing BD patients with healthy subjects (Bigot et al., 2020; Townsend & Altshuler, 2012). However, when people diagnosed with BD and MDD were directly compared, they displayed significant differences in activating those brain areas during ER tasks (Rai et al., 2021; Rive et al., 2015). Taking these data together, the overall impaired connections found in these patients could support the shared difficulties in ER, while the dissimilarities might point toward psychopathological differences that are too subtle to be detected by self-administered tests used in the included studies and also a misdiagnosis of BD as MDD appears to be frequent (Daveney, Panagioti, Waheed, & Esmail, 2019), so diagnostic biases might dilute a possibly existing difference in terms of ED. Although most of the included studies supported their diagnoses with the adoption of structured or semistructured interview tools, BD patients may be very aware of their depressive symptoms while ignoring or minimizing hypomanic ones (Vieta et al., 2018) or experience several depressive episodes before the onset of mania or hypomania (O'Donovan & Alda, 2020), impeding the proper diagnostic orientation. Moreover, the high heterogeneity observed in some CERQ-related comparisons and in all DERS-related comparisons, which is not explained by consideration of the BD type or affective state, could also be related to other aspects interacting with ER. One study (Varo et al., 2021) explored the heterogeneity of emotional cognition in a sample of people diagnosed with BD or MDD, finding that people with mood disorders can be grouped into different clusters based on their emotional reactivity, adopted ER strategies, or correct recognition of facial expressions. Due to the unavailability of this information, it has not been possible to know how this result may have affected our population. Nevertheless, additional features beyond those related to the diagnosis alone are expected to help us better understand the phenomenon.

In our meta-analysis, patients with BD significantly differed from patients with MDD regarding positive rumination, as confirmed by the small effect sizes of the comparisons of the '*emotion focus*' and '*self-focus*' subscales of the RPA, and this difference remained when analyzing the prediction intervals. BD is often linked to increased expression of positive emotions in response to or in expectation of positive or rewarding stimuli (Gruber, 2011). The persistence of positive emotions may be related to high-risk and impulsive behavior in this population (Muhtadie et al., 2014). This type of conduct is often later associated with feelings of regret (Rydahl et al., 2022), and for this reason, we expected that people with BD could have been more involved in dampening their positive emotions when compared with MDD patients. However, there was no difference in the '*dampening*' subscale of the RPA between these groups, even when looking at the sensitivity analyses. Still, specific features of this subscale may partially explain this finding. Some of the items of the RPA contributing to the '*dampening*' subscale score (e.g. 'Thinking: *My streak of luck is going to end soon*' or 'Thinking: *I don't deserve this*') (Feldman et al., 2008) may be related to pessimistic thinking, which is a core MDD characteristic (Katayama et al., 2019), contributing to overall high scores in this population rather than the need to soothe positive emotions.

Patients with BD and MDD did not significantly differ in ruminating on negative emotions. Considering the comparison relative to the '*reflective pondering*' subscale of the RRS, significance was achieved after removing one study (Aslan & Baldwin, 2021) that included only currently depressed patients. In contrast, other studies (Kim et al., 2012; Shapero et al., 2015) included both

symptomatic and euthymic patients in their sample, suggesting that the current affective symptomatology may influence the differences in terms of negative rumination. In addition, acutely depressed patients with MDD scored significantly higher than acutely depressed BD patients when looking at more absorbing and negative emotion-focused form of ruminations, although this comparison was not significant after conducting a sensitivity analysis. A study comparing MDD patients presenting different levels of rumination (Tsuchiyagaito et al., 2022) observed that higher degrees of rumination were associated with greater connectivity between brain areas dedicated to language processing and areas involved in ER: the heterogeneity found at the level of brain connectivity may further influence the differences observed in our analyses.

BD and MDD patients also significantly differed at the 'risk-taking' subscale of the RSQ. BD is related to higher risk-taking behavior (Hıdıroğlu et al., 2013), which may be followed by dramatic social and health consequences, especially in the case of comorbid substance abuse (Meade, Graff, Griffin, & Weiss, 2008). No differences were found relative to the 'impulse' subscale of the DERS. Most of the participants included in these studies were euthymic, and our findings corroborate with existing literature that failed to discriminate euthymic people with BD and MDD based on their trait-impulsivity (Henna et al., 2013; Ozten & Erol, 2019). This finding remained even when a subgroup analysis based on mood states was conducted, but more studies focused on acutely ill patients are lacking.

In this meta-analysis, BD patients presented a significantly lower level of overall difficulties in ER compared to BPD patients. Among maladaptive ER strategies, they significantly differ from patients with BPD in negative focus, scoring lower at the 'self-blame' and 'catastrophizing' subscales of the CERQ. Usually, patients with BPD display monocausal reasoning when explaining positive or negative situations, with the tendency to catastrophize as they only consider a little explanation (Schilling, Moritz, Schneider, Bierbrodt, & Nagel, 2015). Additionally, self-blame seems to be a core feature of BPD (Sorgi-Wilson & McCloskey, 2022); it could represent a significant clinical target due to its role in internalizing symptoms like anxiety, depression, or emotional withdrawal (Tanzer, Salaminios, Morosan, Campbell, & Debbané, 2021). Despite these elements' importance in BD, their predominance in BPD may be suggested by different clinical characteristics. Indeed, unlike BD, BPD presents a more continuous and trait-like course, a lower age at onset, and fewer available treatment strategies (Leichsenring, Leibing, Kruse, New, & Leweke, 2011), which may contribute to the more pervasive adoption of maladaptive ER strategies. For the same reasons, these groups may differ in their impulsive response to negative emotions. This finding is in line with previous reports underlining BPD's higher broad and trait-impulsiveness compared with BD patients (Bøen et al., 2015).

No differences were found in the 'rumination' subscale of the CERQ. Since negative rumination can be defined as a form of thinking that involves excessive and repetitive negative thoughts or themes that interfere with other forms of mental activity, several types of ruminations may be considered depending on their object (e.g. depression, worry, and anger). However, the items composing the 'rumination' subscale of the CERQ may be too general and lacking in specificity, failing to capture the various aspects and types of rumination. Therefore, although both BD and BPD patients may share the same propensity to ruminate, they may differ in their content, considering the association of depressive and anger rumination with borderline personality features (Baer & Sauer, 2011).

Interestingly, in our meta-analysis, people with BD rely on more adaptive ER strategies than BPD patients. Adopting specific ER strategies is possibly influenced by the family environment and the relationships experienced during childhood (Thompson, 2019). Importantly, early-life abuse and childhood maltreatment are associated with higher levels of ED (Gruhn & Compas, 2020). Childhood abuse is commonly reported by patients with BD (Fisher & Hosang, 2010), but rates of emotional, physical, or sexual trauma seem higher in the BPD population (Merza, Papp, & Kuritárné Szabó, 2015; Temes et al., 2017), suggesting that previously learned strategies, usefully adopted in response to a real or perceived threat, turned into dysfunctional or inappropriate coping mechanisms. However, some of these observed differences are not significant using a more conservative significance level, suggesting the need for further investigation in this direction.

It is important to note that all studies included in the meta-analyses adopted structured or semistructured interview tools to confirm their diagnosis and exclude comorbid cases. However, the prevalence of BPD in BD is reported to be around 21%, rising up to 37% in BD type II (Fornaro et al., 2016), and real-world patients may have more severe ED characteristics than those described in this systematic review and meta-analysis, as suggested by studies specifically focusing on this population (Bayes et al., 2016). Hence, the clinical question on the intensity of ED in BD comorbid to BPD requires additional research.

A quantitative approach was not viable to study the differences in ER-ED between BD and other psychiatric conditions. The higher scores at the 'blaming the others' subscale of the CERQ reported by patients diagnosed with schizophrenia may be due to the higher rate of self-serving bias or broader social cognition deficits described in this population (Müller, Betz, & Bechdolf, 2021). People with BD compared to young patients with ADHD showed higher levels of ED relative to negative emotions. Despite no available evidence allowing us to explore this comparison in adult life, varying clinical course and high rates of psychiatric comorbidities (Franke et al., 2018) could worsen the intensity and presentation of ED in ADHD patients. Studies comparing BD to anxiety disorders reported contrasting results and this may be due to the broad diagnostic category considered. Anxiety disorders are in fact conditions with widely heterogeneous clinical presentations and severity, so future studies should consider these entities separately to assess ED.

To the best of our knowledge, this is the first systematic review and meta-analysis focusing on different aspects of ED in BD compared with other psychiatric disorders. In this meta-analysis, patients with BD displayed fewer differences than those found in our previous work involving healthy controls and first-degree relatives (De Prisco et al., 2022). ED is a transdiagnostic construct, present throughout different disorders, albeit with different pervasiveness. Our results can be useful in outlining features that are particularly relevant for understanding BD, although the extent of divergences between conditions is smaller. As suggested for mood instability (Kessing & Faurholt-Jepsen, 2022), ED assessment in clinical trials may be more valuable than conventional outcomes in estimating disease severity or patient functioning. In general, addressing ED in clinical practice can be helpful in accelerating the transition from categorical to quantitative nosology. In fact, this dimension lies above the classical diagnostic categories and could guide future genetic research better than

the latter (Kotov et al., 2021) as well as to assist the development of treatments aimed at these transdiagnostic features (Capitão et al., 2022; Solmi et al., 2020).

The present study has some limitations. First, the available evidence precluded us from making meta-analytic comparisons with other psychiatric disorders like schizophrenia, ADHD, anxiety disorders, or PTSD, limiting the understanding of differential ED features between BD and those conditions. As described in other ED-related constructs (Miskowiak & Varo, 2021), there is no specific consensus on which tools are more appropriate to assess ED, with the risk that the same aspects are measured by different tools, making a meta-analytic approach difficult. Second, the paucity of studies did not permit us to perform meta-regressions to study the impact of continuous variables on the overall effect size or to explore publication bias. Meta-regressions on affective symptom severity scales would have given us a better understanding of their role on different effect sizes, especially considering that in some studies the two groups appear to differ significantly, although often within a similar range of severity. Third, precise data about medical and psychiatric comorbidities or psychopharmacological treatments were seldom reported, limiting our understanding of their influence on ED. Additionally, we did not have data on patients' previous psychotherapy experience or whether they suffered from subthreshold symptomatology that is concerning, given their role on ED (Crockett, Martínez, & Jiménez-Molina, 2020; Sloan et al., 2017). Fourth, sample sizes were small in general, and only a few studies contributed to any comparison, suggesting the need for further studies on the matter. Fifth, most of the included studies did not provide sufficient information on sample recruitment or the statistical methods used to calculate sample size, and the study populations were not always adequately matched. As a result, less than a third of them were considered to be of good quality, limiting the strength of the observations made in this review. Sixth, the exclusion from this review of studies assessing ED (or related aspects) through behavioral measures limits the generalizability of our findings. Although our goal was to focus on instruments that are quick to administer and easy to use in clinical settings, the inclusion of tasks designed to explore explicit or implicit emotional regulation may have allowed for the identification of more subtle differences in the populations studied. Seventh, some studies included populations without specifying their affective status or enrolled patients at different phases of illness. In the latter cases, however, most of the patients in the two groups belonged to the same affective polarity.

In conclusion, ED is present in different degrees among psychiatric disorders. This construct appears as a transdiagnostic feature, and small to moderate differences were found when comparing BD with other conditions. Patients diagnosed with BD did not differ from those diagnosed with MDD in adopting many of the adaptive and maladaptive ER strategies. However, positive rumination and risk-taking behaviors were more common in the former. Conversely, people with BPD displayed a higher degree of ED compared with patients diagnosed with BD. This suggests a potential clue to clinically discriminate between these two populations and a potential treatment target.

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